CAJAMARCA PROJECT 2000

PERÚ Y LA REGION DE CAJAMARCA

Peru

Peru is a country of contrasts: the rich fertile valleys near the coast - the barren desert - the imposing mountains - the rich diversity of the rainforest; the hustle-bustle of Lima - the tranquillity of the country; the wealth of the few - the poverty of the many. Through its history dynasties have come and gone, each leaving their own unique mark on both the land and on the people. Peru is not only the land of the Incas, but also the land of the Moches, the Chavins and, of course, the Spanish C*onquistadores.*

Peru is the third largest country in South America, the size of France, Spain and the United Kingdom combined, and is stretched out along the Pacific coast north of Chile. The terrain can be split into three main regions; the coastal region where 44% of the population live, the highlands with 50% of the population, and the jungle – which although the largest of the three regions contains only 6% of the people. Peru has had a rocky economic past with periods of enormous inflation, but this has now stabilised and in 1994 Peru registered the highest economic growth rate in the world. However, recent estimates class 49 percent of the population as poor, and almost a fifth of the population live in extreme poverty. Over one third of homes have no electricity or running water, and a third of children suffer from chronic malnutrition. In the highland regions (where Cajamarca is situated), the figure for those living in poverty rises to above two-thirds.

Cajamarca

Cajamarca is a beautiful colonial town and the most important in the Andes of Northern Peru. It is an ancient city dating back to Inca times, and indeed was the city where Pizarro and his *Conquistadores* began their conquest of the Inca Empire. Its population are mostly *Campesinos* - local peasant people of mixed heritage, though largely indigenous Indian. The major language of the region is Spanish, with Quechua (the language of the Incas), still spoken in some isolated villages. Within the region there live around 300 000 people, with 70 000 of these being living within the town of Cajamarca itself.

The culture of the region reflects the traditions of the people. The cuisine is rich and varied - from the ever present “cuy” (guinea pig) to simpler dishes such as “papa a la huancaina” (potatoes topped with a spicy cheese sauce). The chance to try such delights never far away as the Peruvians have a sense of hospitality and family which has been lost in the western way of life. A large proportion of the people are employed in food production - from the basic tilling of the fields to selling produce on the streets. More recently foreign-operated gold mines have brought new employment and some air of prosperity to the area, although this is somewhat superficial and for many does not outweigh the ecological concerns.

FARMING AND THE VETERINARY PROFESSION

The keeping of Livestock

Within Peru, as with many developing countries, agriculture plays a very important role in day to day survival for many of the people. Agriculture contributes only 7% to the Gross Domestic Product of Peru, but employs around one-third of the population (mostly in the highlands). In the Cajamarca region the mainstay of the economy is milk production (as such it is often described as the 'cheese capital' of Peru). The main production animals kept are cattle, sheep and pigs of “creole” origin (the breeds originally brought in by the Spaniards). Over time the “improved” genes of breeds such as Holstein have begun to filter through, and are now quite prevalent. These species are typically kept in very small groups by *campesino* families - with only the occasional larger farm. The animals are bought and sold at the weekly market - ultimately being slaughtered at the local abattoir (some home-slaughter occurs, which is often a public health risk). Also, guinea pigs, chickens, horses, cats and dogs are ever present. The animals are utilised in ways not seen in much of the western world for generations - from oxen being used for ploughing to cock-fighting for entertainment.

Cattle disease

Cattle in the Cajamarca region face a considerable disease challenge. The major parasite of the region is *Fasciola hepatica* . In the climate of Cajamarca, warm and wet during the rainy season, it thrives. Recent studies found 90% of local cattle infected (clinical case outcomes ranging from anaemia to death), therefore massively reducing production. Not only this, but recent studies have shown 15% of rural children to be infected. In addition, coccidia, Cryptosporidium, PGE and parasitic bronchitis all have a part to play.

Parasites may also have a part to play in the relatively high abortion rate. This speculation can be supported by recent research, which has isolated Neospora caninum from a considerable proportion of aborted foetuses in the Lima area. Another factor in the abortion rate may well be Brucellosis, which is only one of several diseases that are notifiable in the United Kingdom, but remain a significant problem in Cajamarca. Others include Foot and Mouth Disease and the occasional rabid cow!

Several of the other diseases which occur in the region could perhaps be expected; lameness in the wet season, calf respiratory disease, mastitis, lymphosarcoma. In addition, the location of Cajamarca also means that altitude sickness is not uncommon in either calves or cows. Disease in animals is especially significant due to the fragile economic state of most farmers – and any loss of production can have a highly significant effect on a family’s wellbeing.

The Veterinary Profession

In Peru the veterinary field encompasses a wide range of areas including those of farm animal management, public health and animal welfare. The majority of vets are employed by dairy companies, the health and agriculture departments of the government, poultry farms and drug companies. Only around 10% are employed in private practice. However, although low, the number of vets in private practice is quickly rising (the first of the practitioners in Cajamarca only appeared three years ago). The veterinarian is increasingly called upon to attend to the health of companion animals, at least in part due to the influx of the miners. Simultaneously to this increase in the scope of veterinary influence, there is a revolution taking place within the field. Practices in Peru are becoming ever more like those in the western world as a massive range of new drugs, foods and techniques are being employed. Veterinarians are continually trying to improve the service they offer and are very keen to receive information about products or procedures.

Outside the purely clinical role, veterinarians have a very important role to play in other spheres. Within the region, zoonotic diseases are a major problem. Bubonic plague, Cysticercosis, Rabies, Fascioliosis, Brucellosis, T.B. are all examples which still require careful control in the area. Vets play an essential role in multidisciplinary teams that tackle these problems. In addition, food hygiene etc. can obviously pose a risk to public health. This situation is exacerbated in the Developing World where hygiene may be poorer and there is widespread sharing of living space between humans and animals. A well-trained veterinary service is essential for effective control of public health in the Developing World, assisting in prevention of disease epidemics. Animal welfare is another important task for vets, as under the extreme pressures of the economy of a Developing Country, it frequently carries a low priority. Veterinarians can help to redress this balance, and in doing so maintain a respect for the animals on which the economies are so dependent.

FACULTAD DE CIENCIAS VETERINARIAS, UNIVERSIDAD NACIONAL DE CAJAMARCA

The University of Cajamarca is based within a self-contained campus on the outskirts of the city. It has seven faculties, including a very active Veterinary Faculty. This part of the university has over 400 students working their way through the course. Each year there is an intake of around 80-100 students, of whom around 20-30 will eventually graduate after a period averaging 6-8 years. Those studying in the faculty show an amazing thirst for knowledge - in a way that often seems to be missing in many students in the western world. Not only content with the challenges posed by veterinary studies, they are very keen to receive textbooks and language materials in English, also thus expanding their international perspective. The veterinary faculty of La Universidad Nacional de Cajamarca is also very lucky to have many staff who have benefited from periods of graduate study in the U.S.A., Britain and Chile. These highly qualified individuals work in very challenging facilities to provide the best learning experience and research possible.

Facilities within the Veterinary School at Cajamarca

The university is poorly funded, which shows through in the facilities of the Veterinary Faculty. In November 2000 representatives from the International Veterinary Students' Association (IVSA) visited Cajamarca. At that time there were a range of problem areas within the faculty. The very few texts present in the library were old, and mostly outdated. There were no computers in the faculty - leaving the valuable information resource provided by the Internet untapped. The laboratory for the teaching of Histology contained two microscopes to teach 75 students per year. The staff did not even have suitable equipment for producing the sections to be viewed.

Clinical facilities were also sadly lacking, without X-ray or inhalational (gaseous) anaesthesia facilities (there were not even proper facilities for sterilising surgical instruments). The diagnostics laboratory at the faculty is supposed to serve the whole locality, but had fewer facilities than the average school laboratory in the United Kingdom! Mains water was only supplied during each morning, the rest of the day spent working with water from buckets. Even the top research laboratories in the university were in desperate need of equipment - such as that used by Pedro Ortiz Oblitas, who is a world authority on *Fasciola* immunology (and pioneered research into Triclabendazole therapy in human fasciolosis).

At the time of writing, the vet faculty is waiting for customs clearance of a donation of equipment from the IVSA. This includes:-

- Textbooks, video facilities and computers for the library
- microscopes, a video microscope, a microtone and tissue processors for laboratory teaching
- autoclave, inhalational anaesthetic equipment and instruments for the clinical department
- a wide range of equipment and facilities for the diagnostics laboratory, from a permanent water supply, to incubators, centrifuges, microscopes and consumables to name but a few items.

Much of the equipment listed above was donated through the veterinary faculty in Glasgow, with other items coming from Cambridge, Bristol, Lyon, and Vienna among others. This equipment will revolutionise certain key areas within the faculty, but is far from a solution for the challenges that are faced by staff and students in Cajamarca.

Studying Veterinary Medicine in Cajamarca

A typical student in Cajamarca might study the following courses:-

1st year :

- *Biology*
- *Embryology*
- *Applied Mathematics*
- *Chemistry I*
- *Chemistry II*
- *Language and Communication*
- *Animal Production*
- *Veterinary Anatomy*
- *Biophysics*
- *Applied Botany*
- *Histology*
- *Zoology*

2nd year :

- *Veterinary Physiology*
- *Genetics*
- *Biochemistry*
- *Pasture and Forage Management*
- *Ecology*
- *Biostatistics*
- *Veterinary Immunology*
- *Agricultural Economy*
- *Veterinary Parasitology*
- *Aquaculture*
- *Computing*

3 rd year :

- *Animal Production Systems*
- *Veterinary Pathology I*
- *Veterinary Pathology II*
- *Parasitology and Parasitic Diseases I*
- *Parasitology and Parasitic Diseases II*
- *Veterinary Microbiology I*
- *Veterinary Microbiology II*
- *Ruminant Nutrition and Feeding*
- *Monogastric Nutrition and Feeding*
- *Civil Defence*
- *Veterinary Clinical Diagnosis*
- *Veterinary Pharmacology I*
- *Veterinary Pharmacology II*
- *Experimental Animal Management*
- *Health and Production of Guinea Pigs and Rabbits*
- *Milk derivatives*

4th year :

- *Clinical Pathology*
- *Poultry Production*
- *Farming Administration*
- *Bromathology*
- *Farming Project*
- *Infectious Diseases*
- *Environmental Health*
- *Physiopathology of Reproduction and Artificial Insemination*
- *Major Ruminants Health and Production I*
- *Major Ruminants Health and Production II*
- *Public Health and Zoonosis*
- *Veterinary Gynaecology and Obstetrics*
- *Poultry Pathology*
- *Artificial Insemination and Reproduction*
- *Production Systems*

5th year :

- *Meat and Fish Inspection and Classification*
- *Dairy Products*
- *Meat Products*
- *Veterinary Internal Medicine I*
- *Veterinary Internal Medicine II*
- *Pigs Health and Production*
- *South American Camélids Health and Production*
- *Veterinary Surgery I*
- *Veterinary Surgery II*
- *Equine Health and Production*
- *Veterinary Toxicology*
- *Employment Legislation*
- *Management and Health on Dairy Farms*
- *Clinical rotations*

Following this period of dialectic study, and before graduating, the students are also required to carry out a period of 6 months “practice” (incorporating e.g. dairy work, poultry work etc.) and also to produce a thesis. These thesis’s are produced following a period of time working in a laboratory (normally in the university). However, the scope of the work is obviously extremely limited due to the lack of laboratory facilities.

The knowledge acquired as part of a veterinary education can be viewed as being gained in three main ways:

1 The material learnt and discussed in lectures and seminars

2 The cementing of this material in private self-study periods

3 The practice of these skills in a working environment.

When these three areas are considered, it is clear that the students of Cajamarca desperately need greater self study learning opportunities. Every effort is made to provide the students with ample practical experience (a very important constituent of the course) but with limited facilities, the learning is inhibited. Unfortunately, all areas to be encountered in practice cannot possibly be covered in practical sessions in the final years of study. The veterinary degree is a marathon under the best of circumstances, and under these conditions, it is difficult to imagine how the students cope (and indeed the high dropout rate suggests many do not).

However, in certain areas of the course the very positive attitude of staff and students is more than evident. In anatomy, students receive a very strong grounding in lectures, reinforced by comprehensive notes and practical dissection (albeit they must find their own dog!). This hands-on approach is continued in surgery despite the poor facilities. The students also use their own initiative to benefit the community, such as running a rabies vaccination program.

Veterinary Research in the University

Due to the lack of funding, there is limited research carried out within the University. However, every student must produce a short thesis before graduating, and this does mean that at all times there is work ongoing. These thesis's also form the largest reference resource on work which has been carried out in Cajamarca area in the past. However, as the students must pay all expenses incurred during their thesis work, the scope is somewhat limited.

In addition to the thesis work, there are also a small number of other research projects carried out. One example of this is the "Bovine Mastitis Pathogens of Northern Peru" Project, information about which can be found in the following pages. Two other projects are at present in the planning stage, and a brief outline about each is given below:-

- **"Epidemiological study of human and porcine *Taenia solium* in rural communities in Peru using immunological and molecular methods."**
  Higher education link to be funded by the British Council between the University of Salford and the University of Cajamarca.
  The human parasite *Taenia solium* is endemic throughout South and Central America. The adult stage is present in the human gut as a large tapeworm, and can cause mild enteritis and malabsorption. The larval stage occurs in both humans and pigs. Infected pig meat is usually condemned at slaughter, causing significant economic loss to primary producers. In humans, larval infection may result in moderate or severe neurological problems, particularly epilepsy, which causes suffering and places heavy financial burdens upon both the carrier's family and the health services. This project will identify the risk of *Taenia* infection in Cajamarca region of Peru, screen for human and porcine carriers using sensitive diagnostic tests, and treat all positive cases with suitable chemotherapy, resulting in an improvement in community health.

  The proposed project will give solid data on the prevalence of infection with *Taenia solium* within target communities by use of well-characterized diagnostic tests. The coproantigen ELISA for detection of adult *Taenia* infection in humans can also determine the resolution of infection after treatment, giving immediate information on the success of control in chosen communities. Further visits to the chosen communities (from an extended link) could give valuable information on rates of re-infection with *Taenia*, and the effect of regular chemotherapy on community health.

- **"Control of *Fasciola hepatica* in Cajamarca"**
  A research project on the epidemiology, immunology and control of fasciolosis in dairy cattle in Cajamarca, Peru was carried out between 1993 and 1996. The project was conducted as part of a collaborative research between the Faculties of Veterinary Science of the Universities of Liverpool and Cajamarca.
  The epidemiological data suggest that the infection follows an annual cycle of infection being December and May the period of time in which most of new infections occur (Claxton et al. 1997). Based on these results a new control program was suggested and applied on the last year of the project (Claxton et al. 1998). The objective of this new control program was to diminish the presence and dissemination of F. hepatica eggs in the pastures during the months of august and September in which parasite eggs were detected to be produced. The new control program suggested the use of two strategic doses of triclabendazole per year during August/September and December/January of each year. This program was evaluated and compared during a year with the traditional treatments normally given to the animals. The results of this new method of treatment suggest that Fasciola infection can be controlled in a similar way that the traditional systems do.

  The new control program was monitored only for one year using a small number of farms. Further work will involve a larger number of farms for at least three years of continued treatment of the animals under the new proposed system of control of fasciolosis.

BOVINE MASTITIS PATHOGENS OF NORTHERN PERU

Following the International Veterinary Students' Association visit in November 2000, the author of this document (John Harvey) became very aware of the potential impact that well targeted research could have within this region. Drawing upon previous experience of research in microbiology and an interest in antimicrobial resistance, the seeds of an idea were sown. This idea focused upon mastitis, as in an area so heavily reliant upon milk production it was undoubtedly of great importance.

The team

The project team consisted of nine persons working full time on the project. These were:-

- John Harvey, Veterinary student, University of Glasgow
- Lesley Penman, BVMS MRCVS, University of Glasgow
- Maureen H. Milne BVMS MVM Cert. CHP MRCVS, University of Glasgow
- Zoe Belshaw, Veterinary student, University of Cambridge
- Jierson Mendoza Estela, Veterinarian, University of Cajamarca
- David Silva Villacorta, Veterinarian, University of Cajamarca
- Héctor Guerra Hoyos, Veterinarian, University of Cajamarca
- Maribel Arévalo Saavedra, Veterinary student, University of Cajamarca
- Sergio González Nuñez, Veterinary student, University of Cajamarca

Pedro Ortiz Oblitas and Maria Cabrera Nuñez, a husband and wife vet team who work within the veterinary faculty, were essential in facilitating the work. , Both have trained at Liverpool School of Tropical Medicine, for a PhD and a Masters respectively. Maria is a Parasitologist and in charge of the diagnostics laboratory of the veterinary faculty, while Pedro is an Immunologist and in addition is a Director of the University with responsibility for technical co-operation. Their support encompassed a range of areas including all liaison prior to the project, interviewing and selecting Peruvian workers, providing advice and support during the project, and in Maria's case allowing her laboratory to be invaded during the period of study!

Within the University of Glasgow a range of members of staff have provided support. Of especial note are Prof. David Taylor who provided support in project design and planning, and Prof. Max Murray who provided invaluable support in finding sponsors for the work.

Project funding

The project funding is somewhat unusual with respect to the number of funding bodies involved. The final budget totalled just over £12 000. The funding bodies involved are:-

Department for International Development
The Wellcome Trust
Pfizer
British Cattle Veterinary Association
The Carnegie Trust
British Veterinary Association
Intervet bursary
Norbrook Laboratories
Travel grant, University of Cambridge
Principal, University of Glasgow
Prof. Holmes, University of Glasgow
University of Cajamarca

Project design

The aims of the project could perhaps best be summarised as follows:-

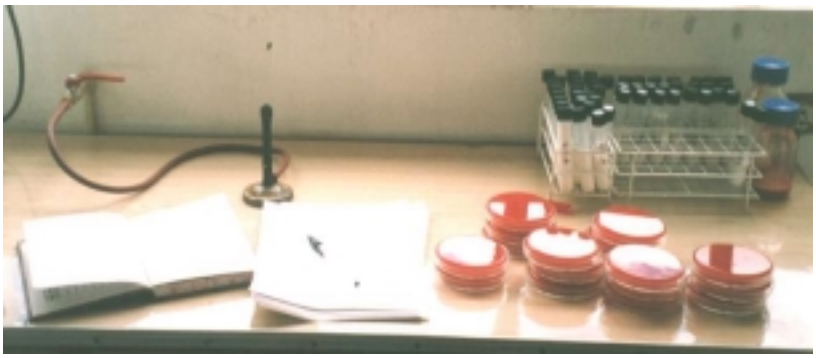
- To investigate the prevalence of mastitis in the Cajamarca valley and the surrounding area
- To investigate farm management in the Cajamarca region
- To provide some initial results on the levels of antibiotic resistance to be found in mastitis pathogens of the area.

In addition, a key point in the protocol for the work was to concentrate, at least in part, on the *Campesino* smallholder farmers (who are rarely included in such work). Prior to the start of the work, a survey was designed that would provide greater information about the farms being visited. Drawing upon ideas from a survey used in Tanzania, this was designed to cover such areas as; background details, farm resources and constraints, stock details, disease control, feeding and management, milking management. Many of the questions were structured in such a way as to indirectly provide information on the farmer's economic situation and level of education.

Before beginning the work the two main milk collection companies in the area (Nestle and Gloria) were contacted and asked to lend their support to the work. This was received in the form of a letter from each company, explaining the work and stating that, although independent and anonymous, the research was supported by the company. Two purposes were served by this liaison – the removal of any risk of distrust of the project from the dairy companies, and also this served as a ticket onto farms that might be suspicious of strangers.

The team was split into four groups each week, which were rotated. Three "mini-teams" of two people each were sent out sampling, while the remaining three persons were based in the laboratory. The sampling teams travelled out to farms in time for morning milking (at any time from 4 am onwards). During sampling a variety of forms of transport were utilised including walking, motorbike, taxi, hitchhiking, "combi", a university bus and at one point even a horse lent by a *campesino* farmer. The farms were not warned in advance about the visits (due to poor communications this would be almost impossible anyway). However, turning up "on spec" allowed the farms to be sampled as found, and somewhat surprisingly teams were only turned away from less than 15 farms during the whole period of sampling. Once on the farm, the survey was asked – a process lasting around 25 minutes. A GPS reading was taken which allowed easy assessment of areas sampled and pinpoint accuracy in terms of farm location and altitude. In addition, as many of the cows in lactation as possible were sampled. This initially consisted of assessments of hygiene, body condition, teat and udder lesions, and a California Mastitis Test. The CM test was assessed as either positive or negative. Individual milk samples were taken from quarters showing any signs of clinical mastitis, and a combined sample taken from all quarters if sub-clinical mastitis was found in a cow. All milk samples were taken with special attention given to avoiding contamination.

All the laboratory work was carried out within the diagnostics laboratory of the Veterinary Faculty in Cajamarca. The milk samples were returned to the laboratory, and plated out on Sheep Blood Agar and MacConkey. Pure cultures and gram stains were made from each colony type identified on sheep blood agar. Further processing was carried out towards an initial identification as appropriate - utilising the catalase test, DNAase agar, Edwards agar and the CAMP test. Following identification, strains of S. aureus (or suspected S. aureus due to the 18% error in the DNAase test when compared to coagulase), S. uberis and S. agalactiae were plated for antibiotic sensitivity. This was determined by the Kirby-Bauer disc diffusion method, with strict adherence to the methods and standards as described by the National Committee for Clinical Laboratory Standards. The antibiotics tested were; Penicillin G, Cloxacillin, Amoxycillin/Clavulonic acid, Kanamycin, Tetracycline, Cefaperazone.



All information collected from the survey, sampling and in the laboratory was collected within a Microsoft Access database, in preparation for interpretation of results.

Challenges (problems!)

The project faced several unexpected hitches along the way. However, principally through good teamwork, it was possible to work around all of these, and remain within budget, without jeopardising the results. The first of these problems was the lack of equipment from the United Kingdom, due to a combination of a broken down ship and the bureaucracy of Peruvian customs (which continues 8 weeks later!). However, through a mammoth shopping trip in Lima, and accepting some compromises (plate-washing experience gained by all!), it was possible to obtain most items required. One of the few items that had made it through from the United Kingdom, a vortexer, refused to function. Using a little initiative it was discovered that a liquidiser base and a rubber bath plug can make a very acceptable substitute!

The basic facilities of the laboratory also posed some challenges. At some points there was no water for the whole day, a situation which was rectified by fitting a water tank on the roof. In addition, for the first time in living memory the university had an unexpected power cut – a situation that lasted 15 days. However, this too was worked around through the hire of a small, if rather noisy, generator.

The scientific work went extremely well, although the bacteriaemia, which swept through the “blood sheep” (who made donations to our sheep blood agar), was undoubtedly not a high point!

Education

An extremely important aspect of the project was that of education. This was carried out in an informal and relaxed environment. As a result, both Peruvian and British workers were heard to comment on their lack of interest and understanding of microbiology during the veterinary course, compared to their time spent during the project. However, education was also provided in a range of other areas including working with farmers (none of the workers had experience of working with *Campesino* farmers, and initially this was viewed somewhat nervously) and language training. There is no doubt that all members of the team gained useful experience for the future through the work.

There are two key points about the training which individuals gained on the project that should be noted:-

1. It has been a common problem that when individuals from developing countries are trained entirely in a western country that the work achieved upon return home is limited due to lack of equipment or technicians etc. However, the training on this project was different in that it was all carried out in the environment in which the Peruvians will work in the future – with it's inherent problems (see above).
2. In general, education given was not from a "teacher", but rather in an informal environment by passing skills from one team member to another. While more formal teaching undoubtedly has its place, this technique of educating maximises interest and therefore uptake of information (questioning at all times was encouraged). Overall, this meant that those involved discovered far more through questioning and investigation than they would have if a "sit down and learn this" approach had been taken.

Results

At the time of writing, three days after the end of work, few results are available. During the period of sampling, 254 farms were visited. At these farms a total of 1066 cows were sample, and 940 samples were returned to the laboratory. The median number of cows on the farms visited was 7 (maximum 90, minimum 1) and the median number of cows lactating was 3 (maximum 47, minimum 1). Average yield per day per cow was found to be 8 litres (maximum 25, minimum 1). **75.3% of lactating cows were found to have sub-clinical mastitis** in one or more quarters, with an additional 7% having clinical mastitis.

Within the laboratory a range of micro-organisms were isolated including S. aureus, Coagulase Negative Staphs, S. agalactiae, S. uberis, other Strep. spp., C. bovis, Bacillus, Coliforms and Fungus.

Successes

The project was enormously successful in many respects. Firstly, the number of samples processed in the short time period. This was due to working long and often antisocial hours (12 hours per day was an average, 6 days per week). This was only possible through the unique way the project was run – utilising a young team, with a relaxed approach, meant that an excellent team spirit quickly built up.

The project was also extremely successful in liaison with farmers. Previous projects that have tried to work with the *Campesino* farmers, in addition to larger farmers, have reported hostility as a major problem. However, this was not a problem during the work of this project – with over-friendliness being more of an issue; many invites for meals, much *Chicha de jora* (home-made maize beer), offers of marriage (accepted in moments of poor Spanish!). In a one area in particular, Chetilla, there were a multitude of warnings made to members of the team about how unfriendly the people were and how sampling would be impossible. However, in this area in particular we had no problems – indeed for much of the time people were asking us to come and sample their farms, their cattle, their food and their drink. This success in liaison can perhaps be attributed to a variety of factors. Firstly, a willingness to help people; assisting with weeding, replacing prolapses, other veterinary advice etc. Also, at all times the farmers were treated as equals, and never in any way spoken down to. The presence of *"Gringitas"* (white people) in the teams also seemed to help – whether the farmer viewed it as a novelty or an honour to be visited by one. In addition, all samplers were loaded with sweets for the children, and at the end of our time at each farm, each farmer was given a free anti-parasitic sachet. These measures also ensured that at all the farms sampled, our return would be more than welcome.

In addition to the above, the project also resulted in massively increased interest in the diagnostics lab. The lab is now oversubscribed with students wishing to carry out their thesis work. In addition there has been massive exposure for the lab to farmers and vets.

The above are just a few of the achievements of this work, above and beyond the simple scientific. As such, it must therefore have the potential to act as a very strong base on which to build in the future.

FUTURE WORK AND LIAISON WITH CAJAMARCA

A recent meeting in Ghana was reported in Parasitology Today, August '99 by Wastling, Williams and Akanmori under the title:-
"How developing Countries might improve the control of zoonotic disease within existing infrastructures."
They concluded that in the circumstances of poor data in Developing Countries, the appropriate direction of resources is impossible - leading to the misuse of already limited resources.

South America, and Peru in particular, is an area that is under-researched. Being outside the areas touched by the Commonwealth has meant that in the past it has received far less interest than for example Africa – a fact that is demonstrated clearly by the small number of papers published about the region in English language journals. However, there is enormous need for well-targeted work in the veterinary field in the area.

Following on from the "Bovine Mastitis Pathogens of Northern Peru" project, there is obviously enormous potential for a larger project (of years as opposed to months). There is undoubtedly the need for further research, and education, into the problems of mastitis in the region. Such work could be used to build up links with farmers, which would allow follow-up research and also the potential for work in other areas. A future project could be expanded to cover other major dairy areas within Peru, and also dairy areas within the neighbouring countries of Bolivia and Ecuador. Prior to the start of this initial project, funding bodies had already mentioned interest in further work. The current project has identified suitable team members both from Peru and Britain, and developed an approach with farmers which makes successful education possible.

Another area in which there is great potential for the future is that of forming closer links between the veterinary faculties of Glasgow and Cajamarca. There is enormous energy and ambition within the staff and students of Cajamarca that with a little nurturing can be fully unleashed. Liaison could take a whole range of forms; support of student thesis's, Glasgow students carrying out summer projects in Cajamarca, joint research with Masters and PhD positions, course and facilities development work. The list of benefits to both institutions is almost limitless. The staff and students in Cajamarca are keen. The contacts have been made.

As this document has shown, the "Bovine Mastitis of Northern Peru" project has been an enormous success in its own right. However, this should not be the end of the work, but merely the beginning.