Poultry Research Foundation

ANNUAL REPORT
2004

UNIVERSITY OF SYDNEY

CONTENTS

OBJECTIVES OF THE FOUNDATION

The objectives of the Poultry Research Foundation are to advise the Senate of the University of Sydney and the Vice-Chancellor on matters associated with poultry research within the University of Sydney and to provide an interface between the Australian poultry and allied industries and the university.

AIMS OF THE FOUNDATION

1. To provide an interface between the poultry and allied industries in Australia and the University of Sydney.
2. To undertake research of relevance to these industries.
3. To assist in the training of scientific and technical personnel to service the private and public sectors of these industries.
4. To act in an industrial liaison capacity.

PRIORITIES 2005

1. Develop links between the University of Sydney and the Poultry CRC
    a. Research projects
    b. Educational programs
    c. Postgraduate scholarships
2. Develop research projects lead by the Chair of Poultry Science
3. Complete infrastructure maintenance of Layer and Deep Litter Sheds
4. Promote postgraduate opportunities within the Poultry Research Foundation
5. Organise the 2006 Australian Poultry Science Symposium

Management of the Foundation is vested in a Council comprising the President, Deputy President and Director, Industry Members in the categories of Governor, Company member and Member, and Honorary Governors and Ex Officio Members.

The administrative office and Research Unit are based at Camden.

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University of Sydney
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Camden, NSW
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TRIBUTE TO EMERITUS PROFESSOR TERRY ROBINSON

When Terence James Robinson was appointed as the foundation Professor of Animal Husbandry at The University of Sydney in 1956, in most peoples' minds science had very little to do with the breeding of farm animals. It was an enlightened appointment because, in a remarkable and distinguished research and teaching career, Robinson demonstrated to a skeptical agricultural community that high quality science was an essential and exciting component of modern animal husbandry. When he died in Bathurst, NSW, Australia on Friday 3rd September 2004, he left a legacy that those in the field will recall with awe and appreciation not just for his achievements themselves, impressive though they are, but for the attitudes and approaches that he pioneered.

Terence James Robinson (Terry, and later Prof) was born on 14th July (Bastille Day) 1919 in Reading, Berkshire, UK. He left England with his family at an early age and was raised in Western Australia. He took a Bachelor's degree in Agricultural Science at The University of Western Australia (UWA). He was first influenced by Professor Eric Underwood, renowned for his work with trace elements, but it was one of Underwood's overseas colleagues, Sir John Hammond (Cambridge) that inspired the young man the most. Terry met the great Hammond on a visit to UWA in 1938, and thereupon resolved to work with him. The war intervened and, after graduating, he joined the Royal Australian Navy as an anti-submarine officer. He sailed from Fremantle on 8th August 1942 in the corvette Tamworth, accompanying merchant convoys in the Indian Ocean and Persian Gulf. In all, the Tamworth accompanied 56 convoys of more than 400 ships and lost only three to German submarines, rescuing 130 seamen in the process. He returned to Fremantle in May 1944, and spent a short term of duty in Darwin before demobilization at the end of the war.

Between 1945 and July 1947, Terry returned to UWA, where he worked with Underwood on a condition called 'clover disease' that caused severe infertility in sheep. They developed a bioassay for phyto-oestrogens that were found to be the causal agents in the clovers, and this furthered his interest in reproductive biology. Eventually, he won a prestigious Hackett Scholarship that enabled him to realize his ambition to work with Hammond in Cambridge. The Cambridge years were defining. For his Doctorate of philosophy, he worked on ways to induce sheep to breed at times of the year when they would normally not breed. This was a seminal work in itself, but more importantly he absorbed the Hammond philosophy that became the Robinson style. Both men were interested in applying science to practical agricultural problems. Both would guide their students without directing, and would contribute ideas and provide support, but would allow self-expression. During his work with Hammond, Robinson was among the first to apply mathematical rigour to physiological data. After his PhD, on Hammond's advice to gain some 'hybrid vigour', Robinson headed to the University of California at Davis where throughout 1950 he worked with two American greats, Harold Cole and George Hart. There, he gained an appreciation for the 'American way of doing things' and an enormous respect for the American university system. He furthered his interest in how the hormone, oestrogen, affects breeding behaviour before returning to Australia to the University of Melbourne in 1951 as a senior lecturer. It was during his time at the University of Melbourne that Terry Robinson met his lifelong partner and love, Helen Abrecht. They married in 1953.

In 1956 Robinson and family moved to Sydney where he took up the post of foundation professor of Animal Husbandry at The University of Sydney. It was here that he made his major contribution. He built up the fledgling Department of Animal Husbandry, developing

farms and facilities at Camden and overseeing the construction of new laboratories and offices on the Sydney campus. On his retirement in 1984 he left a thriving department of 18 academics and other support staff. He strategically appointed specialists, and fostered team-building, focusing on the major areas of nutrition, reproduction and quantitative genetics. Drawing on his American experience, he set up the Dairy Husbandry Research Foundation and Poultry Husbandry Research Foundation in 1959 to involve producers in directly supporting research and development in their own industries. Robinson personally supervised 32 postgraduate students, and authored more than 100 papers and reviews that were published in internationally recognised journals. He took particular pride in editing 'Hammond's Farm Animals', a definitive text of Animal Husbandry in its time, originally authored by his mentor. He was one of the founding fathers of the Australian Society for Reproductive Biology and its first Chairman in 1969 to 1973. He later became the founding editor of a new international journal of animal reproduction, *Animal Reproduction Science*, in 1978.

One of Robinson's proudest achievements was the establishment of enduring scientific links with France, during periods of sabbatical leave at INRA Jouy-en-Josas in 1962 and Nouzilly in the early 1970s. This pioneered a path of scientific collaboration that has since been frequently and successfully trodden in each direction by both French and Australian scientists, many his own students and colleagues. At an international level, he has represented Australia on the Standing Committee of the International Congress on Animal Reproduction (1966-82), on the International Planned Parenthood Federation in the UK (1974), and in the Food and Agriculture Organisation conference in Rome (1963). He chaired the Animal Science Division of the Pacific Science Association for seven years and organized the Pacific Science Congress in Hawaii in 1960. He organised and taught in a postgraduate course in Animal Husbandry in Indonesia and was an advisor on the establishment of Animal Husbandry courses at the Universiti Pertanian in Malaysia. He remained active in university affairs after his retirement, being until recently a member of the Advisory Council of Orange campus of The University of Sydney, among other activities.

At the practical level he made his most outstanding contribution in the field of artificial reproductive technology. In the 1960s he devised a system of controlling the breeding of sheep that has been used, virtually unmodified, for the last four decades. This system is the basis of artificial insemination programs throughout the world and it is no exaggeration to say that artificial insemination in sheep, which is now used routinely in moist countries where sheep are run, would not have been possible without Robinson's contribution. The story of how he achieved this is an outstanding example of the inter-relationship between fundamental science and pragmatic animal husbandry.

As a world-recognised endocrinologist studying the hormonal control of reproduction in sheep in the 1950s, Robinson carefully elucidated for the first time the way in which hormones control the sheep's breeding activity. This opened the means for making subtle but effective changes in the hormone regime to manipulate the timing of breeding which has enormous practical significance in the sheep industry. First, it meant that sheep could be bred 'out-of-season', or at a time of the year when they did not breed naturally. Second, it allowed farmers and veterinarians to synchronise the timing of ovulation in large numbers of animals to provide the means of artificially inseminating them successfully in a single session. This was the key to making the technique of artificial insemination an economic reality and, in turn, opened the way for breeders to capitalise on the genetic advantages of using this technique in their breeding programs. Today, not only Australia but every advanced country in the world uses Robinson's technique to control the breeding of millions of animals. While

it has not been publicly recognised, it is arguable that his work and that of his colleagues and students contributed significantly to the development of human IVF science.

Terry Robinson led a full life outside the academic sphere. First and foremost he was a family man, a devoted husband to Helen, who passed away in late 2003. Never one to do anything by halves, Terry's great loves of skiing, sailing and flying were shared with his family. His love of good cheese and wine, fostered by the French connection, such that most important occasions were a time for glass of Vouvray or another 'good drop', also found expression in his more than 30 years membership of the Wine and Food Society of NSW, including 2 years as President. The property he and Helen ran outside Bathurst from the late 1960s became a gathering place for postgraduate students and agricultural scientists of diverse walks and nationalities, and at varying times ran flocks of 'experimental' sheep or provided choice fat lambs to Sydney's boutique restaurants.

Terry Robinson's work was recognised by the award of a Doctor of Science degree at Cambridge (1973) and, belatedly, by the award of an AM through the Australian Honours System. His work lives on not only through the legacy of his scientific discoveries but also through the scientists he trained in the process and whose work he encouraged. It is a great feat for one man to have such an enormous impact on his science, colleagues and friends. Many young people have been unknowingly touched by his philosophies. He will be missed as a friend, leader and mentor by his surviving colleagues and former students, and as a father and grandfather, but the spirit will endure.

Terry is survived by his children, Ann, Katharine and Peter and their families.

Gareth Evans, David Lindsay and Kate Robinson

PRESIDENT'S REPORT

I am pleased to report that this has been an excellent year for the Foundation, which has taken on a new air of activity and optimism. I can say with considerable confidence that the Foundation has re-established itself as an effective link between the University and the poultry industry.

After a period of several years in maintenance mode, our organisation has entered a phase of active growth and efficiency.

The Foundation once again offers a valuable opportunity for the poultry industry to participate in moulding the research and teaching program of the University and we should all focus on sustaining this. By the same token, the staff and students of the University have a ready means of maintaining a dialogue with leading industry representatives.

The recent success and new-found optimism in the Foundation can be attributed to the vision, dedication and sheer hard work of Professor Tom Scott. I would like to take this opportunity to thank Tom sincerely for his great leadership.

Professor Scott is also to be congratulated on the great success of the 2005 Poultry Science Symposium. Attendance was well up on last year and there has been much positive feedback from delegates. There were several innovative changes to the program of recent years and these were generally very well received. In particular we owe Tom a debt of gratitude for completing the mammoth task of editing the Proceedings.

Thanks are also due to Jo-Ann Geist, firstly for her exemplary handling of the administration of the Foundation throughout the year. Secondly, Jo did a magnificent job in ensuring that the 2005 Symposium ran smoothly in every respect. In this she was ably assisted by Stuart Wilkinson to whom thanks are also due in no small measure.

The Poultry Research Foundation is back on track and I thank all members for their continuing support.

Dr Ian G Partridge

DIRECTOR'S REPORT

In the first year and half as director of the Poultry Research Foundation and Chair of Poultry Science, I have found that the criteria established by industry that support my position has provided many challenges, with the main objectives being defined as to:

- Develop a program that focuses on poultry nutrition and digestive physiology;
- Identify and facilitate collaborations between industry and scientists;
- Serve as the primary contact person for industry regarding research conducted by the poultry group;
- Play a major role in organising the Australian Poultry Science Symposium, and;
- Foster strong linkages between the undergraduate program and the poultry industry.

I feel that the poultry group has worked very hard to meet these challenges and we will continue to maintain these objectives as core priorities for future development. Therefore I gratefully acknowledge the poultry research and support staff for their dedication and hard work; as well as their patience as we proceed to further achievements. Included in this acknowledgment are a variety of university support staff that provides overall support in administration and teaching.

We also gratefully acknowledge the membership support of the Poultry Research Foundation, this support provides administrative assistance, and Jo-Ann Geist in this position is much appreciated by all members of the poultry group. We also recognise the research support of RIRDC, Australian Poultry CRC, Premium Grains for Livestock Programme and AECL. We hope that stronger collaboration can be developed with these funding bodies as well as directly with industry. Likewise, we are fortunate to receive approximately one third of the cost of hosting the Australian Poultry Science Support from industry sponsorship. With respect to the 2004 APSS, we gratefully acknowledge the invited speakers for their contributions and time, likewise for those presenting and attending the scientific sessions, particularly with our last minute change of venue and difficulties with audio/visual facilities.

Key objectives I will continue to work towards will be in developing our capacity to conduct poultry research and provide opportunities for learning (undergraduate and postgraduate). Immediate demands include upgrades to infrastructure, which we hope to achieve through industry, university and government (Australian Research Council) support. On this list is: a) new growing and laying cages for use in the environmental control rooms, existing cages do not comply with the new industry codes; upgrading feed milling equipment to include steam pelleting and feed cooling/crumbling as well as to minimise labour and OH&S concerns. In the past year we have installed two research incubators (2,200 egg capacity/unit) and upgraded basic laboratory equipment. Your support and assistance in achieving our goals is essential and it is our intention to demonstrate the value of this contribution to you.

I look forward to continued interactions as well as building new ones. In particular, your support in developing professional training opportunities for undergraduates and postgraduates is needed. I hope these interactions are as rewarding for yourselves and the students as they continue to be for myself.

Respectfully,
Tom A. Scott

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The President, World's Poultry Science Association (Australian Branch)

The Program Manager, RIRDC Chicken Meat Program

The Program Manager, Australian Egg Corporation Ltd

A representative, Australian Egg Industry Association

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Mr. John Darling

Mr. Ern Newton

STAFF AND STUDENTS

Academic Staff

Professor T.A. Scott, BScAg (Saskatchewan), MSc (McGill), PhD (Sydney)

Dr. W.I. Muir, B.Sc.Agr., PhD (Sydney), GradDipEd (UNE)

Dr. J.A. Downing, WDA (Wagga Agr. Col.), B.Sc., PhD (Macquarie)

Honorary Research Fellows

Dr. P.H. Selle, B.V.Sc, PhD (Sydney)

Support Staff

Mrs. R.J. Gill
Mrs. M.E. Hayter
Mr. S.J. Wilkinson, B.Sc.Agr., MScVSc. (Sydney)
Mrs. J. Geist (Administrative Assistant)

Postgraduate Students

Kim Huang – PhD – University of Queensland – Graduated 2005
Mohammad Al Jibali – MSc course work

Honours Students (conducted thesis projects in poultry)

1. Michelle Barron, Assessment of immune response in chickens immunised in-ovo and at the day of hatch (Wendy Muir).
2. Yvonne Reynolds, The relationship between measures of fearfulness and the response of laying hens to stress (Jeff Downing; CRC Honours Student Scholarship).
3. Ashleigh Whitehead, Lactobacillus fermented grain-based diets as a functional feed for broiler chickens (Tom Scott; CRC Honours Student Scholarship).
4. Gillian Cronk, Dietary intervention to improve performance of broilers in hot climates (Tom Scott).
5. John Mulligan, Eggshell as a nutraceutical calcium source for increased calcium retention in laying hens (Tom Scott).

External Appointments

Professor Scott was asked to become an advisor to the Premium Grains for Livestock Program
Professor Scott is on the Poultry CRC Education committee, responsible for reviewing applications for postgraduate and honours scholarships; and for development of CRC education program.

Degrees Awarded

Higher degrees were awarded to the following postgraduate students of the Poultry Research Unit during 2003.

Doctor of Philosophy

None

Master of Agriculture

None

Conference Attendance

Australian Poultry Science Symposium 2004, including presentations by Drs.W.I. Muir, P.H. Selle and Professor T.A. Scott

New Zealand Poultry Industry Conference, including presentations by Dr. P.H. Selle and Professor T.A. Scott

Acknowledgments & Awards

AUSTRALIAN POULTRY SCIENCE SYMPOSIUM - 2004

The 16th annual, combined scientific meeting of the Poultry Research Foundation and the World's Poultry Science Association (Australian Branch) was held on February 9-11, 2004. A total of 125 participated in the 2004 APSS. A total of nine invited presentations and 45 contributed presentations were heard at the meeting. Invited speakers and presentation titles, include:

Professor Hank Classen, University of Saskatchewan	Effects of conventional and novel processing on the feed value of canola meal for poultry. Day length affects performance, health and condemnations in broiler chickens.
Professor Malcolm Mitchell, Roslin Institute UK	Spontaneous and stress induced myopathies in modern meat birds: A cause for quality and welfare concerns. The poultry transport thermal environment – matching "on-board" conditions to the birds physiological requirements.
Dr. Douglas Korver, University of Alberta	Amino acid requirements for broilers: Relationships with growth and meat quality. Modern poultry production and avian bone biology.
Mr. Patrick Garland, BOCM Pauls Limited, Norfolk UK	Influences of market forces on ingredient use and feed processing. Consumer concerns and feed industry response to those concerns.
Professor Tom Scott, University of Sydney	A possible explanation for limited feed intake of wheat based diets by broilers.

Australian Poultry Science Symposium - 2005

The 2005 Australian Poultry Science Symposium will be held on February 7 - 9th. The main themes of the Symposium will be:

1. Starch: Form, function and feed – Highlight on sorghum
    a. Professor J. Taylor, University of Pretoria – cereal chemist
    b. Dr. H. Enting, Schothorst Feed Research, the Netherlands
    c. Dr. J. Black, Premium Grains for Livestock Programme - Australia
2. Feed Intake: Key to growth and efficiency
    a. Professor M. Forbes, University of Leeds, UK
    b. Dr. R. Lentle, Massey University, NZ
    c. Professor R. Pym, University of Queensland
    d. Professor T. Scott, University of Sydney
3. Hot Topics
    a. Associate Professor J. Roberts, University of New England "Egg nutrition for health promotion"
    b. Poultry CRC Highlights
    c. Dr. J. Dixon, Australian National University "Social life of the Australian chicken"
    d. P. Meggisson, Aust-Asian Business Solutions "Changes in the Asian livestock industries"
    e. Dr. A. Turner, Andrew Turner Consulting, "An update on avian influenza"
    f. Professor P. Coloe, RMIT University "The changing nature of food borne pathogens"

Sponsorship of the Symposium (2004) was kindly supplied by:

Speaker Sponsors	Australian Egg Corporation Ltd RIRDC Chicken Meat Program Australian Oilseeds Federation
Gold Sponsors	ADM Australia Pty Ltd Alltech Biotechnology Pty Ltd Degussa Australia Pty Ltd DSM Nutritional Products Pty Ltd
Silver Sponsors	Biomin Australia
Bronze Sponsors	Adisseo Australia Pty Limited Danisco Animal Nutrition Elanco Animal Health Novus International Pty Ltd OziBioPharm
Other Sponsors	Baiada Poultry Pty Ltd Pace Farm Pty. Ltd Australian Poultry CRC

FOUNDATION RESEARCH IN REVIEW

For some 40 years the Poultry Research Unit at Camden has been very active in both broiler and layer research. Some major achievements during the last decade are listed below. This is a very succinct summary with research findings and industry outcomes listed for each major research area. Organisations that appear in brackets e.g. RIRDC indicate the major source of funding for the research area.

1. Amino Acid Digestibility Studies (RIRDC)

Research Findings

i) Development of an assay model for the determination of endogenous amino acid losses under a continuous feeding regimen using guanidinated proteins.

ii) Comparison of excreta and ileal-based assays to measure amino acid digestibility; the results showed that ileal digesta analysis is more appropriate.

iii) Development of an ileal digestibility assay for routine determination of amino acid digestibility.

iv) Compilation of a database of the apparent ileal amino acid digestibilities of feedstuffs.

v) Development of a method for tryptophan analysis and compilation of ileal tryptophan digestibility of feedstuffs.

vi) Evaluation of feed enzymes on digestible amino acid supply.

vii) Application of digestible amino acids to feed formulation.

Industry Outcomes

- Publication of a database: "Digestible Amino Acids in Poultry Feedstuffs" (RIRDC)
- Favourable cost/benefit analyses of industry outcomes (RIRDC)
- Standardized Ileal Digestibility of Amino Acids in Poultry - International Compilation (Industry)
- Reference data for development of *in vitro* test methodology (Industry)
- Feature article in Feedstuffs (July 3, 2000) "Digestible amino acid values more appropriate than total amino acids".

2. Modulation of lean tissue deposition by dietary fatty acids (RIRDC; ARC)

Research Findings

i) Demonstration that dietary inclusion of n-3 and n-6 fatty acids can reduce carcass fatness.

ii) Demonstration that dietary inclusion of n-3 and n-6 fatty acids can improve feed conversion efficiency.

Industry Outcomes

- Recommendations for inclusion of fatty acids that will optimise growth and feed conversion efficiency.
- Enriched meat and eggs as functional foods (Smart Food Centre, University of Wollongong).

3. Development of a non-invasive test for stress in laying hens (RIRDC)

Research Findings

i) The relationship between corticosterone and catecholamines in egg albumen was established.

ii) Corticosterone and not catecholamine concentrations in egg albumen reflect stress in hens.

Industry Outcome

- Egg albumin concentrations of corticosterone could provide a non-invasive measure of stress in hens.

4. Mucosal immunity in chickens (RIRDC)

Research Findings

i) Identification of the site of precursors of IgA producing cells.

ii) Identification of cytokines involved in regulating secretory IgA.

iii) Investigation of *in ovo* vaccinations.

iv) Investigation of the potential for nutrients to modulate the immune response in chickens.

Industry Outcomes

- Facilitate improved mucosal immunity.
- Development of oral vaccines.

5. Nutritional and toxicological evaluation of transgenic plants (CSIRO Division of Plant Industry)

Research Findings

i) Enrichment of lupins with sulphur containing amino acids.

ii) Insect resistant field peas.

Industry Outcome

- Improved poultry feed sources.

6. Application of feed enzymes (Industry)

Research Findings

i) Antinutritive effects of phytate with regard to energy and protein.

ii) Enzyme combinations and improved nutrient utilization.

Industry Outcome

- Estimation of the value of feed enzymes in modifying feed formulations.

7. Mycotoxins in poultry feeds (ADAB)

Research Findings

i) Contamination of corn by aflatoxin, zearalenone and fumonisins and effects on nutritive value.

ii) Toxicology of ergot alkaloids in poultry.

Industry Outcome

- Improved understanding to reduce the risk posed by mycotoxin contamination of poultry feeds.

8. Egg Shell Quality (RIRDC)

Research Findings

i) Defining conditions for beneficial responses to dietary sodium bicarbonate supplementation.

ii) Influence of intermittent lighting at high temperatures.

Industry Outcome

- Defining conditions for improving egg shell quality

9. Amino acid balance for heat stressed broilers (Industry)

Research Findings

i) Identification of need for increased dietary arginine:lysine ratio.

ii) Interaction of dietary sodium bicarbonate with arginine:lysine ratio.

iii) Influence of dietary arginine:lysine ratio on the relative efficacy of different methionine sources.

Industry Outcomes

- Identification that dietary amino acid balance varies with ambient temperature.
- Defining optimum dietary arginine:lysine ratios.

10. Nutritional requirements of recently imported layer stock (RIRDC)

Research Findings

i) Lysine requirement of ISABrown layers.

ii) Methionine requirement of ISABrown layers.

Industry Outcome

- Defining lysine and methionine requirements of ISABrown laying hens under Australian conditions.

CURRENT RESEARCH PROJECTS

Professor Tom Scott:

Projects that have received support in 2004:

- 3yr RIRDC funding "Early dietary management intervention on broiler breast meat"
  - Objectives: Yield of breast meat is determined by muscle fibre number and subsequent growth. Muscle fibre numbers can be manipulated by early dietary intervention directly or as we hypothesise by increasing early gut development to facilitate nutrient intake and absorption to meet these requirements.
- 1yr RIRDC / PGLP funding "Proof of concept to demonstrate the applicability of NIR calibrations to predict feeding value of wheat / triticale"
  - Objectives: Define what characteristics are critical to the feeding value of wheats and sorghums, with an emphasis on wheat; and provide an approach that will contribute to a more complete understanding of feeding value for these cereal grains.
- 18mo CRC funding "Oral delivery system for poultry health products"
  - Objectives: This project will evaluate methods of oral delivery of intact and active bioactive compounds (e.g., vaccines, antibodies, peptides, enzymes, probiotics) to the mucosal surface of the intestinal tract. Successful oral delivery of health stimulants will replace other "hands-on" methods of administration and offer alternatives to maintaining health in an era of restricted use of in-feed antimicrobials. The principal focus will be on delivery of vaccines.
- Submitted an ARC Linkage grant with industry support from Feedworks and Baiada "Dietary intervention strategies to improve reproductive fitness of broiler breeder males and females".
- Approved spending of $150 K on infrastructure and equipment for poultry feedmill, sheds and laboratory; includes RIBG Equipment Fund ($35K) for new broiler chick bioassay cages; Sesqui Teaching Equipment ($8K) for incubators.

Dr. Wendy Muir:

Dr Muir is involved with collaborative research projects that have been funded by the Australian Poultry CRC. The projects are:

1. Application of genomic-based technology for the development of new health products – involves collaboration with CSIRO AAHL Geelong, University of Melbourne, University of Sydney, University of New England and Bioproperties Pty Ltd.
   Work at the University of Sydney involves assessment and enumeration of IgA antibody producing plasma cells present in tissue samples, with a particular focus on tissues of the mucosal surfaces.

2. Development of new generation mycoplasma based vaccines – involves collaboration with University of Melbourne, CSIRO AAHL Geelong, University of Sydney and Bioproperties Pty Ltd.
   Work at the University of Sydney is focussed on establishing an ELISA system to identify an effective immune response to the *Mycoplasma gallisepticum* ts-11 vaccine. ts-11 specific ELISA's are being established for each of the antibody isotypes IgM, IgG and IgA. Both serum and samples taken from mucosal washings of birds vaccinated with the ts-11 vaccine are being evaluated in the optimised ELISA.

Dr. Jeff Downing:

Enrichment of chicken meat and egg with n-3 fatty acids

Studies have continued this year aimed at optimising the feeding strategies needed to produce both eggs and meat that would be classified as enriched sources of n-3 fatty acids under Australian food standards. This work has been conducted using a patented fortified tuna meal supplement ('PorcoMega') and has been funded under an ARC linkage grant in conjunction with the University of Wollongong's "Smart Food Centre'. A large trial was conducted in the broiler shed to evaluate the commercial implications of using this supplement. For similar reasons a large layer trial was run to evaluate the use of the supplement in commercial layer diets.

In conjunction with Dr Wendy Muir the influence feeding this supplement on the immunological competence of broilers has been evaluated (Commercial-in-confidence).

Non-invasive evaluation of stress in hens

These studies are being funded by AECL. This work uses techniques developed at the Camden laboratory to measure corticosterone levels in albumen as a non-invasive measure of stress in hens. The work this year has looked at various aspects of the husbandry practices used in the egg industry.

In collaboration with Geoff Stewart at the University of Queensland the effects of the different housing systems (free range, barn, conventional cages and environmental controlled housing) on stress levels are being evaluated. The first collection of eggs was completed in late July and second collection is scheduled for later in the year.

In collaboration with John Barnett at Werribee the effects of various modifications to furnished layer cages on stress in hens is being evaluated. The first egg collection was completed in May and the second collection has just been finalised.

At Camden work has continued on aspects of heat stress and presently, studies are in progress examining the effect of bird age on the ability of hens to handle stress when housed in conventional cages.

Dr. Peter Selle:

Evaluations of potassium diformate

In this study, the inclusion of 4.5 g/kg potassium diformate (Formi®) in broiler diets significantly ($P < 0.04$) reduced pH of crop contents from 5.6 to 5.1. However, potassium diformate did not alter growth performance from 1-33 days post-hatch, nutrient utilisation [apparent metabolisable energy (AME) and nitrogen (N) retention] or bone mineralisation (percentage toe ash). Natuphos® phytase (600 FTU/kg) significantly increased weight gain ($P < 0.005$) by 4.6% and feed intake ($P < 0.01$) by 3.8%, but did not influence feed efficiency. Phytase significantly ($P < 0.01$) increased AME of the diets by 0.29 MJ (14.13 to 14.42 MJ/kg DM) and tended to increase N retention. In addition, phytase significantly increased toe ash (10.6 to 11.6%; $P < 0.005$), which confirms that the diets were inadequate for nonphytate-P, as was intended. There were no treatment (Formi x Natuphos) interactions, at the 5% level of probability, observed for the parameters assessed.

In the previous study completed at Camden, potassium diformate generated significant increases in weight gain, feed intake, AME and N utilisation. Therefore, the distinct lack of responses to potassium diformate, other than crop pH, observed in the present study was not expected. The lack of responses may have been because the inclusion rate of potassium diformate was inappropriate. In the previous study wheat-based diets with meat-&-bone meal as the major P source were used. In contrast, diets were predominantly based on sorghum with dicalcium phosphate serving as the major P source in the present study. Consequently, differences in diet composition may have modified the acid binding capacity of diets and/or the microbial biomass in the gut, which impacted on the magnitude of responses to potassium diformate.

Given that the diets were P inadequate, the responses to phytase supplementation were modest. It may be that wheat-based broiler diets are more 'phytase-responsive' than those based on sorghum and this possibility is discussed.

There is a very real need to identify alternative feed additives to the so-called antibiotic growth promotants to enhance broiler performance as it is unlikely that the continued usage of antibiotics will be permitted. Therefore, despite the lack of responses observed in the present study, further evaluations of potassium diformate appear justified. Broilers kept on deep litter are likely to be subject to a greater bacterial challenge than caged birds and an evaluation of potassium diformate in this context is merited. The effects of exogenous xylanase on potassium diformate responses in wheat-based diets could prove instructive. Additional studies could investigate the effects of diet composition and acid binding capacity on responses to potassium diformate and its capacity to reduce pH levels in the gut.

In this connection, a Preliminary Research Proposal (PRP) was submitted to the Poultry CRC in January 2004 seeking funding of a 12 months project (July 2004-June 2005) to investigate the impact of diet composition on responses to the inclusion of organic acids in broiler diets. The genesis of the proposed research project was the discrepancy in results between the two potassium diformate studies completed by the Poultry Research Foundation.

Evaluations of soyabean meals

The influence of soyabean meals of different origins (USA or Malaysia), without and with the dietary inclusion of 'full-fat' soy (supplied by Soon Soon Oilmills, Malaysia), in sorghum-based broiler diets on growth performance, protein efficiency ratios, nutrient utilisation and eviscerated carcass yields was investigated.

The dietary inclusion of 'full-fat' soy at 100 g/kg was beneficial with significant improvements in weight gain (3.8%), feed efficiency (5.2%) and protein efficiency ratios (6.4%) from 1-27 days post-hatch. Significant improvements in feed conversion (3.0%) and protein efficiency ratios (2.7%) were observed from 1-42 days post-hatch. These results were associated with a significant increase of 0.79 MJ/kg in apparent metabolisable energy (AME), but 'full-fat' soy did not enhance nitrogen (N) retention. While the increase in AME is overstated because the diets were not isoenergetic, as intended, it remains a valid observation and implies that the beneficial effects of 'full-fat' soy may have been more 'energy' than 'protein' driven.

In the starter phase (1-14 days post-hatch) soyabean meal (SBM) ex Malaysia generated increases in weight gain (6.1%; $P < 0.02$) and feed efficiency (3.2%; $P < 0.07$) in comparison to SBM imported from USA in diets not containing 'full-fat' soy. Moreover, the main effect of Malaysian SBM on AME was an unconfounded increase of 0.56 MJ/kg DM ($P < 0.001$) versus USA SBM, which again suggests an 'energy effect'. Interestingly, several significant treatment interactions were observed where the combination of 'full-fat' soy with USA SBM was more beneficial than with Malaysian SBM, which may have been in response to the provision of additional energy.

This study demonstrates the value of full-fat soy as a feed ingredient and supports, but not establish, the contention that Malaysian SBM is of a higher quality than USA SBM. It is recommended that a comparative study in which SBM is the only protein source in diets with relatively low energy densities would be instructive and may even resolve this issue.

RESEARCH COLLABORATION AND INDUSTRY SERVICES

Professor Tom Scott has completed contract research work with the following companies:

1. Completed PGLP layer AME bioassay of 44 grains

2. Ongoing association with Pace Farm and Baiada to monitor laying hens (four strains)

3. Completed a study on calcium / protein supplement – NSI Dental in broilers

4. Completed a study to evaluate a protein nutraceutical – Bega Nutritional Products

5. Completed a study to evaluate a butyrate acid supplement for eggshell quality

Dr. Wendy Muir is involved with two collaborative projects supported by the Australian Poultry CRC

1. Application of genomic-based technology for the development of new health products – involves collaboration with CSIRO AAHL Geelong, University of Melbourne, University of Sydney, University of New England and Bioproperties Pty Ltd.

2. Development of new generation mycoplasma based vaccines – involves collaboration with University of Melbourne, CSIRO AAHL Geelong, University of Sydney and Bioproperties Pty Ltd.

Dr. Peter Selle has completed four industry supported projects and a further four are in progress.

Completed:

1. A dose titration study involving potassium diformate in broiler diets (BASF Animal Nutrition)
2. A comparative feeding study with different soyabean meals (Soon Soon Oilmills)
3. The effects of the dietary addition of cysteamine hydrochloride on growth performance of broilers (BASF Animal Nutrition)
4. The effects of exogenous enzymes on performance of broilers offered sorghum-based broiler diets (Danisco Animal Nutrition)

In Progress:

1. Interactions between Natuphos phytase and potassium diformate additions to broiler diets (BASF Animal Nutrition)
2. A comparative feeding study with different soyabean meals, without and with “full-fat” soy (Soon Soon Oilmills)
3. The effects of cysteamine hydrochloride and an exogenous enzyme on growth performance of broilers kept on deep litter (BASF Animal Nutrition)
4. Effects of dietary phytate levels on responses in energy utilisation to Natuphos phytase in broilers(BASF Animal Nutrition)

COMMUNICATIONS

Publications:

Silversides, F.G., **Scott, T.A.** and Bedford, M.R. 2004. The effect of phytase enzyme and level on nutrient extraction by broilers. Poultry Science 83(6):985-89.

Silversides, F.G. and **Scott, T.A**. 2005. Changing the energy content of feed of four lines of laying hens in an effort to increase body weight and bone strength. Poultry Industry Council, Canada Report #136.

Selle, P.H., Huang, K.H. and Muir, W.I. 2004. Effects of postassium diformate inclusion in broiler diets on growth performance and nutrient utilisation. Australian Poultry Science Symposium 16: 55-58.

Huang, K.H., Li, X., Selle, P.H., Muir, W.I and Bryden, W.L. 2004. The effect of age and dietary amino acid levels on protein deposition in broiler chickens. Australian Poultry Science Symposium 16: 125.

Muir, W.I. and Gough, M.K. 2004. The influence of dietary ascorbic acid on mucosal immunity. Australian Poultry Science Symposium 16: 134.

Scott, T.A. 2004. A possible explanation for limited feed intake of wheat-based diets by broilers. Australian Poultry Science Symposium 16:9-16.

Papers submitted to the Australian Poultry Science Symposium 2005, Volume 17:

1. Cadogan, D.J., **Selle, P.H.,** Creswell, D. and Partridge, G. 2005. Phytate limited broiler performance and nutrient digestibility in sorghum-based diets.
2. **Wilkinson, S.J. and Scott, T.A**. 2005. Satellite cells: A review of their physiology, manipulation and importance to muscle development.
3. **Muir, W.I., Downing, J.A**., Howe, P.R.C. and Bryden, W.L. 2005. An evaluation of dietary omega-3 fatty acids on avian immunity.
4. **Scott, T.A.** 2005. The impact of pelleting and enzyme supplementation on feed value of twenty-five Canadian wheat samples.
5. Barnett, J.L., Cronin, G.M., **Downing, J.A**., Janardhana, V., Lowenthal, J.W. and Butler, K.L. 2005. Effects of group size and space allowance on laying hen welfare.
6. **Selle, P.H**. Ravindran, V., Ravindran, G and Bryden, W.L. 2005. Amino acid digestibility and growth performance interactions to phytase and lysine supplementation of lysine-deficient broiler diets.
7. **Muir, W.I. and Baron, M.L.** 2005. Comparison of in-ovo and day-of-hatch vaccination on the early immune response in chickens.
8. **Whitehead, A. and Scott, T.A**. 2005. Fermented feed for broilers. Pp 303-304.

Invited presentations:

NEW ZEALAND POULTRY INDUSTRY CONFERENCE (North Palmerston, NZ, October 2004)

Scott, T.A. Minimising losses of eggshell and interior quality.

Scott, T.A. Wheat-based broiler diets – limits to intake.

Selle, P.H. Organic acids in broiler diets: Alternatives to AGPs (Antibacterial Growth Promoters)

NOVUS INTERNATIONAL POULTRY CONFERENCE (Blue Mountains, November 2004)

Scott, T.A. Issues of concern in broiler nutrition.

3RD INTERNATIONAL POULTRY BROILER NUTRITIONISTS CONFERENCE – POULTRY BEYOND 2010 (NZ, April 2005)

Scott, T.A and Wilkinson, S.J. Perspectives on early nutrition.

Scott, T.A. Loss of potential – Nutrient wastage.

RECENT ADVANCES IN ANIMAL NUTRITION IN AUSTRALIA 2005(UNE, July 2005)

Scott, T.A. Variation in feed intake in broiler chickens

Other:

- T. Scott - Presented information at the University Food Science and Technology Showcase - October
- T. Scott – Presented information at the Vet Science Animal Industry Research Workshop - February