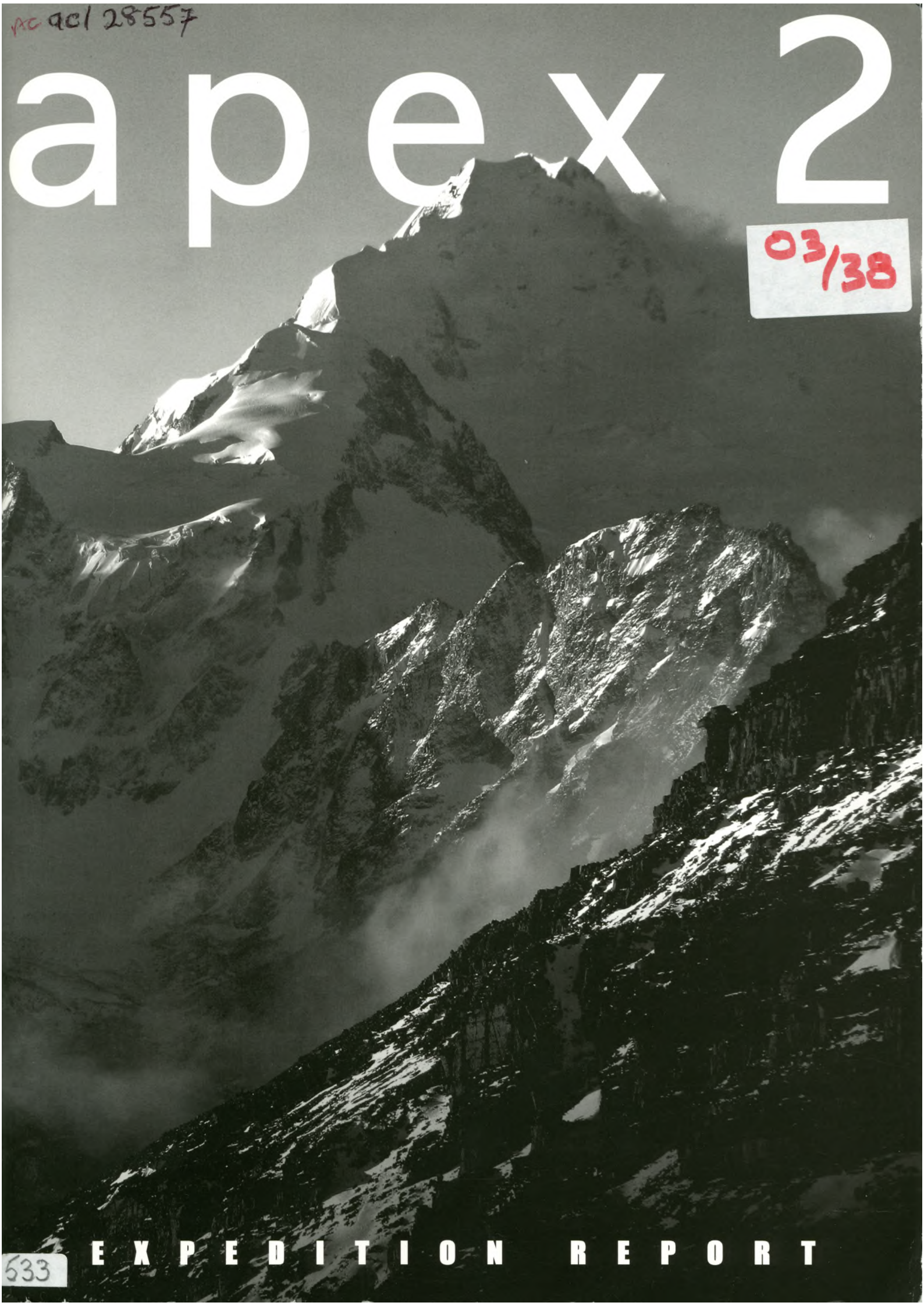
apex 2



EXPEDITION REPORT

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Expedition leader	Dr Roger Thompson
Deputy Leader	Dr Alistair Simpson
Research Co-ordinator	Dr Kenneth Baillie

Team Leaders

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apex 2 is a University of Edinburgh expedition

www.apex-altitude.com

Introduction

Roger Thompson

The study of humans at high altitude is a fascinating area of physiology. A great deal remains unknown and research in this field will not only increase understanding of altitude physiology and altitude illness but will also contribute significantly to our understanding of sea-level conditions characterised by hypoxia or in which oxygen delivery is impaired.

Apex 2 brought together research ideas from diverse areas of altitude medicine and aimed to give these research projects greater statistical power than previous work at altitude by providing a large number of subjects. Field research is logistically difficult and often studies in the mountains can only be carried out on a few individuals.

It was while writing the Apex Bolivia 2001 expedition report that I had the idea of taking groups of around 20 to Chacaltaya in series. Given the success of our inaugural expedition in 2001 and the links we had forged in Bolivia, I was confident that a large expedition would be logistically possible. In the end, 104 expedition members travelled to Bolivia in August and September 2003. We successfully collected data for the vast majority of the projects that had been designed for the expedition and, once again, the group had a magnificent experience working at the unique Chacaltaya laboratory. Over 20 research projects were carried out, including two trials of drugs that may be beneficial in altitude illness; a trial of antioxidant supplements and a trial using Viagra®.

The results of these projects are not included in the expedition report, as a lot of analysis remains to be done. However, we will ensure that we realise the full potential of the research by presenting it to others and publishing it in the medical literature. By doing this we will not only disseminate new hypotheses that can be tested in the future, but we will secure the foundations that are necessary for another successful Apex expedition.

I think there is great potential for future Apex expeditions. Strengthening the links we have with the University of Edinburgh and building on the new collaborations set up in 2003 is necessary to make the most of this potential. The generous advice and immense support we have received from others has been the key to our success to date.

As with its predecessor in 2001, Apex 2 would not have been possible without a committed team behind it. The individuals who led each of the five groups formed the core of this team. I can't really thank them enough for their help setting up the expedition. I must also give due credit to the team of researchers who stayed for a total of six weeks at the lab and who helped carry out and supervise the research. Most have contributed to this report and they reflect on their experiences as part of Apex. Finally, I would like to thank the people who actually made the research possible. These are also the people most critical to ensuring a bright future for Apex, the research volunteers.

The program of research on Apex 2 was ambitious and I urge the next Apex leader to aim to answer carefully selected questions and not to get carried away by the attraction of including all the great ideas that will undoubtedly be suggested. I hope that we have proved that large expeditions are feasible and I would encourage this scale of expedition for Apex 3, whether travelling back to Chacaltaya or elsewhere.


PRE-EXPEDITION

Recruiting the Team Leaders

Alistair Simpson

One of the key features of the second Apex expedition was its size. From its initial conception, we had been keen to bring a much larger number of subjects to the lab in Bolivia so as to maximise the statistical power of the research. However, we also knew that the lab would only comfortably house around 30 people. And so the decision was made to break down the expedition into 5 individual teams. Each team would have its own leader, with Roger overseeing the team leaders, and me essentially assisting Roger as a deputy.

Our pressing task then became recruiting these leaders. We began advertising the positions, using posters around the University, and stalls at the Fresher's Fair and elsewhere. In addition, we got significant interest from the University Expeditions Society, ExpEd. In fact, from a single evening that had had the original purpose of simply being a presentation of our work from the first expedition, we ended up recruiting 3 of our 5 team leaders. We had reasonable interest, and by the deadline we set, had received about 20 applications. As with the subsequent volunteer selection process, not all of those who submitted applications successfully attended an interview. In the end we interviewed around 12 potential team leaders.

The interviews were generally enjoyable. Most of the 2001 organisers were together again, and were keen to ensure that the standard of the first expedition would be maintained in the second. However, making decisions after interviews is never easy. There were some people who were clearly not suited to the job, or not ready to take on the responsibility. But there were more good candidates than there were vacancies, and five organisers who had to all agree on the final selection.

Even after a second interview, we were still undecided. Successful Team Leaders would have to work well, not only with Roger and I, but also the other leaders, the researchers and with their teams. Indeed, we needed people who had the presence, organisational skills and maturity to be able to run their own teams, and take charge of organising large parts of the expedition itself. All of the final selection had had experience of leadership to some extent, and most had been involved in some sort of outdoor group activity, but none had taken on a role such as this before.

Clearly we chose the right leaders. It is difficult to overestimate the importance of group dynamics on the success of an expedition such as ours, and we had kept this in our minds when selecting all of the members of Apex 2. The team leaders brought everyone together, and transformed 104 individuals into a cohesive team with a clear goal.

Recruiting the Research Volunteers

David Hope-Jones

When the leadership team met for the first time in October 2002, recruitment was high on the evening's agenda. The 2001 expedition had little trouble recruiting 25 excellent volunteers from The University of Edinburgh, but it was with considerable apprehension that we began the formidable task of searching for 125 committed and enthusiastic volunteers.

The process of publicising the expedition had begun before the Team Leaders had been decided upon, with a stall at the Fresher's Fair, a series of lectures, collaborations with the University expeditions society (ExpEd) and an article in the student newspaper. Subsequent lecture announcements, departmental emails and posters around the university all continued to raise awareness of the expedition and bolstered the number of weekly applications. Outside the university, events such as the 2002

Wilderness Medicine Conference and the Royal Geographical Society's 'Explore 2002' conference in London helped attract applications from around the UK and Europe.

The expedition's website (www.apex-altitude.com) was integral to the success of recruitment. Prospective volunteers were able to gain accurate and up to date information about the expedition and fill out an online application form, which helped make the application process as accessible and inclusive as possible.

Many on-line applications were submitted; however, only a fraction of these applicants successfully turned up to pre-scheduled ten-minute interviews in the right place at the right time (perhaps the greatest pre-requisite for selection!). The interviews consisted of a series of pre-set questions, through which the panel of team leaders attempted to assess the applicants' suitability in five key areas: teamwork, character, skills / ideas, enthusiasm and commitment. Past expedition experience was noted but intentionally omitted from the selection criteria, as Apex 2 required no specific mountaineering skills. In fact, a number of candidates who brought CVs bursting with mountaineering and skiing experience were denied places on the expedition as they displayed insufficient interest in the research. As with all aspects of the expedition, the selection process involved a steep learning curve for the leadership team. The early interviews were prolonged, awkward and intimidating for all parties; however, as time went by interview techniques were improved upon and questions were refined, making the interviews more relaxed and succinct.

In general the team leaders were impressed with the commitment, enthusiasm and (most fundamentally) interest in the research displayed at the interviews and on Christmas Eve 2002, 109 applicants received letters of acceptance to their home addresses. Between January and May 2003 there was an average dropout rate of approximately one volunteer a week. Reasons included: financial difficulties, academic commitments (such as exam re-sits), conflicting expeditions and conflicting medications (such as anti-malarials). This dropout rate was offset by continued recruitment throughout the Easter and summer terms. Although the total number of volunteers was reduced from 125 to 104 for pragmatic reasons, the recruitment and selection process was a success as every volunteer integrated well into their team and, no matter what their skills and past experience, greatly contributed to both the expedition and the research.

Publicity (TV)

David Hope-Jones

Apex: Bolivia 2001 was filmed by the BBC and subsequently broadcast as a half-hour prime-time special on Tomorrow's World. This unique publicity raised the profile of the research, helped raise finance for the expedition and rewarded both volunteers and sponsors.

To help attract sponsorship for Apex 2 we contacted the London-based production company, Embryo Films. Their plan was to incorporate an Apex 2 documentary into a series looking at how the body survives in extreme environments. Both The National Geographic Channel and The Discovery Channel expressed great interest in commissioning the programme, but unfortunately Embryo Films was unable to secure funding in time for the expedition.

Some other opportunities for filming the expedition became apparent in June and July, but by this stage it was too difficult to set up a filming without the backing of a broadcasting network.

Publicity (Other)

Student, October 2002. Expedition Set To Probe Altitude Sickness.
Edinburgh Evening News, June 2003. Students off to Andes in search for illness cure.
Herald & Post, Edinburgh, June 2003. Students have high hopes for research trip to Bolivia.
Financial Times, July 2003. Frontiers of Knowledge.
The Daily Record, July 2003. Guinea pigs get high on Viagra.
BBC News Online, July 2003. Students conduct altitude study.
Sunday Telegraph, July 2003. Students test Viagra on Bolivian Mountain.
Evening Times, Glasgow, July 2003. Daredevil doctor leads mountain expedition.
Sunday Mirror, July 2003. Students' height of passion.
Scottish Daily Mirror, July 2003. Viagra in new high.
Sunday People, July 2003. Going up and away!
The Herald, Glasgow, July 2003. Students in high altitude tests.
The Oxford Times, July 2003. Reaching new heights of research.
The Courier, July 2003. Medical students set sights high.
Press & Journal, July 2003. Students hit heights to aid sickness research.
The University of Edinburgh eBulletin, July 2003. Students' high-level study may solve mystery mountain illnesses.
HERO, www.hero.ac.uk, July 2003. Students getting high.
Nevisport News, July 2003. Students to conduct world's largest controlled-ascent altitude study.
USA today, August 2003. Viagra gets tested for another purpose.
Channel Red Uno, Bolivia National Television, August 2003. Interview on El Mañanero. Apex 2 at the Chacaltaya Laboratory.
The Great Outdoors (TGO), August 2003. Students probe high altitude sickness.
United Press International, September 2003. Viagra tested for altitude sickness.
Geographical: The magazine of the Royal Geographical Society, September 2003. High-level study may solve altitude sickness.
Oxford Radcliffe Hospital News, September 2003. Students in mountain top tests.
Hype, October 2003. Keeping it up in the mountains!
Oxford Medical School Gazette, January 2004. Viagra at Altitude

Presentations
International Medical Student Altitude Medicine Conference, October 2003.
Sysmex User Symposium, October 2003.
Wilderness Medical Society Student Conference, November 2003.

Fundraising

Sorel Cosens & Alex Phythian-Adams

It was agreed that all fundraising for Apex (Registered Charity SC 030345) would contribute to costs directly associated with the aims of the expedition and the charity, i.e. the research, laboratory and charity costs. Every member of Apex 2 was invited to come up with ideas and get involved in fundraising activities and events to fund the research costs, thereby lowering the amount they would need to contribute in order for the research on the expedition to proceed.

Trusts and Grants
Applications were made to grant-giving bodies whose funding criteria met the aims and objectives of Apex. Team leaders sent off in excess of 350 letters to organisations listed in the Directory of Grant Making Trusts; volunteers wrote to their schools and local fundraising bodies. We would like to record our sincere thanks to all of the groups who supported the expedition; a full list is included in the accounts. We would like to thank in particular the organisations who supported us for Apex: Bolivia 2001, and then again for Apex 2; donations from the Mount Everest Foundation, the University of Edinburgh Development Fund, the Carnegie Trust for the Universities of Scotland and the Royal College of Physicians in Edinburgh were invaluable in the realisation of Apex 2.

Gift Aid
Thanks to donations from tax-paying family and friends of people involved with Apex and also from other generous donors, Gift Aid will fund a significant part of the research that has been on going since the expedition returned from Bolivia. The Gift Aid scheme allows tax-payers to permit the charity to claim back tax they have paid to the Inland Revenue in order to fund the charity's activities.

Events
Thanks to the diligent work of volunteers, many successful fundraising events were organized. Of particular note was the club night in association with *Why Not?,* which raised over £3,000, and the sell-out ceilidh supported by the Caledonian Brewery that raised £1,650. Successful comedy events, band nights, pub quizzes and musical concerts raised over £850 between them and students in fancy dress also collected over £750 from the public in street collections and pub-crawls.

A number of sponsored events centring around mountaineering were organised by the keen climbers on the expedition: a run up Ben Nevis raised £510; climbing at an Edinburgh climbing wall, Alien Rock, totalling the 6,500m height of Sajama, Bolivia's highest peak raised over £200; the Welsh peaks challenge organised by Oxford University members of Apex 2 raised an amazing £812. Many thanks to venues and companies who helped us with our fundraising events and raffles.

Sponsorship (Research)

Ian MacCormick & Roger Thompson

Cryovials, test tube racks, and disposable pipettes: just some of the items that were needed for many of the research projects. Though ordinarily small and inexpensive, such disposable scientific equipment represents a serious outgoing for a large expedition (over 16,000 cryovials alone were required). Several scientific supply companies were approached to sponsor the expedition and donate cryovials and other essential laboratory supplies. After several months of letter writing and telephoning, Nalgene, VWR International, and Starstedt had agreed to supply the expedition with cryovials, pipettes, hypodermic needles and blood tubes. Nalgene also generously donated a plastic water bottle to each one of our volunteers.

In addition to the disposables that we were kindly supplied with, we were also able to obtain several important pieces of research equipment from generous sponsors. A portable echocardiography device was given to us on loan by Siemens; coagulation testing equipment (Roteg® and PFA100®) was provided by Sysmex UK; a blood gas analyser was supplied by Bayer UK; cognitive testing equipment was again donated to Apex by Cognitive Drug Research; and a full Vmax™ cardio-respiratory testing kit with all consumable gases and ergometer was supplied by Sensormedics, Bilthoven, The Netherlands. Without these generous loans, the research on the expedition could not have taken place. As a small charity it simply would not have been possible to fund the purchase of these items and due credit must go to the companies that helped us for supporting our research ideas.

Transport of our research samples was fully supported by the international specialist courier company, Marken. At late notice, this company saved the research by agreeing to transport our frozen blood samples from La Paz to Edinburgh, a costly and intricate undertaking. Marken employed the services of a reliable local courier in Bolivia and successfully deposited samples for storage at the Western General Hospital in Edinburgh. Their divine intervention was justly highlighted in USA today.

Furthermore, Pfizer and Cultech kindly donated active and placebo tablets for both of the drug trials conducted on the expedition. Detailed project descriptions stressing the quality and originality of our research convinced these companies to support Apex 2.

Obtaining such loans and sponsorship was no mean feat. We could not guarantee the same large-scale publicity of the 2001 expedition as no contract for television coverage had been signed. Hence the basis of such sponsorship arrangements generally fell to strong presentations of our proposed research by email, phone and with meeting representatives from the companies. Many of the companies used their own marketing departments to subsequently direct publicity, relating to their support of Apex 2, to their target audience and customers. Over the next few months, presentations and publications will form the basis of providing the recognition that these companies deserve for supporting the expedition.

Sponsorship (Kit)

David Hope-Jones

From the outset the leadership team recognised a responsibility to minimise the costs incurred by the expedition's volunteers, who were already donating much of their time and finances. It was clear from the interviews that some of the volunteers had considerable experience of high-altitude expeditions; however, the fact that this was not a prerequisite for selection meant the many lacked essential personal equipment. We therefore placed great emphasis upon finding a sponsor who could subsidise the costs of personal kit for the volunteers. A kit list was drawn up by those present on the 2001 expedition and distributed to the volunteers. The priority was to borrow or subsidise items, such as sleeping bags, Therm-a-Rest®s and down/fleece clothing, which would make life at the laboratory more comfortable.

It was, however, extremely unlikely that any manufacturer would be willing/able to fully equip all 104 volunteers. Hence our emphasis was on approaching retailers rather than manufacturers, in the hope of finding a single kit sponsor who could offer a blanket discount off a range of products.

Letters and pamphlets were sent to all major outdoor equipment distributors in the UK and followed up by phone calls to their marketing departments. Many of the large distributors expressed an interest but were pessimistic about equipping such a large number of people at such short notice.

Quite surprisingly it was one of the smaller companies, Fell and Mountain of Accrington (www.fellandmountain.co.uk), who expressed the greatest interest in equipping the expedition. The Managing Director of the company was interested in the research and keen to support the expedition by offering an extremely generous blanket discount off all the volunteer kit he could source in time for the expedition.

Throughout June and July the friendly, enthusiastic and committed Fell and Mountain staff worked closely with the Apex leadership team to equip the 104 volunteers. There were, inevitably, difficulties in trying to source such large quantities of cold-weather kit in mid-summer but thanks to the considerable time, effort and funds Fell and Mountain put into supporting the expedition, the vast majority of items were successfully sourced from around the UK and Europe and sold to the volunteers at a fantastically discounted rate. We offer our sincere thanks to all at Fell and Mountain.

Risk Assessment

Alex Phythian-Adams

Before the expedition, a risk assessment was written to assess the likely risks associated with each stage of Apex 2. The assessment was based on our existing knowledge of the area from the 2001 expedition, research into the atmospheric and topographical conditions, assessment of the political stability in Bolivia and investigation of likely health problems. The level of risk for tasks carried out during the expedition was reached using a risk matrix. This matrix incorporated the location of the identified hazard, the groups likely to be involved if that problem occurred, the severity of the risk and the probability of that event occurring. Control measures were suggested to reduce the risk and to indicate an appropriate plan of action if the identified hazard was to occur.

The assessment of risk did not stop with the completion of the document, as risks changed throughout the course of the expedition. Examples of change included weather conditions and political stability. With changing risks, the control measures suggested in the risk assessment were altered appropriately.

The document was submitted to the University of Edinburgh Expeditions Committee prior to the expedition. The risk assessment was made available to the expedition members and was discussed prior to departure and in while in Bolivia. Members of the leadership team carried hard copies of the document during the expedition.

Insurance

Nina Rzechorzek

It is extremely difficult to insure any large expedition. The nature of Apex 2 and the risks involved compounded these difficulties. A great deal can be learned from our experience. After multiple discussions about fine-tuning the policy wording, we were able to take out full travel cover through the University's travel policy scheme. The fact that Apex 2 was to operate within the boundaries of expert advice in the field of high altitude medicine was a key factor in obtaining this policy. Through the University of Edinburgh we were offered an excellent policy schedule at a good price that also covered volunteers if they chose to go mountaineering in their free time after their stay at Chacaltaya. In addition to a University property insurance policy, we also took out supplementary cover for all the research equipment. Although it took some time to establish what assistance the University could offer, it quickly became apparent that it was an invaluable source for specialist and equipment insurance. They were also able to provide indemnity cover for subjects taking part in the drug trials that were conducted on the expedition – this was critical. Expedition cover of any worth should not be obtained without very thorough reading of any potential policy schedule. Start early, explore every avenue ruthlessly and never cut corners to save money.

Flights

Nina Rzechorzek

Previous to Apex 2, I had only ever booked flights for one – which can be stressful enough at the best of times. I was now faced with the task of booking flights for the whole expedition to one of the hardest places in the world to fly to – La Paz. It was imperative to get the best possible deal but the flight dates had to coincide exactly with our team and research schedule. To complicate matters, no airline flies directly to La Paz, post '09/11' no airline was in the position to give large discounts to charities and it

wasn't going to be easy to obtain airline approval for the transport of a very large number of suspicious-looking barrels with 'FRAGILE' plastered all over them.

In the beginning it was necessary to make some '3-way' calls to the few companies that offer connections to Bolivia. The good thing about this was that each was eager to undercut the other in order to hold onto our custom. We finally settled on a very reasonable deal with American Airlines who could also offer flexibility in case we needed to change any flight dates at the last minute and we were given a lot of slack in terms of a deadline for the final full payment for tickets. Needless to say, we milked the opportunities handed to us (unavoidably) and I could only feel sympathy for Teresa (AA's Group Booking Representative) who kept her cool as I begged her to change just one more flight (for the 20th time!).

With all bookings settled and permissions obtained for transporting research kit it was a fingers-crossed wait to see if all would run smoothly for each team. It didn't start well. Team 1 arrived in Miami to discover that some seats on the second leg of the journey from Miami to La Paz had been double-booked. Temptation was high to accept the ever-increasing compensation offers from AA for waiting until the next available flight, but after explaining that should a volunteer miss the flight, they would have to be lost from our sample number, it was possible to encourage other passengers to give up their seats for Apex. The problems didn't stop there; departure from Miami was delayed as Roger tried to persuade airport officials that one of the research barrels was suffering only with a little condensation because its contents were being kept cool and the chemicals inside the barrel were not hazardous. This had been preceded by a four-and-a-half hour wait in a queue for Customs and Immigration. Successive teams generally had a less troublesome journey. At the end of the day, a huge number of people were successfully flown to and from Bolivia in one piece, for which we are all very grateful.

Equipment Transport

Ian MacCormick

Research projects inevitably seem to involve large amounts of expensive and fragile scientific equipment, and altitude research requires that each item be transported safely from sea level up to the tent, mountain hut, or laboratory where samples are to be taken. In our case, equipment collected in Edinburgh, Scotland, was sent to La Paz, Bolivia, before being taken up to the Chacaltaya laboratory, high in the Andean mountains. Fifteen projects were scheduled, and each primary researcher was responsible for obtaining the list of instruments, reagents, chemicals, test tubes, and other materials needed to carry out their particular experiment. Needless to say, several inventories were made, grouping every item by research project and also in order of packing – i.e. which box or barrel it would go in. These lists were crucial: they were needed in case anything went missing, and to help us unpack efficiently in the thin air of the lab, but also for Bolivian customs in order to prove that we had not sold anything while in country for which we would be charged tax. Before departure, these lists helped us secure approval from the Bolivian Embassy in London and the British Embassy in La Paz for the transport of our equipment into Bolivia.

The bulk of our equipment was sent as checked baggage with the research volunteers, carried for us in the American Airlines flights. This was by far the cheapest method of transportation, but was not without complication. A month or two before departure we discovered that the airline had a 'ban on cardboard boxes on flights to South America', and just for the four weeks surrounding our flight! However, we managed to fit everything into about a dozen blue plastic barrels. These were normally used for storing fertilizer, but were perfectly formed to fit within the airline baggage regulations. They became a common sight in my flat, which had by this time become a way-point for most of the expedition research equipment, stacked into surreal towers like some new form of modern art. There were a few items that could not go as hold luggage for reasons such as excess size or weight, or more interestingly because the material was classified as hazardous – for example, the mercury sphygmomanometer, and

carbon monoxide calibration gas. These items were sent by airfreight. This was much more complicated, and involved many phone calls to different freight companies before any progress was made. Regulations had to be followed, and special packing carried out before anything could move. Once in Bolivia, the freighted equipment was at the mercy of Bolivian customs officials until released by our Customs Agent. This process inevitably delayed the arrival of some of the research equipment at the laboratory. However the vast majority was up and running for the first sample day at 5200m.

At the end of the research period all the equipment had to be repacked and safely returned to the UK. Again the Bolivian Customs officials had to be satisfied that all our equipment had left the country and we had to ensure that loaned equipment was returned in good condition to the companies from whom it was kindly donated. Volunteers from Team 4 and 5 took much of the equipment back as hold luggage. The equipment was stored in the Wellcome Trust Clinical Research Facility for the duration of our post-expedition sampling in Edinburgh and loaned items were eventually returned. Unfortunately the transport of dangerous goods back to the UK has proved more difficult. The departure of the gases used for our cardiorespiratory testing has been delayed by customs regulations, civil unrest in La Paz and sub-optimal handling by our shipping agent. The gas cylinders may eventually arrive home by sea.

Pre-expedition 'Bonding'

David Hope-Jones

Arguably Apex 2's greatest assets were it's 104 committed volunteers, without whom there would be neither an expedition nor any research. It was recognised from the outset that much of the success of the research and the expedition as a whole depended upon the forging of teams who worked well together, especially in stressful and uncomfortable conditions. Early in February 2003 volunteers were divided into five teams and placed under the control of a specific team leader. In the vast majority of cases volunteers were able to choose the team they were assigned (and therefore the dates of their time in-country) although some minor alterations were made to balance numbers and produce eclectic teams. All five team leaders worked hard organising regular formal and informal meetings not only to disseminate information but also to bring the team together into one cohesive unit.

In March 2003 five separate two-day team-building expeditions in the Cairngorm Mountains were organised to give the volunteers their first taste of working together in arduous surroundings. Two professional mountaineering instructors were employed to teach the volunteers basic winter mountaineering skills (crampon familiarisation, ice axe arrests etc). It was made clear that such instruction was not training for Apex 2 (which did not itself involve any mountaineering or climbing) but rather a way of bringing teams together and a useful experience for those choosing to climb in their free time. These Cairngorm expeditions were not compulsory but 86 volunteers were able to attend, all of whom came away with a better idea of what the expedition would involve and who they would be working alongside and living with (for better or worse!).


EXPEDITION

Expedition Schedule

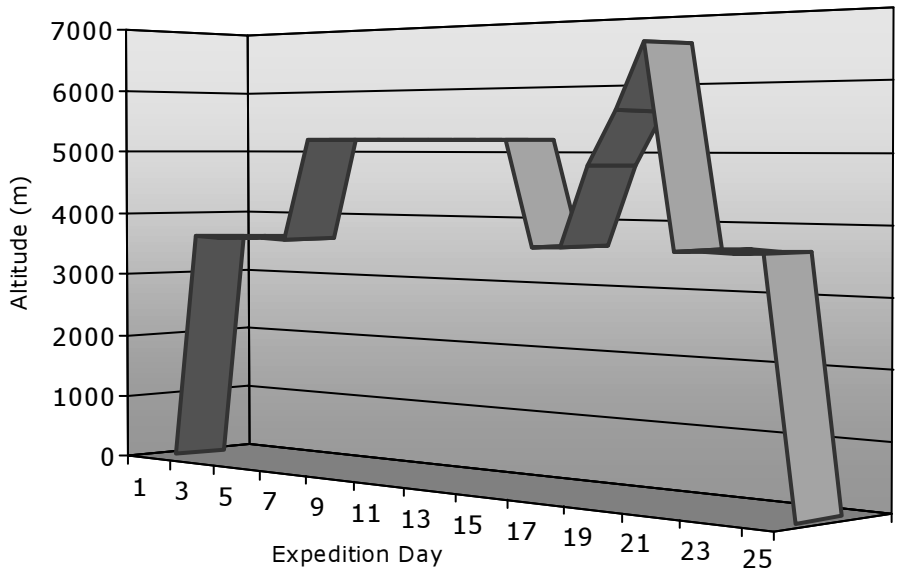
The expedition ran from the 6th August to the 4th October and consisted of five teams travelling in series to Bolivia. Each team spent 4 days in La Paz, then 7 days at the Chacaltaya laboratory at 5200m above sea level. Following the period of research at the laboratory the team members were free to travel in Bolivia for 2 weeks. There were 104 expedition members of whom 56 were male. The average age was 21.7 (range 18-59).

Expedition researchers:	7 members	6th August – 4th October
Team 1:	24 members	6th August – 3rd September
Team 2:	19 members	14th August – 11th September
Team 3:	20 members	22nd August – 19th September
Team 4:	16 members	30th August – 27th September
Team 5:	18 members	7th September – 4th October

Chacaltaya:	15°43'55" S 67°37'03"W
Mean barometric pressure at the Chacaltaya laboratory:	543 millibars.
Temperature inside the laboratory:	+1°C to +12°C

Altitude Profile

Average altitude profile for each team



Expedition Leader's Overview

Roger Thompson

My last day as a junior doctor finished at 4pm. By 8pm I was in a car park near Ian's flat sorting our luggage into a van for transport to Bolivia. The months of preparation were at an end. Save the eleventh hour arrival of our trial drugs and the apparent chaos of some last minute packing, we had a smooth overnight journey to London. The researchers, who would be in Bolivia for the whole duration of the expedition, and the first team of volunteers, met safely in Heathrow and our kit made it on board with only some minor problems regarding screwdrivers and nail scissors. The drug trials commenced with minimal confusion and only sporadic reports of embarrassing side effects.

In Miami, our luck continued as the overbooked flight yielded enough seats to accommodate our whole group and a problem with condensation on one of our blue barrels did not result in any items of equipment not making the final leg of the journey.

Shortly before boarding in Miami we met Professor Rob Roach. Rob, as an expert in high altitude medicine, was to lead a team conducting research into cerebral blood flow and its regulation at altitude. I was relieved to find that he was laid back, understanding and friendly and throughout the course of the expedition he was a valuable source of advice and encouragement. His team, Luciano Bernardi, Gaia Casucci and Matt Kinsey proved a great addition to the atmosphere at the lab, not to mention their superb scientific and engineering expertise. Only the skill of Rob and Luciano made our exercise experiments possible.

My first few days in La Paz were somewhat different from that of the rest of Team 1. Many of the team members helped source missing items that would be needed at the lab but I spent every waking minute with 'our man in La Paz', John, making last minute preparations. Alistair, Mark and I made the first trips to the laboratory, bringing Martha the cook, her food supplies and much of the research equipment. With oxygen saturations almost two-thirds of that at sea level, we shifted furniture and old physics equipment in order to set up the working laboratory.

At that time, the weather was a significant concern. Heavy snow had made the road to the lab treacherous in places and the truck carrying our food and equipment struggled to complete the journey. Negotiations with IMBEX, the rental company, eventually secured new tyres with decent tread and two excellent drivers for the 4x4s. Alessandro and Egberto unselfishly provided the 24-hour on-call service required for swift evacuation of ill volunteers from the lab. Their punctuality was also an important part of the research schedule on the initial sample days for each team. Moreover, when the roads were blocked by protesting Campesinos, both drivers ensured safe passage for the expedition members; Egberto by thoughtful negotiation, Alessandro by brandishing the wheel lock hidden under his jacket as a gun.

The initial research days at Chacaltaya were difficult. Illness among the researchers and lack of preparation time for setting up the experiments inevitably led to delays and problems with data collection for a number of the projects. These teething troubles were soon remedied and by the time Team 2 arrived, most projects were running well. Thanks to initial preparation by John, there were few problems with our regular supply of dry ice and oxygen, the analysis of full blood counts in Laboratorios de La Paz and with the storage of our research samples in a –80C freezer in IBBA. Express Cargo Services, the agent employed by the international courier, Marken, facilitated shipment of the samples at IBBA. Each week, around 4 boxes of samples were transported back to Edinburgh packed in dry ice.

Chacaltaya again provided a secure base for the experiments. The power failed two or three times during our stay, but only on one occasion did this interfere with the research. The director of the Instituto de Investigaciones Fisicas, Alfonso Velarde, played a crucial role in the preparation of the expedition. As well as kindly offering us the full use of Chacaltaya for 6 weeks, he helped to secure transport of our samples and research equipment and sourced many of the items we needed in La Paz.

With working showers, additional electric heating and more entertainment in the form of DVDs and an X-Box, Chacaltaya was positively luxurious compared with the conditions in 2001. Surrounding the lab, the scenery was just as spectacular, although there was little snow cover around the laboratory and on the Club Andino piste.

All five teams dealt with the environment at the lab superbly. The volunteers worked tirelessly to help with the research protocols and patiently acted as research subjects. They were asked to comply with some general restrictions because of the research. Alcohol, caffeine and coca tea were prohibited for 24 hours before each sample day. Volunteers were also only allowed to descend to an altitude of 4800m. The team leaders and volunteers did a magnificent job, ensuring that these restrictions were observed.

When Team 5 left the laboratory, there was finally some free time for the researchers who had spent 6 weeks at Chacaltaya. Most joined Team 5, mountaineering around Condoriri and discovering paradise in the jungle near Coroico. We met back in La Paz to deposit shortbread and whisky with those who had helped us so much in Bolivia. Arrangements were made for Andy, the expedition doctor, to give a presentation at Hospital de Thorax near IBBA and at an international student conference on altitude medicine in La Paz.

Fortunately, the expedition proceeded with few serious problems. Safety of the volunteers was a priority throughout, especially with regard to medical problems at the laboratory. Alistair or I met each team in La Paz and a doctor stayed with the team for the two days following arrival in Bolivia. During research-free time at the laboratory, the permanent researchers descended to La Paz but two doctors always stayed at 5200m with expedition members. A doctor accompanied each evacuee and oxygen was available during transport back to the city.

The expedition saw little of the political instability in Bolivia, save several demonstrations in La Paz, some tear gas straying into the Hostal Republica and the unfortunate hampering of expedition members from travelling north to Copacabana, Sorata and Peru. We departed from La Paz on the 4th October without complication, just days before Campesinos blockaded all the main roads to the city.

Our Man in La Paz

John Somner

The role of 'our man in La Paz', was something like that of the knights Templar of old, in so much as it involved quests. Roger had entrusted me with several. I was to: finalise plans for accommodation, transport and dry ice; meet up with international collaborators; check the arrangements for shipping samples back to the UK; contact customs and extract shipments of calibration gases, ergometers, eye charts and wedge spirometers; find a local hospital for any emergency care required; and as an afterthought, see about getting hold of some acetone, hydrochloric acid and a -80°C freezer. A piece of cake I thought! This was before a morning's saunter around La Paz which made me realise that the workings of Bolivian Customs are about as transparent as granite, that our 4x4s were currently in a rain forest beset by storms, that Dan and Jill, two of our colleagues were stuck at the wrong end of the world's most dangerous road, that Matt Kinsey was jinxed and that acetone and hydrochloric acid were controlled substances essential for the manufacture of cocaine! Things could not get a lot worse I thought, until I began to look for the freezer and discovered a labyrinthine road to its cold interior.

Fortunately help was at hand, Rene Mariaca, the manager of Hostal Republica was outstanding in his organisation of the hostel and transport for the arriving teams. He even went so far as to repaint the hostel and organise local musicians and dancers to welcome Apex to Bolivia. Praxair were almost efficient at organising dry ice and Dra. Veronica de Chamon soon had a Laboratorios de La Paz fired up

and ready to process our full blood counts. Carlos Aguilar proved adept at teasing our equipment out of customs and I got on with the freezer, acetone and hydrochloric acid. I soon realised, after a visit to the department of internal affairs that I personally could not get hold of these chemicals. I needed to be police checked and on average the procedure takes at least three years! The British Ambassador didn't have any luck either, what I needed it appeared was a local drug dealer! Fortunately it didn't come to that, to cut a long story short…. Alfonso Velarde, the head of the Bolivian institute of cosmic physics, phoned a friend in the chemistry department who was willing to make a trade: 6 pairs of rubber gloves and some washing powder for enough acetone and hydrochloric acid to keep both Roger and Henry happy! Without further ado, I got on with the freezer quest that saw me writing letters and presenting our case to the Head of the Faculty of Medicine, kindly aided by Dra. Hilda Spielvogel, and pleading with all and sundry to give us two and half shoeboxes worth of freezer space. Negotiations were protracted and beset by red tape, but finally the Instituto Boliviano de la Biologica de Altura came to the rescue and put a whole freezer at our service. There were several more minor missions for me in the ensuing weeks including the rescue of a Bolivian School girl from the lab where she had come down with high altitude cerebral oedema. The quest of 'our man in La Paz' was completed without undue havoc and I was soon heading for the hills.

Team 1

Ian MacCormick

We flew out of Heathrow and arrived as a tired and slightly breathless group in the airport above La Paz. Met by 'our man in La Paz' (aka John Somner), who had been sent out to make advance preparations, we trundled off down the winding motorway and into the city. The metropolis lay sprawled out below in the pale (but deceptively bright) altitude sun, and Illimani stood against the sky beyond. These first impressions of Bolivia and the excitement of finally beginning the expedition proper left us in high spirits, though I remember feeling nervous about the many jobs that needed to be done. We stayed in La Paz, enjoying the hospitality of the Hostel Republica for four days. The volunteers explored the city and acclimatised until they were sent up to the Chacaltaya lab two thousand meters above. At the lab we witnessed glorious sunsets, followed by dark nights in which scores of bright constellations trooped out, lit against an infinite black sky. The cold thin air may have been unpleasant to breathe, but its clarity was unrivalled and made for astounding aerial displays.

In contrast to this undeniable beauty were the discomforts of daily life. The lab was not a warm place, we slept on the floors, shared two toilets between almost forty people, and experienced symptoms of altitude sickness to varying degrees. Breathlessness was a common feature, and we learned to carry out tasks at the slowest possible speed in order to avoid the work of catching again the breath that was so easily lost. Several volunteers were evacuated with worsening symptoms, but for the rest of us time brought improvement. Acclimatisation proceeded until after a few days most of us were walking up to the peak of Mount Chacaltaya - a steep climb behind the lab. Those who had gone down due to illness reascended more gradually and also adapted. Our stay in the lab ended after a week, and we returned to La Paz to make plans for the remaining time in South America. Some went to climb Illimani and others went to the jungle. Almost everyone travelled to the salt flats. They all came back with stories and many many pictures.

Team 1 was made up almost entirely of medical students, several of whom were actually setting up and carrying out experiments; and this gave some members of the team extra work and responsibility. We had the job of bringing all the kit from Edinburgh to La Paz, and there were several odd looks in Heathrow when we presented ourselves at the ticket desk with dozens of blue barrels for luggage. We also had to help set up the equipment in the lab, but not before the 4x4 had been pushed through a snowdrift delivered that day by an unseasonable storm. A problem with the power supply meant some of the early experimental samples were processed by torchlight.

Many things could have gone wrong on the expedition. Most things went amazingly well, but as the first group of volunteers arriving with the researchers we dealt with some situations I hope later teams did not have to. For the most part these were related to the set up of the research protocols, which inevitably needed to be fine tuned before a smooth routine was established. However it is difficult to think of a time when discouragement or low morale was a problem. This, I think, was largely due to the fact that we had a great set of people who got on with each other despite the difficulties, and whose cooperation and personality made the expedition enjoyable and interesting.

Team 2

Sorel Cosens

Ten days after Team 1 had left the UK, Team 2 followed in their footsteps, very grateful that we didn't have the same amount of equipment to transport, and for their top tips for surviving Miami airport delays. In fact, when we did arrive in Bolivia, ahead of schedule and with customs going very smoothly, the Expedition Leader was only just out of bed and so our welcome party arrived at the airport as our coach was pulling away.

For most of us, the drive into La Paz at sunrise was our first sight of Bolivia, so all exhaustion from travelling left us in the excitement of the stunning scenery and seeing the early morning city come alive. We spent our first two days exploring the markets, museums and restaurants as we acclimatised to the altitude. For those of us that were struggling with the steep streets, the courtyards and garden at Hostal Republica were a pleasant and relaxing haven. On day three we all felt comfortable enough to venture further afield; a party went to Copacabana and Lake Titicaca overnight, and the rest of us took the day trip to the pre-Inca ruins at Tiahuanaco. It seemed that the common theme of these adventures was the novel, if slightly scary, modes of public transport we all encountered!

Team 2's stay at Chacaltaya was a relatively healthy and very energetic one – while some people took a little while to acclimatise, others appeared to be extraordinarily resistant to high-altitude symptoms and were out climbing the mountain on their second day there. We had one precautionary evacuation, for a member who had a high pulmonary artery pressure on arrival, and two people went down after a few days of fighting bad headaches and other symptoms of altitude sickness, but all returned much improved to join in the fun.

Everyone enjoyed being a part of the research team at Chacaltaya, both as a subject and getting involved with their various roles in running sampling at the laboratory. While the sleep study was uncomfortable and unpopular, and some of us did test our headaches to the absolute limit on the tilt table, we all threw ourselves into the lab work in good humour. One of the best things about our stay at Chacaltaya was that, despite the cold hard floors, poor showers and lamentable diet, members of Team 2 did not want to leave at the end of ten days and would have stayed on for more research given the opportunity.

Roo's 21st birthday party luckily fell in our two-day break, when chocolate, caffeine and a little bit of alcohol were allowed back on the menu, and they certainly contributed to the party games and competitions that followed. My favourite memory of Chacaltaya with Team 2 was watching sunrise from the top of the mountain, then climbing down for real coffee on our last morning there.

Following our descent from Chacaltaya, after showers, a huge dinner and a decent night sleep in the very welcoming Hostal Republica we went our separate ways. Twelve of us set out for Sorata, from where we spent five unforgettable days climbing Ancohuma, with seven members reaching the 6427m summit. One team member visited Chile, another went to the Amazon to research for his dissertation, and a group travelled in Peru before a large party toured the Bolivian salt flats. We all met up in La Paz

again, where we agreed that our various travels had been time well spent, and we just regretted not having more time to explore the country.

You can't visit Bolivia without football-fever taking hold, and Team 2's trip coincided with two matches that had La Paz in a frenzy of excitement. The evening before going to the lab, a group of us got tickets for the sell-out Sud-America Cup match, a local derby between the two La Paz teams, Bolivar and Strongest. With some bonus British supporters to tip the balance (sporting all the merchandise, of course). Strongest won on penalties. The football craze continued with tickets to the Bolivia – Columbia World Cup qualifier the afternoon before we left to come home – again, our extra support, once we had picked up and joined in the singing, brought all the luck to the winning home team! It was a fitting end to our expedition to a fantastic country.

Team 3

Nina Rzechorzek

A twenty-strong group successfully undertook the Apex 2 expedition and not one member had to be evacuated from the laboratory – an achievement for which they gained the worthy reputation of being the 'healthy team'.

The trip of a lifetime was pre-empted by a meal out in London the night before departure. The team was a bundle of excitement: we had all been waiting for this to come and now it appeared to be hurtling towards us at full pelt. The last few days at home had been filled with the frantic gathering of kit items that were still required at Chacaltaya or had, for whatever reason, become dysfunctional and needed replacing. I will admit to feeling slightly less stressed once we had boarded the plane – but not before a 'pre-expedition' group photo at Heathrow. The journey had been well practised by the first two teams and we hoped that this would bode well with Miami officials who would by now be accustomed to large groups of young people sporting Apex 2 fleeces – this wasn't entirely the case. As warned, Miami was a laborious affair with long queues and I was twice requested to remove the cognitive laptop from my hand luggage for thorough inspection. It was also here that we met with Ajay Duggal – the Pfizer representative who was a very welcome addition to the group, handling all the Viagra questions fired at him with tact and good humour.

Sleepy, but eager to commence the expedition we half stumbled out of La Paz airport, greeted by Deputy Expedition Leader, Ali. The coach ride at dawn into the city was particularly quiet, as those that hadn't succumbed to the clutches of slumber were awestruck by the unfamiliar but magnificent sight of Bolivia's capital. At the hostel we were briefed under the late-morning sun, at which point Team 3 began to apply varying amounts of sunblock with red-haired Adam taking the lead at the upper extreme of sun – 'cream' – bathing.

Prior to ascent, we travelled to Isla Del Sol via Copacabana and Bolivia's best-kept secret – a tent supplier that met us halfway up the motorway exit from the city. This stop had been meticulously planned by Seb – our eldest geographer who persuaded most of the team to camp on the beach that night with take-away pizza. The team bonded through their exploration of Bolivian culture and the majority were unperturbed by a little breathlessness upon physical exertion. On our last night in the city we indulged in Café Vienna – a top class restaurant recommended by many for its steak and live pianist.

Taking the advice of Team 2, the 4x4 up to the lab was padded out with emergency supplies of chocolate for our days off. Our hunt for suitable treats had led to a rewarding discovery by Suzy – dairy-free chocolate-covered peanuts (they are apparently impossible to get back home). Our driver Egberto effortlessly tossed backpacks onto the 4x4 as we said farewell to Team 2. There were hints of anxiety

as Egberto navigated the well-worn hairpin track up to the lab – the altitude had the potential to end the expedition for any one of us…

Most of the team coped well with the absence of luxury at 5200m and settled into 'lab life' with table football and hikes up to the peak of Chacaltaya. To the backdrop of snow-speckled mountains that concertinaed to the horizon, we experienced our first meal at the lab. We simply loved Martha and her culinary creations, which, whilst providing long-stay researchers with a continuous feeling of déjà-vu, were always a pleasant surprise to the team. It was true to say that Bolivian food did not offer much choice for special dietary requirements, but Victoria allayed my concerns as she cheerfully whipped out her stash of gluten-free crackers. One by one, the group overcame their 'first shower in freezing conditions' fear and focused their energy on prospective research tasks, blood giving and drug taking. Our days off were conveniently punctuated with Johnny's birthday party - a truly stylish event with the world's most energetic high altitude table football tournament. The birthday cake of vast dimensions was hungrily eyed-up by the lab dogs before being demolished at Johnny's party.

Post-lab the majority attempted a climb of Bolivia's highest peak, Sajama, standing at 6500m. This included a mud bath dip at sunset – one of the many highlights alongside a fantastic mountaineering experience immersed in natural beauty. Unfortunately a fair number of us were held back at high camp by diarrhoea and vomiting, but four climbers summitted and were issued with hero status by their teammates on their return. The rest of the free time was jam-packed with cycle rides into the Amazon, trips to the Salt Flats, nights out in La Paz and even an archaeological dig attended by final-year geologist Lys.

The long wait in La Paz airport was frustrating and mundane but failed to detract from the incredible month we'd all had. The team included students from up and down the country (as well as all over Europe!) with a wide range of ages, experience and personalities. I believe these people gelled exceptionally well on Apex 2 and achieved the team objectives. It was a real privilege to lead such an enthusiastic and talented group of friends; they and Apex have given me the unforgettable memories of which I dreamed back in October 2002.

Team 4

David Hope-Jones

Consisting of just 17 volunteers, Team 4 was always the smallest of the five Apex 2 teams. From our first meeting it was clear that the team contained a diverse mix of characters: medics, geographers, outdoor educationists, biologists, economists etc. Furthermore the geographical dispersion of the 17 volunteers around the UK precluded the team meeting in its entirety prior to the expedition. It was therefore with great excitement that the 17 intrepid volunteers met at some ungodly hour of the morning of the 30th August at Heathrow airport. Drugs, airline tickets and Apex fleeces were distributed in the first expedition team 4 briefing. Somewhat inevitably, the conspicuously labelled "Blood Barrel" attracted some interest at the point of check-in but with considerable reluctance it was accepted on to the flight.

The expedition proper began with an inauspicious start as one of the team, a Malaysian national, was told at Heathrow he was not permitted to travel. The volunteer had gone to considerable lengths to obtain the visas and all other documentation necessary to enter Bolivia. The problem, we were told, was that the U.S. (presumably in response to a specific threat) had that week begun a 60-day embargo of Malaysian males transiting through the States. After phoning every imaginable embassy, consulate and organisation (bizarrely the most useful being the Malaysian Coast Guard) it became clear the problem would not be resolved before departure and the volunteer was forced to stay behind and spend that week obtaining the additional visa to travel out with Team 5.

The 16 remaining volunteers travelled (quite uneventfully) to Miami and onto La Paz where we were met by Roger and taken to the Hostal Republica, which was by this point virtually an independent Apex state! The majority of the team, like myself, had little if any experience of such altitudes and were relieved to find that the headaches and shortness of breath were not as dramatic or crippling as many had feared. However, being keen to avoid over-exertion, the first two days in country were predominantly spent resting at the hostel.

Early on the 2nd September all 16 Team 4 volunteers travelled by bus to Copacabana and then by boat on Lake Titicaca to the beautiful Isla Del Sol. Feeling confident after two days of acclimatisation, the team embarked on a modest walk to the northern end of the island. By nightfall one of the volunteers was displaying the symptoms of quite severe Acute Mountain Sickness and had distressingly low oxygen saturation levels. Fearing High Altitude Pulmonary Oedema (HAPE), the volunteer was monitored throughout the night (by the team's invaluable final-year Oxford medical students). The volunteer's oxygen saturation levels had not increased by the morning so a boat was commandeered and he was rapidly evacuated back to La Paz. The Apex doctors arranged a chest x-ray for the volunteer at a private clinic in La Paz and a diagnosis of HAPE was made. The volunteer was hospitalised for four days but made a full recovery.

The HAPE victim and one other volunteer (who was suffering from a gastrointestinal infection) were not able to ascend from La Paz; however, the remaining 14 travelled by 4x4 to Chacaltaya Laboratory in three sections between the 4th and 5th September (thus allowing volunteers to be fully sampled within 7 hours of arrival). Despite the habitual headaches and shortness of breath, throughout the eight days at Chacaltaya, the team displayed steadfast commitment to the research and worked exceptionally well together. Between the 4th and the 12th of September four members of the team were evacuated due to worsening altitude sickness; all were reluctant to leave the laboratory but all benefited from the salubrious effects of rapid descent.

After the eight days at Chacaltaya laboratory the team divided into two, with four choosing to explore the Amazonian jungle to the north and fourteen opting for six days of mountain climbing. The climbing contingent had, before leaving the UK, decided to make a summit attempt on Ancohuma (a remote 6,427m mountain to the West of La Paz). After two failed attempts (first by bus and then by 4x4) to get through the myriad of the civilian road blocks (part of the civil uprising against the Bolivian government's policy on gas exportation) and two failed attempts to negotiate a military escort from the entrenched Bolivian Army, it was clear we would not be able to safely travel to Sorata, the starting point for an assault of Ancohuma. The plan was amended and the team set itself a new challenge, to climb four peaks (Cerro Ala Norte, Cerro Tarija, PequeHo Alpamayo and Huayna Potosi), in just six days. The first three were climbed from a base camp in the Condoriri range, on the north shore of Chiar Khota, and Huayna Potosi (6,088m) was climbed in two days from the East. Astounding strength and stamina was displayed by all, resulting in each of the four peaks being successfully climbed by at least 13 of the 14 climbers.

On the 21st September all sixteen volunteers were re-united in La Paz and decided to travel the next day to the salt flats in the south of the country. After a hellish overnight bus journey to Uyuni, three 4x4s were hired to take the team across the salt flats. On the first night of the tour through the flats, one of the team suffered a broken clavicle after tripping in the dark. This resulted in another emergency evacuation to La Paz where the fracture was reduced and his arm immobilised. The rest of the team met back in La Paz on the 26th September and flew out on the 27th having enjoyed a thoroughly successful 27 days in-country but looking forward to the comforts of home.

When I think back to the expedition it is not to the majestic mountains of the Altiplano, the hospitable people of La Paz, the awe-inspiring climb or even the ground-breaking research, that my mind first turns to; before all this, I remember the 16 enthusiastic, committed, friendly, and good-humoured people I shared my summer with. It was a tremendous privilege to lead such a team.

Team 5

Alex Phythian-Adams

Just imagine a fantastically diverse group of characters thrown together at 5200m above sea level, all with different reasons for being there, but crucially all working towards the same aim. No this wasn't a reality TV show the likes of which are increasingly popular these days, it was reality; Team 5 on the 7th September at 0800 taking their pills in Heathrow Airport part of Apex 2. Thoughts, ideas and work had met reality - we were really going. With the question "Am I taking a placebo or otherwise?" in the backs of minds we checked through customs and with a momentary gate panic for some we boarded the plane.

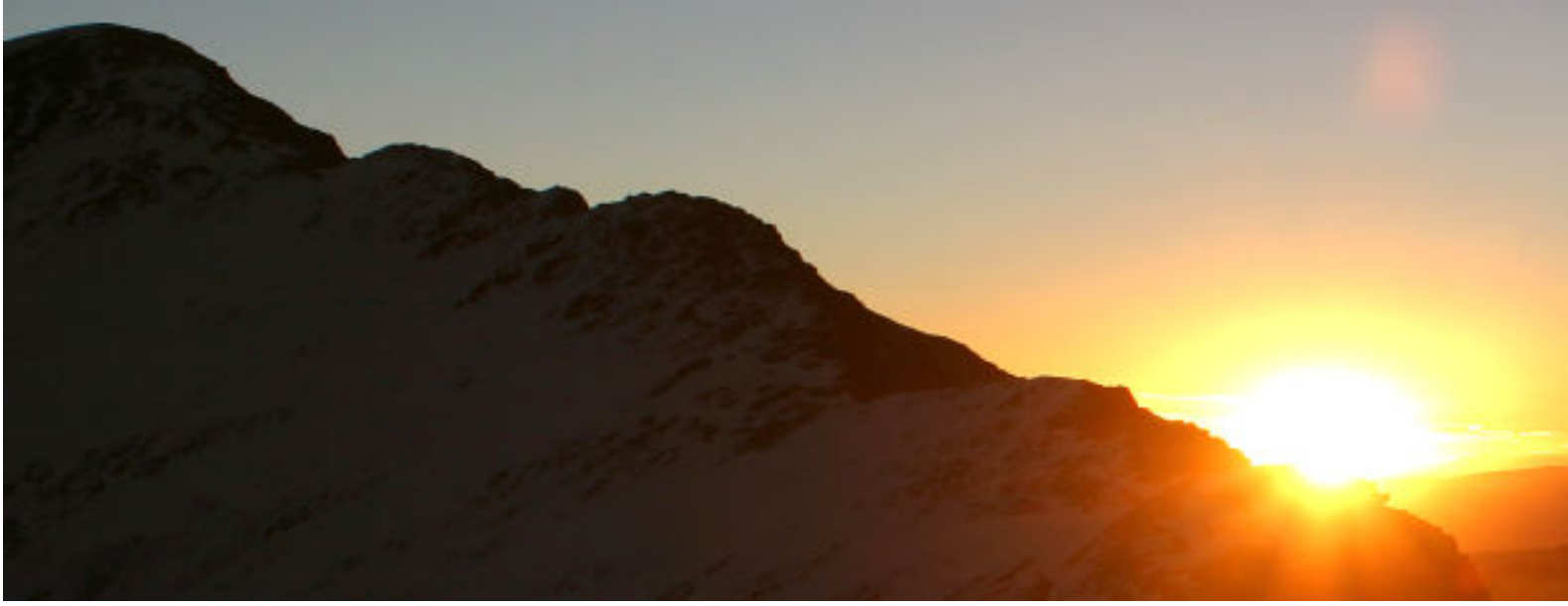
Arriving in Miami and grateful to get through customs without a hitch most of the team took a well-earned cooling off in the pool, while others made the short trip to Miami Beach. The short stopover quickly ended and the second half of the flight saw us stepping off the plane at 0630 breathless, but anxious to see something of our new and stunning environment. La Paz airport is in fact part of one of the largest shantytowns in the world, stretching out over the Altiplano above La Paz. Arriving there gave us one of our first views of the stark contrast between rich and poor in Bolivia, whilst the bus trip into La Paz afforded us one of the most spectacular entrances to a city to be had any where in the world.

Most of us were grateful to arrive at the hostel to be given a pep talk by Andy and to have a cold shower and breakfast. Some narrowly avoided Coca Tea thanks to Becky's sharp eyes! Unfortunately, things were not quite so simple for Ee Fu who came face to face with Bolivia's less than efficient immigration system but fortunately initial fears of deportation subsided by day two. Our first four days in Bolivia were an adventure in themselves and saw members of the team visiting the Valley of the Moon, seeing Tiahuanaco, hiding in shops to avoid the imminent clash of protesters and riot police, and trying out the local and international cuisine. All of this was immersed in the amazing colour and culture of traditional dress and cathedrals meeting tower blocks and suited businessmen.

The four days of acclimatisation were needed to varying degrees: while some were forced to retire to bed confused and breathless, others went in search of the best poncho deals amongst the colourful buses and the hustle and bustle of the Witches' Market. AMS can truly strike without warning and in the most unexpected people. By day 3 most of the team were fit enough to get down to some traditional Bolivian dancing around a blazing fire in the centre of the hostel. Day 4 saw discussion, which brought the research back to the front of people's minds, with some skilful negotiating about the order of ascent taking place. "How will I cope at 5200m?" was a very real question in everyone's minds as the first group boarded one of the 4x4s for the trip to the lab.

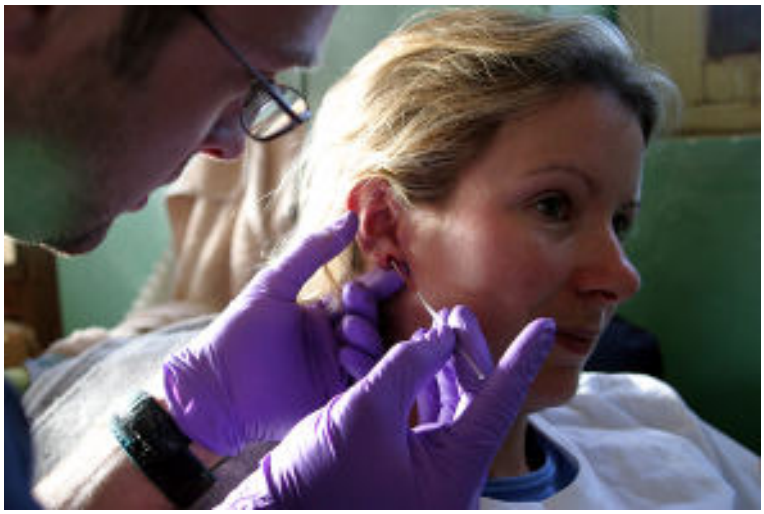
The "bloodless coup" as Team 5 took over from Team 4 completed, everyone tried to settle down to work at the lab. However the random AMS struck again and people felt ill to varying degrees during their first 2 or 3 days at the lab. There were four evacuations during those initial days at the lab and although nobody wanted to go down it was clear to all that some things are beyond our control. All got stuck into the first few sample days and all got stuck as the "vampire team", as nicknamed by Dan, became increasingly efficient. The research protocols themselves acquired infamy to varying degrees. Lucy declared capillary blood sampling as the most infamous protocol, but the breath condensate experiment came a close second because it tended to worsen the high altitude headaches. Although many did not like the eye protocols, frayed nerves were suitably placated by sweet bribery. The sleep studies were universally disliked by those good enough to take part; it wasn't so much the super glue in the hair as the ironic nature of a sleep study where not many taking part thought they got any sleep! Having been prodded and poked all were glad to reach their days off.

Nim's inspiration in creating a twister board out of different types of tape (and the provision of suitable supplies due to the forethought of Al, Craig and others) meant that by the end of our two day break,



Clockwise from top:
Sunset from Chacaltaya lab; (*left to right*) Roger, Marta, Andy & Mark collecting gas from Praxair; Dan & David performing the eye experiment; Oli does EBC; Chacaltaya lab as seen by the first arrivals in Team 1

Clockwise from top:
Markus near the lab (Huayna Potosi in background); *(left to right)*; Jamie taking Hannah's capillary blood; John performing Adam's echocardiogram; the expedition barrels



Clockwise from top:
The blood room; Rob Roach tests the Gamow bag; Marken prepare the bloods for shipping to the UK; Adam prepared for the sleep study; Matt performing the exercise protocol

team 5 could reasonably claim the world record highest ever twister game, a high level of proficiency at table footie debagging and the coldest ever game of strip poker. This was all nicely rounded off by chocolate caliente and tostadas at the ski lodge. Many members of the team also enjoyed the spectacular sight of dawn on the summit of Chacaltaya. The final couple of days of Apex 2 sampling ritual seemed to go in a flash. The blur of Kirsten running around the lab while seemingly simultaneously doing the eye and cough tests sticks in my mind at least. All the projects were finally packed up on team 5's last day at the lab much to the researchers' relief. 50 days at the lab had taken their toll.

Our time at the lab completed, the team engaged in all sorts of activities - mountaineering was a major feature for most. Breaking through the blockades of La Paz by using little used tracks, we were guided up into the remote mountains of the Condoriri Massif. The valley we were based in was stunningly beautiful and the climbs up long glaciers and scree slopes at one or two in the morning tough but rewarding. On our forth day climbing, the group split into two with some braving the crevasses of Cabeza del Condor while others the windy ladder and steep ascent of Huayna Potosi. Having completed climbing, the group again assembled in La Paz to enjoy a great night out in the city's legendary restaurants, bars and clubs. There was disappointment for some as Paul, Maria and the rest of the Peru group found that despite all their attempts it was becoming increasingly difficult to get anywhere overland in Bolivia due to increased political discontent, however they did manage a trip to the salt flats. The team enjoyed their final few days either taking part in mountain madness by biking down to Coroico or visiting Cochabamba. Team 5's departure from Bolivia was well timed as we managed to leave just before civil disputes over gas and various other things reached their peak. Time well spent, we all returned to the UK to the sharp contrast of a new term or a new job. Life moves quickly.

Accommodation in La Paz

Sorel Cosens

Apex 2 would have been much harder to co-ordinate in Bolivia without a base for the expedition in La Paz. After mailing, emailing and faxing a large number of hostels and hotels looking for that elusive cheap deal we were overjoyed to make contact once again with Hostal Republica. Rene Mariaca and his staff had provided accommodation for Apex: Bolivia 2001, and were very keen to have us stay on our second expedition.

In Hostal Republica we had found a place where we could book over fifty beds when necessary, use as a meeting place, secure and store equipment, reserve beds to be used flexibly for evacuations and researchers, and set up an online 'office' for the duration of our time in Bolivia. All this was provided at a very reasonable price, in the beautiful surroundings of a former presidential residence five minutes from the city centre. The setting was lovely, with sunny balconies overlooking cobbled courtyards and a secluded garden, perfect for when you wanted to retreat from busy La Paz.

Not only did Rene and his staff welcome Apex members and do everything they could to make our stay comfortable and help the expedition run smoothly, they also held a *pena* or party for our leaving. A highlight of our time in La Paz, the traditional music and dance festivities around a bonfire in the colonial courtyard made an amazing, unforgettable last night in Bolivia.

Food at Chacaltaya

Sorel Cosens

Ask any Apex 2 expedition member about the food at the lab and they will groan, and probably swear that they will never eat packet soup or frankfurters ever again. In some ways I take my hat off to Martha, who cooked for 30 at a time in a very basic kitchen, and was asked to cater for a very foreign diet, that included vegetarians and other special dietary requirements. The food was very plain, and we were very glad of the tip-off from the previous expedition, and stocked up on sweets, nuts, fruit and other snacks in La Paz.

Breakfast invariably consisted of bread and margarine, sometimes with jam or marmalade, and on one momentous morning a tiny rasher of bacon and a fried egg. On our weekend off, Martha excelled herself with hot chocolates and a sweet flaky fried pastry.

Lunch and the evening meals were all very similar, with a range of packet soups, followed by meat and a potato or rice dish or pie. The most popular meal was the lasagne or pasta, mince and tomatoes concoction. On a very few occasions we had other vegetables, or some salad, but there was very little fresh food in our diet – disappointing as a 4x4 was going to La Paz fairly regularly. The cooking was very plain without any seasoning, our least appetising meal almost certainly being a frankfurter sausage (or if you were veggie – five button mushrooms) and smash.

The biggest problem with the food was that at that altitude we all required more energy, but the meals were small. Even if the food had been more appealing we would still have been wanting more. The big-eaters among us did complain of being hungry, and our preparation stocking up on snacks in La Paz proved essential.

The Chacaltaya kitchen wasn't one I could have cooked in, we tried to boil water one night and gave up trying to even light the gas, so I was actually grateful to Martha for that cup of hot chocolate and the occasional serving of lasagne, but very happy with my Cuban feast on returning to La Paz!

A Personal View

John Irving

The invitation to participate in the expedition to Bolivia was accepted rapidly. That I was 40 years older than the average age of the students was not a major concern. To my surprise some of my friends and colleagues did doubt my sanity! As the expedition progressed my problem was keeping up with the pace of climbing and walking at altitude, the speed of cycling downhill on the ''world's most dangerous road'' and the inability to consume as much alcohol. In the bars and eating houses of La Paz, the bill was invariably given to me! There was never a problem with such bills, everyone chipping in readily. They were equally good at helping to carry my bags! There was considerable concern at the central cyanosis, which I exhibited for 3 to 4 weeks.

The expedition was very exciting. The opportunity for clinical observations in a unique physiological environment supported by good technical facilities was unsurpassed. I found the same buzz from the investigative work that I had enjoyed in my previous research work many years ago. This was certainly augmented by the enthusiasm and the energy of the students and the medical team. Hopefully all this work and energy will be converted into solid contributions to high quality journals and research meetings.

Working at Chacaltya was amazing. The view of the mountains and of the Altiplano every morning was spectacular. You had to remind yourself of this regularly as the effect of altitude tended to deaden your appreciation. In the first week, walking up slight slopes was a major exercise. Nausea and light-

headedness was readily provoked. I was lucky not to have any serious altitude related illness other than fatigue. The sensation of relief on descending to La Paz was however very pleasant!

The organisation of the expedition was really very complicated, complicated further by having to negotiate in a foreign language, to have responsibility for 104 students and to arrange transport of equipment and specimens. Several events demonstrate how some of these problems were overcome. Some memories include: all the equipment, rucksacks, specimen bottles etc. strewn round the car park at Pollock Halls; Roger asking the way through Wolverhampton when we were diverted off the M6 at midnight; the blue barrels steaming on the apron of Miami International Airport; Roger and John attempting to obtain dry ice on a Sunday morning in a down at heel corner of El Alto; 6 of us lifting the bicycle ergometer onto the 4x4 which had just reversed onto a rock (needing jacked up to get away); and pushing the 4x4 out of a snowdrift at 5200m. Admiration for the way that Roger and his team completed safely a very successful expedition remains one of the main impressions of the whole period.

Medical Overview

Andrew Sutherland

The APEX 2 expedition was an enormous undertaking from both a research point of view and a medical point of view. The main condition that affects people going to altitude is acute mountain sickness (AMS). This commonly affects people who travel above a height of 3000m. Some people are more susceptible than others but anyone who either goes up too fast to moderate altitudes or goes to extreme altitudes is likely to suffer from AMS. AMS is characterised by headache, loss of appetite, nausea and vomiting, fatigue, dizziness and difficulty sleeping. If AMS is left untreated, sufferers can go on to develop the potentially fatal conditions of High Altitude Cerebral Oedema (water on the brain) and High Altitude Pulmonary Oedema (water on the lungs). Altitude illnesses can be treated with medications, oxygen, and pressure chambers, but the only definitive treatment is descent.

With 104 subjects ascending rapidly to 5200m it was likely that most people would suffer from acute mountain sickness. It was therefore extremely important that we had proper medical provisions. The main aim of the medical team was to identify sufferers of AMS and to monitor and treat them appropriately. We were also equipped to diagnose and treat a wide variety of non-altitude related conditions.

Provision of Medical Care

We had 7 doctors at the Chacaltaya laboratory, with experience ranging from Senior House Officers to a Consultant Cardiologist. We were also privileged to have two altitude experts taking part in the research, Prof Rob Roach and Prof Luciano Bernardi. In Bolivia we had an extensive medical kit to cover most common medical conditions as well as specific medications for medical emergencies and for treatment of AMS, high altitude cerebral oedema (HACE) and high altitude pulmonary oedema (HAPE). We also had ample supplies of oxygen and a Gamow bag® - an inflatable hyperbaric chamber.

The medical provision was arranged so that there were doctors at the laboratory (5200m) and in La Paz (3600m) with extra medical staff available for evacuation of subjects who felt unwell. The mainstay of altitude treatment remains descent. We therefore had two 4x4s with drivers available for evacuations from Chacaltaya to La Paz, 24 hours a day. The drive took approximately 1.5 hours with the majority of the descent in the first half-an-hour. A doctor accompanied all evacuees. In La Paz we identified a medical clinic with facilities to treat subjects if required.

The philosophy behind the medical care was one of vigilant observation combined with a low threshold for evacuation should the need arise. This was achieved by closely monitoring volunteers' AMS scores, heart rates and oxygen saturations. AMS scores were measured using the Lake Louise AMS score sheet. We also had a policy of encouraging subjects to make themselves known to the medical staff if

they felt at all unwell or if they had noticed any of their colleagues feeling unwell. Those feeling unwell were able to rest in the 2-bedded infirmary where they could be monitored more closely. The absolute criteria for evacuation were clearly HAPE and HACE but subjects with moderate to severe acute mountain sickness showing no signs of improvement over several hours were also evacuated. If a volunteer wished to be evacuated, they were evacuated regardless of how well we thought they were clinically. There were also evacuations because of illness unrelated to the altitude. Eighteen subjects, mostly with moderate-severe symptoms of AMS were evacuated.

Experience of Medical Problems

Perhaps the most striking of observations was how well everyone was in the presence of marked physiological changes at altitude. For example, if a patient had oxygen saturations below 90% at sea level a medical team would be very concerned. In Chacaltaya we saw subjects' saturations fall below 70% and they were still essentially well.

Figure 1. Percentage of volunteers with AMS in La Paz and Chacaltaya

	Mild-Mod AMS	**Mod-Sev AMS**	**Total**
Day 2 La Paz (3600m)	36%	3%	39%
Day 1 Chacaltaya(5200m)	59%	12%	71%

As expected we had a very high levels of AMS in our subjects. Anyone scoring more than 3 on the Lake Louise score sheet was deemed to be suffering from AMS. The incidence of AMS was about 39% in La Paz and 71% in Chacaltaya (Figure 1).

No subjects developed high altitude cerebral oedema (HACE). However, a Bolivian girl who visited Chacaltaya on a day trip from La Paz became severely unwell and her colleagues sought our help. She had developed a severe headache and was very unsteady on her feet. We suspected that she had developed HACE and we treated her accordingly. She improved markedly once she had descended back to La Paz in one of our 4x4s.

One subject did get high altitude pulmonary oedema (HAPE) when visiting Lake Titicaca (3800m) 3 days after arrival in Bolivia. This was a salutary lesson that this condition can occur at altitudes lower than that of the laboratory. The subject was treated successfully in a hospital in La Paz but was not able to take part in the high altitude part of the expedition. Their chest x-ray showing the 'fluffy' lung fields of pulmonary oedema is shown on the 'Research' picture page.

As well as altitude related illnesses we also had to deal with a number of other conditions (Figure 2). Diarrhoea and vomiting was a significant problem even though the expedition members did their best to eat in sensible places and to maintain good personal hygiene.

Figure 2. Table illustrating all the medical conditions encountered on the expedition

Condition	**Number**
AMS (LLS >3)	70
Evacuations	18
HAPE	1
Diarrhoea + Vomiting	15
Altitude bronchitis	5
Asthma attack	1
Musculoskeletal injury	2
Head Injury	1

Summary
Overall the expedition was extremely rewarding for all the medical staff involved. For anyone interested in medicine, it was fascinating to see the real physiological changes that occur at altitude as opposed to the rather dry descriptions in textbooks. The volunteers were remarkable. Far from feeling sorry for themselves because they had a severe altitude headache, they helped with all the experiments as well as playing an important role in surveillance of AMS symptoms of their colleagues. If we had not had such a dedicated bunch of volunteers our jobs as the medics on the expedition would have been far harder and certainly less enjoyable.

RESEARCH

Expedition Research

Roger Thompson & Kenneth Baillie

Introduction

There is still a great deal to learn about altitude physiology and altitude illness. In this section, we include summaries of the research projects that took place on Apex 2, demonstrating the diversity of the studies that were performed. At the time of writing this report, much of the sample and data analysis for these projects still needs to be carried out. However, as each project is completed, we will give details of relevant publications and results on our website.

Randomised controlled trial of an antioxidant cocktail and assessment of potential mechanisms of action

A dangerous constriction of lung blood vessels occurs when the body lacks oxygen such as in chronic bronchitis or at high altitude. This may be due to highly reactive chemicals called 'free radicals'. At high altitude, free radicals can also cause damage to red blood cells and blood vessel membranes, causing a potentially fatal fluid to build up in the lungs or brain. Antioxidants, such as vitamin C and vitamin E, are the body's natural defence against free radicals. When the body is short of oxygen, it produces more of these protective antioxidants. We hope to have reduced the constriction of lung blood vessels, and the fluid build-up in the lungs and brain by giving large doses of three antioxidants that work in combination to prevent free radical damage.

Principal researcher: Kenneth Baillie
Other researchers: Roger Thompson, Matthew Bates, Ben Reddi, John Irving, David Newby, Simon Maxwell, Professor William MacNee and Professor David Webb

Randomised controlled trial of oral sildenafil citrate in the prevention of altitude illnesses

Blood vessels in the lung constrict when the amount of available oxygen falls and this increases the pressure in these vessels. This process causes fluid to be forced out of blood vessels and into the lung itself, leading to very severe breathlessness. Sildenafil citrate (Viagra ®) has been shown in a small sea-level study to stop this process completely by blocking a specific enzyme. This study aimed to determine the physiological effects and potential benefits of taking Viagra during acute exposure to high altitude.

Principal researcher: Matthew Bates
Other researchers: Kenneth Baillie, Roger Thompson, Nik Hirani, John Irving and Professor David Webb

Pulse wave analysis and endothelial function at altitude

Exposure to low oxygen levels has been shown to damage the linings of blood vessels, contributing to the leak of fluid out of these vessels and into the lung itself and leading to severe breathlessness. Previous studies to estimate this damage at sea level have needed lots of invasive equipment. Pulse wave analysis (PWA) is a new and accurate non-invasive technique to record the function of those lining cells and give an indication of the amount of damage to those surfaces. PWA was carried out on each of the sample days on the expedition. This study will help determine the importance of damage to the blood vessel lining in mountain diseases and may provide a target for future therapeutic interventions.

Principal researcher: Matthew Bates
Other researchers: Alistair Simpson, Kenneth Baillie, Roger Thompson, and Professor David Webb

The role of cerebral haemodynamics in the origin of high altitude headache/AMS

Brain swelling has long been thought to have a role in Acute Mountain Sickness, an illness which shares many symptoms with sea level conditions involving increases in brain volume. However, the cause of such swelling has not been clear. Three options have been suggested: 1) Brain volume increases due to an increase in cerebral blood volume (CBV); 2) Brain volume increases due to an increase in brain tissue water content (cerebral oedema); 3) a combination of both. Our hypothesis was that increased CBV would be associated with increased severity of headache in subjects with AMS, and that treatment which relieved the headache would also reduce CBV. To test this we measured CBV using near-infrared spectroscopy in subjects with AMS. We then repeated the measurements after giving oxygen – a treatment known to temporarily relieve the symptoms of AMS. We also investigated other factors that are likely to have a role in allowing CBV to increase, including autoregulation, autonomic tone, and critical closing pressure.

Principal researcher: Professor Robert Roach
Other researchers: Ian MacCormick, Matt Kinsey, Gaia Casucci and Professor Luciano Bernardi

Capillary blood gases at altitude

By taking several capillary blood samples from arterialised ear lobes, we investigated the change in the amounts of oxygen and carbon dioxide in the blood during acclimatisation to 5200m. This descriptive study may also help to determine if the rate of acclimatisation for an individual may be related to the severity of their symptoms of AMS.

Principal researcher: Roger Thompson
Other researchers: Andrew Sutherland, Kenneth Baillie, Chris Wolff and Gordon Drummond

Membrane diffusion of carbon monoxide (D_m) at altitude

This project used cardiorespiratory testing equipment provided by Sensormedics, Bilthoven, to test the hypothesis that the diffusion of carbon monoxide, across the alveolar-capillary membrane in the lungs, was impaired at high altitude. It may be impaired by a build up of fluid in the lungs known as subclinical pulmonary oedema.

Principal researcher: Roger Thompson
Other researchers: Kenneth Baillie, Gordon Drummond, and Nik Hirani

Ophthalmic predictors of AMS and pathophysiology of high altitude retinal haemorrhage (HARH)

This study was designed to investigate the changes that occur when the eye is exposed to high altitude conditions and to explore whether these changes are related to, or predict, other known adaptive responses to altitude.

Principal researcher: John Somner
Other researchers: Dan Morris, Ian MacCormick, Anna Thompson, Professor Peter Aspinall and Professor Bal Dhillon

Investigation of the relationship between haemodynamic changes at altitude and natriuretic factors

This research investigated the relationship between physiological measurements at high altitude and the potentially important effects of a group of hormones called natriuretic factors.

Principal researcher: Mark Toshner
Other researchers: Roger Thompson, Kenneth Baillie, and Professor Andrew Peacock

Erythropoietin as a new neuroprotective agent, a study at altitude

Low oxygen levels stimulate release of erythropoietin. In this project we tested the hypothesis that subjects with higher plasma erythropoietin levels on arrival at 5200m will have fewer symptoms of AMS because of the protective effect of erythropoietin on the brain.

Principal researcher: Andrew Sutherland
Other researchers: Roger Thompson, Kenneth Baillie, Christopher Lockie, and Roy Sherwood

Sea level P_{50} as a predictor of AMS

AMS is notoriously hard to predict and affects individuals irrespective of fitness levels. Based on the assumption that P_{50} (a measure of the oxygen carried by red blood cells) may give an indication of how well the brain extracts oxygen from the blood, we investigated whether there is a relationship between P_{50} at sea level and AMS.

Principal researcher: James Scriven
Other researchers: Roger Thompson, Kenneth Baillie and Doug Everett

The influence of altitude on oxygen uptake kinetics

At the onset of exercise, oxygen uptake measured at the lungs increases to meet the increased oxygen demand of skeletal muscle. This increase follows an approximately exponential time course and is faster in those individuals described as 'fit', thus providing a potential indicator of aerobic fitness. Investigation of the time course of oxygen uptake at the onset of exercise (oxygen uptake kinetics) at altitude (low oxygen levels) serves as both an outcome measure to assess interventions at altitude e.g. pharmacological interventions, along with providing a unique opportunity to enhance understanding of the physiological mechanisms controlling an individual's oxygen uptake response to physical activity.

Principal researcher: Claire Fitzsimons
Other researchers: Roger Thompson, Alistair Simpson, Ian Nimmo, Pat Warren, C. Greig, and Professor A Young

Exercise metabolism at altitude

Ascent to high altitude is believed to stimulate preferential use of carbohydrate as a source of energy during exercise. This is believed to return towards sea level proportions following acclimatisation. We collected data at different levels of exercise on an ergometer provided by Sensormedics, Bilthoven.

Principal researcher: Alistair Simpson
Other researchers: Glenn McConnell, John Sproul, Ian Nimmo, and Nik Hirani

Visual analogue scales for AMS symptom scoring

Visual analogue scales were completed on a daily basis on the expedition in order to compare this novel means of assessment of AMS with conventional scoring by the Lake Louie AMS score sheet.

Principal researcher: David Collier
Other researchers: Kenneth Baillie, Roger Thompson, Alex Phythian-Adams, and Sorrel Cosens

Postural hypotension in healthy subjects at altitude

Postural hypotension (a fall in blood pressure) immediately on standing was found to be significantly greater at altitude than at sea level. This appears to be a greater problem for boys! Some people with postural hypotension feel noticeably light-headed, and this may suggest why people are more prone to fainting at altitude.

Principal researcher: Oliver Mytton
Other researchers: Alistair Simpson, Richard Oram, Roger Thompson and Adam Darowski

Cardio-respiratory coupling during sleep at high altitude

We investigated whether the normal coupling patterns between heart rate and ventilation during sleep are disturbed at altitude. Abnormal coupling may impair gas exchange and could be associated with more severe altitude illness.

Principal researcher: Nina Rzechorzek
Other researchers: Roger Thompson, Henry Preston and Gordon Drummond

Genetics of normal response to low oxygen

The unpredictable and potentially devastating human responses to low oxygen are in part determined by our genes. It is likely that the same genes are also important in life-threatening lung diseases that occur at sea level. Having successfully conducted a study of the eNOS gene, we will continue this work by examining a range of other genes that are related to the normal responses to low oxygen. We hope to identify genes that may yield clues to the cause of altitude illnesses, and may be useful in predicting the outcome of sea-level lung diseases.

Principal Researchers: Kenneth Baillie, Roger Thompson
Other Researchers: Eve Smith, Matt Bates, Professor David Webb and Professor David Porteous

Special Study Module projects

We were again privileged to gain permission from the College of Medicine to include undergraduate special study modules on the expedition. Six University of Edinburgh medical students carried out research as part of their fourth year curriculum.

High altitude cough

Some individuals who ascend to high altitude develop a dry cough, which can be severe and disabling. It is not understood why this cough develops but one theory suggests that fluid collecting in the lungs may stimulate cough receptors in the airway. This phenomenon of fluid collecting in the lungs is known as sub-clinical high altitude pulmonary oedema. This study tested this hypothesis and aimed to establish whether high altitude cough is associated with sub-clinical pulmonary oedema.

Principal researcher: Victoria Allan
Other researchers: Roger Thompson, Nik Hirani and Gordon Drummond

Blood coagulation at high altitude

Ascent to altitude may result in significant changes in haemostasis, how blood clots. Using thromboelastography and platelet function analysis this study set out to determine the effect of altitude on whole blood coagulation.

Principal researcher: Matthew Barber
Other researchers: Martin Schnopp, Roger Thompson, Lischel Horn, and Carl Moores

Neuropsychological change on exposure to high altitude

AMS symptom score sheets, such as the Lake Louise AMS score sheet, are highly subjective and often fail to yield useful data. However, one effect of high altitude exposure, cognitive impairment, can be measured objectively to give an indication of how effectively a subject is coping with the physiological stresses of altitude. Thus we carried out objective computer-based tests of cognitive function. These could reasonably be expected to indicate the severity of the effects of altitude on the brain tissues.

Principal researcher: James McKinlay
Other researchers: Kenneth Baillie and Professor Neil Douglas

An investigation into the markers of inflammation and oxidative stress present in the exhaled breath of subjects taken to high altitude

The object of this large study was to ascertain whether healthy subjects taken to high altitude have any evidence of lung inflammation or oxidative stress in their exhaled breath samples. Previous research into the effects of altitude-induced hypoxia on the lung has been limited in size because of the invasive nature of available sampling techniques. This project used the non-invasive technique of breath condensate collection to directly sample fluid in the lungs.

Principal researcher: Sonia MacCallum

Other researchers: Roger Thompson, Kenneth Baillie, Gordon MacGregor, Alistair Innes, David Anderson, Nik Hirani and Margaret Imrie.

Periodic breathing and sympathetic activation at high altitude

This experiment aimed to show whether periodic breathing causes sympathetic activation. Measures of periodic breathing, obtained by conducting full polysomnography, will be correlated with urinary noradrenaline levels.

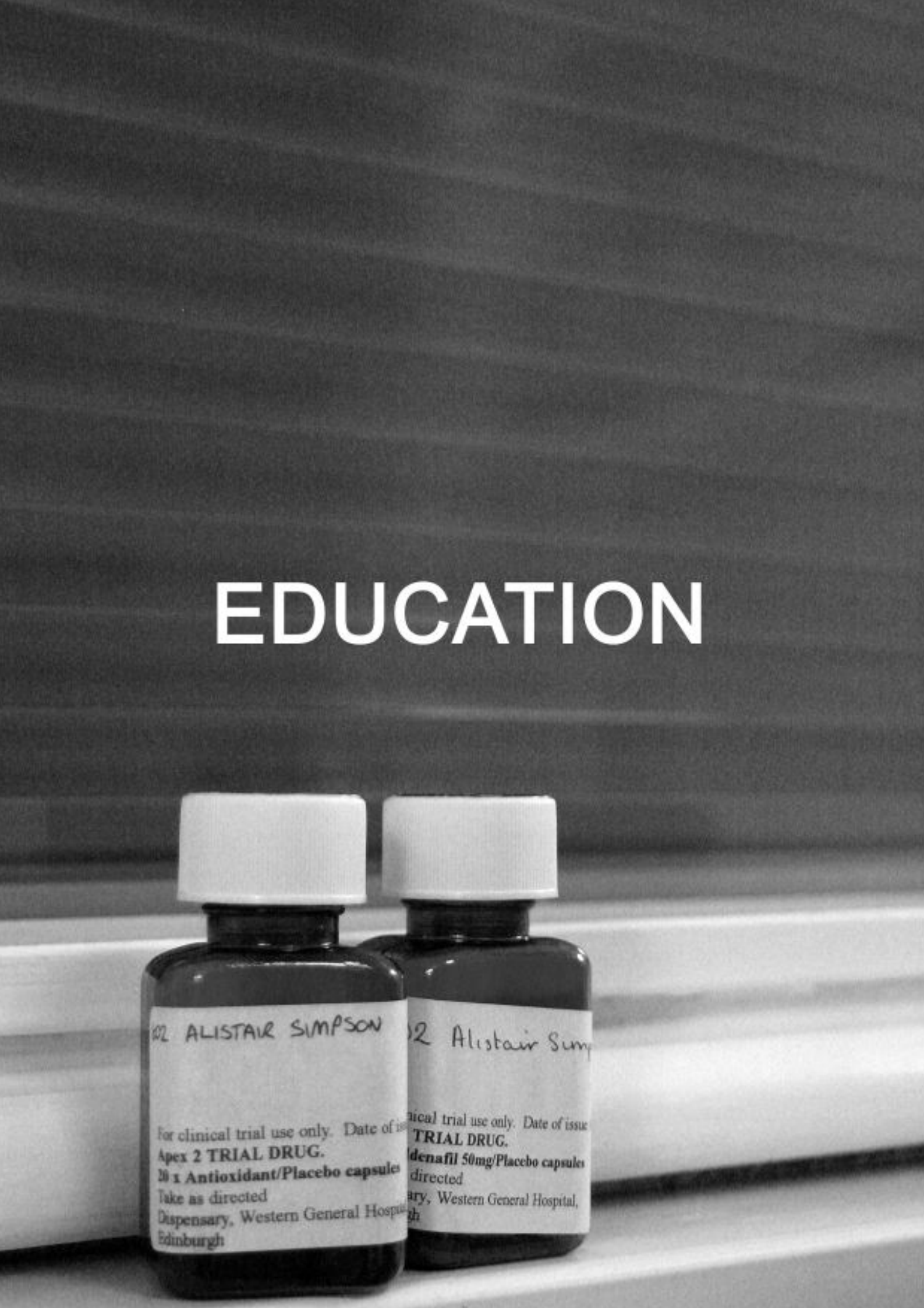
Principal researcher: Henry Preston
Other researchers: Roger Thompson, Gordon Drummond and Professor Neil Douglas

The association between endothelial nitric oxide synthase polymorphisms and pulmonary artery pressure at altitude

A defect in nitric oxide (NO) synthesis in the lung has been suggested to contribute to pulmonary hypertension and the development of high altitude pulmonary oedema (HAPE). Several polymorphisms have been identified in the gene encoding endothelial nitric oxide synthase (eNOS), which is an important enzyme in NO production by endothelial cells. We studied the volunteers for 2
polymorphisms of the eNOS gene and correlated the genotyping results to systolic pulmonary artery pressure measurements (PAP) determined by echocardiography at sea level and 1, 3 and 7 days after ascent to altitude.

Principal researcher: Eve Smith
Other researchers: Kenneth Baillie, Professor David Webb and Professor David Porteous

EDUCATION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Education

Alistair Simpson

We received some 17,000 visitors to our website during the expedition's two months in Bolivia, with up to 400 visitors every day.

The maim aim of creating the website was to inform and educate the public about high altitude medicine and research, and about our expedition in particular. Following our expedition two years previously, we had given lectures and presentations to school pupils, students and colleagues. This time, we felt we could and should expand the educational aims of the charity into something more dynamic and substantial.

The core of the new educational arm of the expedition would aim to bring the expedition right into classrooms across the UK using live internet updates. Importantly, this broadcast was also intended to be interactive, allowing schoolchildren to contact the researchers in the lab, as we performed our work. It was important to me that we did not simply inform our audience, but also interested and inspired them. However, there are several technical issues with maintaining a website live from Chacaltaya laboratory, the key one being establishing an internet connection. Our only method of doing this at the lab was to use a satellite phone, but given the slow data transfer rates available, and the need to hire the phone itself, the costs involved were prohibitively expensive. Our compromise was to update the site daily, or every second day, by taking a laptop to La Paz and using our internet connection there. This system allowed us to provid regular updates of video, images, an online diary, and tutorials about the research, as well as using e-mail to maintain some element of interactivity.

It is very easy to produce a website and write information about what you are doing. However, it is far more difficult to make it a useful learning resource, and to get people to utilise it. This represented one of the key obstacles to the success of this part of the expedition.

To ensure that our project was something that schoolteachers could actively use, and not something that would simply add to already stretched classroom time, we approached a number of educational authorities for advice. After contacting several educational advisors for different district councils in Scotland, I was put in touch with Learning Teaching Scotland, whose advice was to prove invaluable. This government-funded organisation produces learning resource material for teachers and pupils throughout Scotland, and was very interested in the Apex 2 expedition. After meeting with them and discussing our plans, they were able to advise us on how to make our material suitable for the syllabus.

Following the success of the website, we will produce a learning resource pack for schools, in conjunction with LTS. This will most likely take the form of data sheets and possibly an interactive CD-ROM. Furthermore, we have already begun a series of lectures and presentations to schools, universities and professional bodies.


ACCOUNTS
FRAGILE

Accounts

Alex Phythian-Adams & Roger Thompson

The accounts presented in this section are those of the expedition, Apex 2. The income and expenditure included below represent the cost of organising the expedition and conducting the research in Bolivia. These accounts do not include the cost of completing the individual research projects.

Expedition Income

The expedition members funded the vast majority of the cost of the expedition. Trusts within the University of Edinburgh kindly gave the expedition a total of £ 5068.50. Out of these funds the University's Student Travel Fund, James Rennie Bequest and William Dickinson Fund all gave members of the expedition funds towards transport costs. Money from these funds went towards the flight costs that came to a total of £ 77,700. The University Development Trust gave the expedition £ 1000 towards the cost of carrying out research involving 104 people, most of whom were members of the University. Other University Funds, such as the Weir Fund, gave funding to specific research projects.

We were grateful to receive continued support from the Mount Everest Foundation, the Myre Sim Fund and the Carnegie Trust for the Universities of Scotland. Fundraising by our hardworking volunteers contributed significantly to our income and is discussed earlier in the report. Numerous other small trusts and individuals gave donations to support the expedition. Chest Heart and Stroke, Scotland, supported the Expedition Leader and Deputy Leader with generous travel grants.

Expedition Expenditure

The flights made up a large proportion of the expedition expenditure. The transport of our equipment to and from Bolivia includes transport of several items classified as dangerous goods, for example compressed gases. Internal travel comprises the cost of hiring the 4x4s, which we used to transport volunteers to the laboratory and for emergency evacuations. The amount also includes the expenditure on petrol, the 4x4 drivers and coach transport to and from La Paz airport. Accommodation in La Paz was provided for the first four days of acclimatization on arrival in Bolivia. The expedition also paid for a permanent equipment store and a room for subjects and medical staff involved in evacuations from the laboratory. The expeditions members paid for their own accommodation following completion of their stay at the laboratory. Post-expedition costs such as this report and the administration costs of doing presentations and returning research equipment are estimated.

Research Grants

The general costs of the research conducted on the expedition are presented in the accounts. However, several of the research projects were directly supported by research grants and this money has not been included in the expedition accounts. Chest Heart and Stroke, Scotland, awarded a small project grant to Sonia MacCallum to conduct her research on exhaled breath condensate. The Wellcome Trust supported Eve Smith with a grant for her genetics project and John Somner with a grant for the eye project. The Ministry of Defence has also agreed to support research carried out by the University of Edinburgh on the expedition.

Expedition Income

Description	**Totals**	
BP match a donation	£	600.00
Carnegie Trust for the Universities of Scotland	£	2,000.00
Donations, Individuals and Companies	£	1,949.05
Fundraising events	£	7,725.68
Mount Everest Foundation	£	225.00
Myre Sim Fund of the Royal College of Physicians of Edinburgh	£	1,500.00
Pfizer Ltd.	£	400.00
Royal Society of St George Expedition Award	£	500.00
University of Edinburgh Development Trust	£	1,000.00
University of Edinburgh James Rennie Bequest	£	700.00
University of Edinburgh Student Travel Fund	£	1,968.50
University of Edinburgh Weir Fund	£	1,200.00
University of Edinburgh William Dickinson Fund	£	200.00
Volunteer contribution to expedition costs	£	99,080.00
Volunteer payment of team building weekend	£	4,940.00
Total	£	123,988.23

Expedition Expenditure

Description	**Totals**	
Team building weekend	£	4,916.83
Flights	£	77,700.00
Personal insurance	£	7,140.00
Equipment insurance	£	69.83
Equipment transport (freight and customs)	£	6,429.15
Internal travel	£	4,975.96
Accommodation in La Paz	£	4,044.70
Provisions at Chacaltaya laboratory (Water and Food)	£	4,057.89
Cost of using Chacaltaya laboratory	£	2,505.52
Communications	£	864.63
Goodwill gifts	£	215.00
Sundries and logistics	£	546.89
Medical kit	£	323.62
Legal Expenses	£	528.75
Web page costs	£	111.60
Research supplies during expedition	£	7,893.19
Expedition administration	£	1,571.39
Expedition report (estimated)	£	2,000.00
Post-expedition administration (estimated)	£	500.00
Total	£	126,394.95
Difference*	-£	2,406.72

*The cost of the report and post-expedition expenses will come from Apex (SC030345) charity funds.

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Sir Chris Bonington CBE
Dr Fanney Kristmundsdottir

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The University of Edinburgh

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Pfizer
BP
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VWR International	Chris Wells, Becky Conway
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Medical Expeditions Ltd.	
Bedfont	
Camlab	

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Penta Design & Promotion
Caledonian Brewery
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Whittards of Chelsea
Chocolate Soup
The Fudge Kitchen
Why Not?
Oxygen Bar
Alien Rock
The Edinburgh Bear Co
White Dove Crafts
Stockbridge Bookshop
James Thins Booksellers
The Science Sleuth Shop
Scotmid
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Professor Ben Honignam, Colorado Center for Altitude Medicine and Physiology
Professor Robert Roach, Colorado Center for Altitude Medicine and Physiology

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Professor Neil Douglas
Dr Gordon Drummond
Dr Carl Moores
Dr Nik Hirani
Dr Alistair Innes
Professor Bal Dhillon
Professor Ian Whittle
Dr Simon Riley

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Professor Wardlaw
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Top to bottom:
Mark using the Sensormedics equipment; John measuring oxygen saturations in La Paz; the researchers, drivers, Martha and some of Team 5 outside Chacaltaya lab

apex 2

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