



**DEPARTMENT OF MICROBIOLOGY
UNIVERSITY OF OTAGO**

Research Review 1970—1979

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CONTENTS

	Page
Introduction	1
Autoimmunity and autoimmune disease	5
Biological control of insect pests..	7
Epidemiology of human viruses	9
Gastrointestinal bacteriology	11
Genetics of <i>Pseudomonas aeruginosa</i>	13
Immunology	16
Insect and molecular virology	19
Microbial ecology of soil and water	22
Mycology	24
Streptococcal bacteriocins	26
Electron Microscope Unit	28
MRC Virus Research Unit	30
List of theses for which higher degrees have been granted	36
Publications	47

INTRODUCTION

The study of microbiology in the University of Otago dates back almost 90 years. Some bacteriology was taught in the botany section of the natural science course, but it was the development of bacteriological teaching in the Faculty of Medicine which provided the base on which today's flourishing Department of Microbiology was built. Dr W.S. Roberts, who later became the first Professor of Pathology, began courses of practical instruction in bacteriology for medical students in 1891. He had no apparatus at first, but towards the end of the year, managed to extract the sum of \$36 from the University Council and found his teaching in 1892 a little easier as a result.

He was aware, however, of the inadequacy of his classes and was delighted to find an ally in 1908 when Dr F.C. Batchelor returned from London where he had spent some time at Sir Almoth Wright's laboratory. Dr Batchelor, who lectured in Midwifery and later was promoted to a Chair, was convinced that a lecturer in bacteriology was needed. His strenuous advocacy was supported by Dr Roberts and as a result, Dr S.T. Champtaloup was appointed in 1910.

The Department of Bacteriology was established the following year when Dr Champtaloup was promoted to Professor of Bacteriology with the responsibilities of teaching students, providing a diagnostic service for the hospital and performing the duties of Public Health Officer. To assist him he had a technical assistant and a series of medical graduates to fill the position of lecturer. He published a number of articles on vaccine therapy, diphtheria, cerebrospinal meningitis, tuberculosis and influenza, and also found time to write theses on influenza and tuberculosis in New Zealand for which he was awarded the degrees of M.D. and D.Sc. by

Edinburgh University in 1920. Unfortunately Professor Champtaloup died of tuberculosis the following year, but in the twelve years that he was with the University he must be credited with having established and run a progressive Department of Bacteriology and Public Health.

Professor Champtaloup was succeeded in 1922 by Or C.E. (later Sir Charles) Nereus under whose direction the Department continued to provide courses for medical students and a diagnostic service for the hospital and Health Department. Special interests of the staff at that time were hydatids and hay fever. In the 1940s the intake of medical students was increased and teaching was expanded to include bacteriology courses of a basic and general nature for science students. Three further teaching positions were established to cope with the increased work load. One of these positions was filled by Dr M.J. Marples who was a powerful force in the introduction of microbiology as a science subject. In 1952 when science teaching was further expanded to include postgraduate studies the first non-medical graduate was appointed to the staff of the Department.

As the new staff members developed their own interests the scope of research in the Department increased. A streptococcal typing survey was supported by the newly formed Medical Research Council of New Zealand and phage typing of staphylococci was undertaken. The hospital diagnostic service provided a rich source of material for such studies. Dr Marples established a ringworm clinic which provided her with much valuable material for her investigation into the ecology of the human skin. Leptospirosis was shown to occur in New Zealand and techniques for isolating and culturing leptospira were studied in some detail.

In 1947 the Medical Research Council formed a virus laboratory to provide a diagnostic service for hospitals and to conduct research into viruses which cause human disease. At about the same time there was an increased interest in the health of neighbouring Pacific Islanders and a series of expeditions from the Medical School surveyed various aspects of their health, including infectious disease's.

In 1954 Sir Charles Hercus resigned the Chair of Bacteriology and was succeeded by Dr J.A.R. Miles from Adelaide who was appointed Professor of Microbiology. In view of his interest in virology and epidemiology he was also appointed Honorary Director of the Virus Research Unit. Additional courses and a rapid increase in science student numbers enabled further staff positions to be established and filled by lecturers whose interests lay in the fields of microbial genetics, soil microbiology, immunology, medical entomology, medical microbiology, zoonoses and molecular biology.

The interest in Pacific Island medical microbiology continued with staff members carrying out investigations into filariasis, bacterial and mycotic skin infections, respiratory virus infections and dengue. In 1963 the Wellcome Trust financed the erection of a virus laboratory at the Colonial War Memorial Hospital in Suva, Fiji, which was directed for the first ten years by staff seconded from the Microbiology Department and the MRC Virus Research Unit.

A project on the biological control of pasture pests which was begun in 1967 has concentrated on viruses of invertebrates.

In 1976 Professor Miles relinquished the position of administrative head of the Department in favour of Professor J.S. Loutit, a staff

member of twenty years standing. Professor Miles retired from the Department at the beginning of 1979.

The Department has outgrown its accommodation four times. From its original location in a small basement room in the hospital it was moved first to a larger room and then across the street to the Medical School. In 1948 it expanded into an adjacent building and finally in 1975 the Department occupied its own eight-storeyed building away from the Medical School complex.

Financial support for research has come from a number of outside sources, especially the Medical Research Council of New Zealand, but also the Department of Scientific and Industrial Research, the Ministry of Agriculture and Fisheries, the Golden Kiwi Lottery funds, N.Z. Dental Research Foundation, Otago Medical Research Foundation, University Grants Committee, Rheumatology Special Fund, T.J. Lewis Fund, Pfizer Ltd., and various other organisations within New Zealand. From overseas, support has been given by the Rockefeller Foundation, the U.S. Army and the National Science Foundation in the United States, and the Ministry of Overseas Development, the Wellcome Trust and the Nuffield Foundation in the United Kingdom, the World Health Organisation and South Pacific Commission.

Since postgraduate studies began in 1952, the Department has awarded one D.Sc. degree, thirty-five Ph.D. degrees, thirty-nine M.Sc. degrees and fifty-two postgraduate diplomas. Many of the students who earned these degrees and diplomas now fill important teaching, research and administrative positions both in New Zealand and overseas.

In the pages that follow the main research activities of the Department are summarised and a list of articles published since 1969 is appended. The teaching activities of the Department are now spread over four University Faculties, namely Medicine, Science, Dentistry and Home Science, in which ten undergraduate courses are given each year.

AUTOIMMUNITY
and

AUTOIMMUNE
DISEASE

B. L. GIBBINS PhD



Research into immunological disorders which lead to damage of the individual have long been recognised. Two separate lines of investigation have been adopted in this laboratory to study autoimmune diseases. One line is directed to the investigation of autoimmunity in locally derived strains of mice. The other line involves collaborative studies with the Rheumatology unit and ophthalmology unit into associated immunological dysfunction in rheumatoid arthritis and uveitis patients respectively.

New Zealand black mice and their related offspring were derived and characterised as autoimmune in the early 1960's at the University of Otago. These animals have subsequently found wide application throughout the world as an animal model for autoimmunity. The efforts in this laboratory centre on the significance of specific autoantibodies which appear early in life in these animals. These antibodies have specificity for thymus-derived lymphocytes and have been shown to be cytotoxic for these cells. The questions that arise from these observations relate to the importance these antibodies may play in the premature involution of thymic tissue and the role these antibodies may exert in the perpetuation of the disease. The present evidence suggests that autoimmune thymotoxic antibodies exert a measured influence on in vitro mitogen-activated mouse lymphocyte cultures. The influence shows dose dependency and the mediators of the activity are found to co-isolate with mouse immunoglobulin. Furthermore these effects cannot be shown when serum samples from control mice or young NZB mice are used.

The second line of investigation into autoimmune diseases involves the study of lymphocyte and antibody function in rheumatoid arthritis and uveitis patients. Both diseases show characteristic patterns of tissue damage mediated by the patient's immune response. The investigations here are designed to examine base-line mitogen-activated lymphocyte function of peripheral blood cells. Both patient groups demonstrate marked depression in lymphocyte function when compared with normal matched blood donors. Rheumatoid arthritis patients also demonstrate a plasma-borne factor(s) which depresses normal donor lymphocyte function. Examinations of both rheumatoid arthritis and uveitis patients lymphocytes suggest

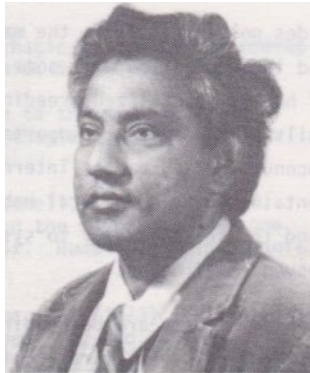
however that both populations are deficient in mitogen-inducible suppressor cells which are thought to play a role in regulating immune reactivity. The relationship among generalised depression of mitogen-activated lymphocyte function, plasma-borne suppressor factor and the diminished concentration of suppressor cells in these patient groups provided the basis for the human studies in this laboratory.

BIOLOGICAL CONTROL

OF

INSECT PESTS

J. S. PILLAI PhD



This programme is concerned mainly with survey and evaluation of various biological agents against insects of medical and agricultural importance. There is an increasing awareness that chemical pesticides produce many undesirable side-effects and there is an urgent need to develop alternative methodologies for insect pest control. Insects have a large range of natural enemies which include microbial pathogens, parasites and predators.

In New Zealand the main emphasis has been on the study of the biology of Coelomomyces pifexi, a fungal pathogen of considerable importance, which parasitizes Aedes australis and Opifex fuscus larvae on the Otago coastline. Other activities include a survey of Protozoan parasites of pasture pests and studies on pathogens of Simuliidae.

In Fiji and W. Samoa the emphasis is on biological control of mosquitoes. A total of 22 species occur in Polynesia and more than half of these are involved in the transmission of Bancroftian filariasis, and a smaller number are vectors of Dengue/haemorrhagic fever and Ross River viral infections.

Aedes polynesiensis is the main vector of filariasis in Polynesia and in association with some other species it utilizes a wide range of highly specialized breeding habitats. These include leaf-axils of economically important plants, tree-holes, crab-holes, coconut shells, bamboo internodes and a whole variety of artificial containers. The natural habitats are very numerous, and do not lend themselves easily to systematic vector eradication processes by conventional means.

In Fiji efforts are being directed towards the use of Bacillus thuringiensis var. israelensis against vector mosquitoes in urban and rural situations. The Bacillus is a new biological product developed under the Tropical Diseases Research Programme by the W.H.O. Other biological agents being tested include Toxorhynchites amboinensis and Culicinomyces sp.

Toxorhynchites are non-biting mosquitoes whose larvae prey on larvae of vector mosquitoes and the species amboinensis is considered as

one of the most beneficial predators. The fungal agent Culicinomyces is one of the few pathogens that is effective against mosquito larvae in the brackish environment and as such, has a great potential in the crab-hole situation where Aedes polynesiensis breeds profusely.

in western Samoa, the main effort is directed towards the testing of komanomermis culicivorax against mosquito larvae in leaf-axil habitats. This is a nematode pathogen of mosquitoes, which has undergone commercial development in the United States as a mosquito parasite.

EPIDEMIOLOG
Y

of

HUMAN VIRUSES

M. J. HOLMES MD



Prior to his appointment to the staff of the Department in July 1976, Dr Holmes spent nine years in epidemiological research on criteria for the transmission and severity of acute human

respiratory virus and mycoplasma infections. The work was carried out at the WHO-MRC Counon Cold Unit, Salisbury (UK), the NIMR laboratories Holly Hill, Hampstead, the Clinical Research Centre, Harrow, NASA-Niles Research Center, California and included three years in Antarctica. His main project comprised a series of comparative human volunteer studies in England and in polar isolation, investigating the progressively increased vulnerability to acute respiratory disease of men in isolated communities. The local and systemic immune responses of both groups were compared and the kinetics of transmission and persistence of a range of viruses and mycoplasmas in the isolated communities were examined. During the two years before he came to New Zealand, Dr Holmes took over the NASA Lunar Biology laboratory at Moffett Field where he worked on the infectivity of airborne rhinovirus in toe human environmental milieu and the microclimates of the human respiratory tract.

The Antarctic studies are being extended here at Otago University, where related collaborative work with the University of Oklahoma and the US Office of Polar Programs has already been in progress for four years. It is hoped that these studies can be further developed to include "antigenically naive" isolated Pacific communities.

In the last two years, human volunteer and laboratory studies of the local immune responses of the nasopharynx have been funded by the MRC. These are aimed at clarifying the nature, extent and roles of the components involved, the persistence of local immunological memory and the degree of autonomy from the systemic immune response. To date, studies have been concentrated on the

development of the technology for assay work in humans correlated with animal model studies being carried out under the direction of Dr Griffin. So far, this laboratory has been successful in developing the first atraumatic sampling system for the extraction of mucosal lymphoid cells from humans and is presently delineating the extent of the total nasopharyngeal lymphoid resources. Armed with these procedures, the project work has now reached a stage where systematic human studies on local mucosal immunity can begin.

GASTROINTESTINAL

BACTERIOLOGY

G. W. TANNOCK PhD



This research has principally been concerned with bacteria associated with the gastrointestinal tract of mammals. Previous research has included the isolation of indigenous microbes from the pig stomach and investigations into the epidemiology, mode of transmission and pathogenesis of Salmonella bacteria with particular

reference to domestic animals. Information on the survival of Salmonella outside the host animal was obtained from in vitro laboratory experiments and experiments performed under natural environmental conditions. Involvement of the upper respiratory tract of mice and sheep in the transmission of Salmonella was also studied. An experimental model was developed to study the effects of adverse dietary and environmental conditions on Salmonella populations in the gastrointestinal tract of mice. Field studies have demonstrated the presence of Salmonella in the nasal passages of sheep on a farm in which an outbreak of Salmonella infection had occurred. The changes in indigenous microbial population levels and their distribution that occur in the gastrointestinal tract of mice subjected to adverse dietary and environmental conditions have also been investigated.

More recently, indigenous microbes from the gastrointestinal tract of mice have been isolated and characterized. Bacterial groups studied include lactobacilli; bacteroides; coliforms; enterococci; fusiform-shaped bacteria belonging to the genera Clostridium, Fusobacterium and Bacteroides; and spiral-shaped bacteria belonging to the genus Campylobacter. Strains of bacteria from some of these groups have been chosen, because of their particular characteristics, for use in experiments with gnotobiotic, BALB/c mice. The main concern in the gnotobiotic experiments has been to determine which indigenous microbes are responsible for interfering with the establishment of Salmonella in the gastrointestinal tract. Mice associated with a lactobacillus strain, a bacteroides strain, and two types of clostridia have fewer Salmonella typhimurium present in the ileum, 3 days after intragastric challenge with the pathogen, than do germfree mice.

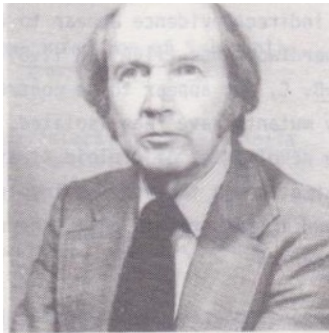
The mechanism of this interference effect is not known. Some indigenous microbes, injected intravenously into conventional mice, increase the resistance of the animal to subsequent intravenous challenge with *S. typhimurium*. The resistance of the mice to infection is measured in terms of the number of salmonella present in the spleen of mice five days after challenge. The phenomenon observed in conventional mice has been confirmed using gnotobiotic mice monoassociated with indigenous microbes (an enterococcus or a lactobacillus strain).

Current research involves the effect of diet on the composition and activities of the indigenous microbiota of the gastrointestinal tract of mice.

GENETICS OF

PSEUDOMONAS AERUGI
NOSA

J. S. LOUTIT PhD



This work started originally with an interest in the resistance of

this organism to antibacterial agents. When it was realised subsequently that Ps. aeruginosa was capable of genetic recombination it was decided to continue investigations into the genetics of the organism. There is little doubt that much more significant results can be obtained from many investigations if the mechanisms of genetic regulation can also be elucidated. Apart from that it seemed that Ps. aeruginosa would be an ideal organism to work with since it appeared to have genetic mechanisms similar to those found in Escherichia coil yet appeared to be unrelated to it.

Investigations have followed three separate lines. Firstly, the isoleucine valine biosynthetic pathway in Ps. aeruginosa has been studied using both genetical and biochemical techniques. It has been shown that there appear to be five steps in the biosynthesis and having isolated mutants at four of these steps it has been possible to map the genes (ilv A, B, C, D), on the Pseudomonas chromosome. The genes ilvB and ilvC map together and according to indirect evidence appear to be coordinately controlled. The other two genes (ilvA and ilvD) map together some 23 minutes after C, but appear to be controlled independently. Some regulatory mutants have been isolated, but further analysis will require the development of diploid strains. It is already clear however, that although the enzymes involved seem to be similar to those found in Escherichia coil, the regulation of the enzymes is very different.

A second interest has been mapping the chromosome of Ps. aeruginosa using the conjugation system. At present it is possible to produce a reasonably accurate map of about half the chromosome, but unfortunately, the frequency of recombination is not high

enough to get accurate results beyond that and attempts have been made to prepare Hfr type donor strains. To this end, strains which are sensitive to mercury at high temperatures have been isolated in the hope that some of them will be unable to replicate their sex factor at that temperature.

In addition, strains which are unable to replicate chromosomal DNA at high temperatures are being sought. Such mutant strains would be valuable in that some cells which could grow in mercury at high temperatures could be expected to have an integrated sex factor and be like Hfr cells (integrative suppression). As part of this work, investigations have been made on pyrimidine metabolism in the hope that it would be possible to isolate a strain requiring thymine for growth. Such a strain would be useful for specific labelling of DNA and in particular in investigations of replication mutants. This work has gone well and the DNA can now be specifically labelled with much greater efficiency. No thymine auxotrophs have been isolated, but work is continuing on this aspect.

Thirdly, a system of genetic transformation of *Ps. aeruginosa* by plasmid DNA has been established. This system is related to that used in *E. coli* in that treatment with CaCl_2 and low temperature is required. However, the *Ps. aeruginosa* will also respond to treatment with MgCl_2 . Furthermore treatment with MgCl_2 allows the uptake and expression of linear DNA in restrictionless mutants. These latter observations are in contrast to that observed in *E. coli*. The basis of the stimulation provided by MgCl_2 and requirement for the use of a restrictionless recipient if chromosomal recombinants are to be obtained are being investigated.

Transformation will prove a useful tool enabling the introduction of DNA molecules which have been manipulated in vitro and of DNA from bacterial species which have no other mechanism of genetic exchange with Ps. aeruginosa.

IMMUNOLOGY

J. F. T. GRIFFIN PhD



Cell mediated immunity (CMI) as measured by lymphocyte transformation induced by phytohaemagglutinin (PHA) is known to be depressed

in pregnancy. Serum factors present in pregnancy have been carried out to determine if aberrant immunoregulation could be associated with this phenomenon. The present study was responsible for complications in pregnancy as found in pre-eclamptic toxemia (PET).

Most studies of lymphocyte transformation in pregnancy have been cross sectional using single samples from individuals at different stages of pregnancy. The present study involved repeated sampling

of primigravidae in the last two trimesters of pregnancy. It is hoped that patients showing clinical symptoms of toxæmia could be validly compared with normal pregnant women at comparable stages of pregnancy.

In the initial study, blood samples were taken from primigravidae at fortnightly intervals during the second and third trimesters of pregnancy. Lymphocyte transformation with PHA was carried out using whole blood microculture and the results from normal patients and those who developed PET were compared. Significant differences in lymphoproliferative activity were seen in PET patients for two to three weeks preceding clinical onset of the disease.

The transformation rates in normal pregnant women were significantly lower at all stages of the last trimester than non-pregnant controls. In contrast to this, patients sampled before the appearance of the clinical symptoms of PET showed transformation rates similar to that found in non-pregnant women suggesting abnormally high levels of immunocompetence for these women during pregnancy. After onset of PET the transformation rates in these women dropped to normal pregnant levels.

Currently attempts are being made to determine whether serum suppressor factors or their absence could explain the anomaly between pregnant and PET women. A longitudinal study is being carried out on pregnant women and lymphocyte transformation is being tested in the presence of PHA, Con A and trophoblast antigen. Whole blood microcultures using 10⁰¹ of whole blood are being tested. Serum exchange is used to assess the contribution made by serum suppressor factors to the immunoregulation found in pregnancy.

Lymphocyte transformation with Con A and PHA is suppressed when cells are cultured in the presence of normal pregnant serum, but not if non-pregnant or PET serum is used. Similar results are obtained when lymphocytes from pregnant, or non-pregnant patients are used. This would suggest that suppression is a feature of serum factors rather than lymphocyte associated. Suppressor factors found normally in pregnant patients seem to be absent from PET patients. The most likely serum factor which could exert such an immunosuppressive effect is α_2 macroglobulin, which has been shown to be elevated in pregnant patients. Stimson has shown that this substance is present in reduced amounts in the serum of PET patients by comparison with normal pregnant patients. Work is being carried out at present to quantitate α_2 globulin levels in normal pregnant and PET patients throughout pregnancy.

Secretory immunity in the nasopharynx

A comprehensive study on a group of 50 students has thrown new light on the kinetics of nasopharyngeal immunity after intranasal immunisation with influenza antigen. The results from serum samples obtained at weekly intervals and nasal wash samples obtained twice weekly indicate that:

- (i) nasopharyngeal immunity is independent of humoral activity
- (ii) parenteral immunisation is not reflected in increased secretory activity
- (iii) booster doses of intranasal vaccine do not enhance nasopharyngeal immunity when influenza vaccine is used.

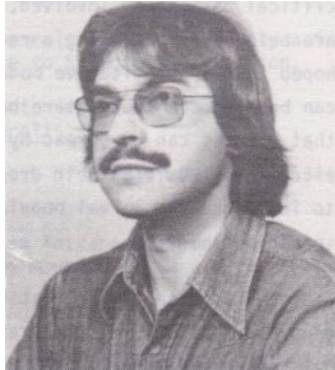
The problems of pre-exposure to influenza make it extremely difficult to assess primary responsiveness in humans so it has been decided to use an experimental ovine model to study nasopharyngeal immunity further. A laboratory vaccine of live IBR virus is being used in this study.

To date the studies have concentrated on the clinical and technological problems of the ovine system. The first vaccination trial has established significant levels of protection in sheep exposed intranasally to a single vaccine of live IBR virus. Quantitative assays of specific and total IgA in the nasopharyngeal secretions of immunised sheep have been performed. Assays of cell-mediated immunity have also been carried out in lymphocytes from the nasopharyngeal mucosa.

INSECT AND
MOLECULAR

VIROLOGY

j. KALMAKOFF PhD



This group has two main research interests: (i) biological

control of insect pests using viruses and (ii) the significance of antibodies to double-stranded RNA in acute and chronic disease.

Investigations into the biological control of *Wiseana* spp., a soil-dwelling insect pest of pastures, using viruses, began about 10 years ago. Several viruses were isolated and the nuclear polyhedrosis virus (NPV) seemed the most promising for pest control. Field trials near Dunedin were established to study the epizootology of these enzootic viruses and to determine the effect of pasture management practices on the host/virus equilibrium. Results suggest that when the pasture is new (2-3 years old) it is at risk of larval damage. However, if there is virus present in the surrounding environment, an epizootic or enzootic infection with NPV usually occurs, which results in a stable host/virus equilibrium being established. A further field trial, designed to examine more carefully the critical parameters involved, is now underway. The viruses are being detected using a radioimmunoassay (RIA) and it is hoped that a quantitative model for the virus-host interaction can be made for the pasture habitat. It has been established that viruses can be spread by birds eating diseased larvae and excreting virus via their droppings. Mob-stocking also seems to influence the larval population and may be important in spreading the virus.

The need to detect quantitatively insect viruses in the environment, particularly in the presence of contaminating material, led to developmental work on solid-phase radioimmunoassay and some theoretical modelling. Some new insights into the

antigen/antibody reaction were obtained, particularly a simple method for assessing the affinity constant, K , of the antibody.

The interest in antibodies to double-stranded RNA (dsRNA) began with some earlier work using poly I:C to induce interferon in tissue culture cells. Antibodies to dsRNA were produced in rabbits with a view to detecting dsRNA in virus-infected cells. This latter method became the basis of an assay for interferon action. The possibility that antibodies to dsRNA may be involved in immunopathology was suggested from work on NZB/W mice which spontaneously develop autoimmune disease where anti-body to dsRNA is a characteristic feature. It was decided to investigate other diseases of unknown aetiology and studies are underway on rheumatoid arthritis and anaphylactoid purpura. Some preliminary results were obtained using a liquid-phase RIA and ^{32}P -labelled poly I:C. It was found that 33% of patients with rheumatoid diseases had antibodies to dsRNA above the normal range. It was also found that 11% had antibody levels below the normal range of controls (blood bank donors). The low dsRNA binding is attributed to the action of a nuclease that is present in serum and which degrades poly I:C. Further investigations are underway to characterise this nuclease activity.

Other research, revolving around Ph.D. projects, which include the study of insect "immunity" to viral disease, characterisation of glycoproteins of insect viruses, a study of endogenous protease activity of Baculoviruses, epidemiology of rotaviruses in domestic animals, development of ELISA kit-set virology and an evaluation of staphylococcal protein A in immunological

techniques, is also being carried out.

MICROBIAL ECOLOGY
OF
SOIL AND WATER

MARGARET LOUITT
PhD



In the last few years our research interests have concentrated on problems relating to water rather than soil.

While our prime interest in water is the role of bacteria in the passage of heavy metals through food chains we have continued our interests in water quality. The latter has involved an investigation into which organisms in oxidation ponds contribute to a positive faecal conform test, and detection of viruses in waste water. We have concluded that the faecal coliform test does not appear to be satisfactory for detecting faecal pollution in water where soil bacteria of the Enterobacter aerogenes group are likely to be washed in. We have also investigated

the factors contributing to "die-off" of E. coli in oxidation ponds. This work is being prepared for publication.

An investigation into viruses in waste water has been started. A particular interest is in chlorinated waste water as there is no information as to whether viruses survive chlorination under New Zealand conditions. A second project on detection of viruses in bodies of water generally will be started shortly. Both projects are funded by the National Water and Soil Conservation Organisation.

Since we established that small quantities of metals in effluents entering a river could be concentrated by bacteria in or on sediments and subsequently passed up a food chain to fish, we have begun investigating marine food chains. Levels of certain heavy metals are quite high in some bottom-feeding and carnivorous fish and we are investigating metal levels in effluents, sediments and various animals to see if we can establish passage of the metals through the food chains. Most of the work is concentrated on the Otago Harbour and the coast adjacent to Dunedin. Effluent which is high in Cr from a tannery is of particular interest in this study. This work is funded by the Ministry of Agriculture and Fisheries, Research Division.

From the work on food chains a number of small projects have developed. The role of bacteria epiphytic on algae and on crabs in concentrating metals is of considerable interest.

A number of bacteria capable of accumulating metals have been

isolated and their properties are being studied.

MYCOLOGY

J. M. B. SMITH
PhD



In the early 1960s Dr Mary (Molly) J. Marples with her profound interest in ecology, demonstrated that the European hedgehog, Erinaceus europaeus, introduced (from Britain) into the Dunedin district in 1885, was an important reservoir of human ringworm in New Zealand. Her work with the "hedgehog fungus" Trichoshyton mentagrophytes var. erinacei led to a world-wide renewal of interest in small wild animals as reservoirs of dermatophytes. With the help of her research assistant at the time, J.M.B. (Sandy) Smith, she was also able to demonstrate the fascinating association of penicillin resistant strains of Staphylococcus aureus with dermatophyte-infested hedgehog skin; work which was later acclaimed as providing the first evidence

that penicillin-resistant bacteria could be selected for naturally, i.e. without the therapeutic use of this antibiotic. This rekindled Dr Marples' interest in the ecology of the human skin and resulted in her preparation of the now widely acclaimed book "The Ecology of the Human Skin" which was published in 1965. Working with her at this time was Dorothy Somerville, herself now a recognised authority in skin microbiology. On Dr Marples' retirement in 1967, Dr J.M.B. Smith, who had spent 3 years at Massey University as lecturer in Veterinary Mycology, was appointed to fill her position in Dunedin. He continued to foster work on the ecology of pathogenic fungi with important contributions being made in regard to the animal reservoir of Microsporum distortum, and in conjunction with F.M. Rush-Munro, the taxonomy of various anthropophilic and zoophilic dermatophytes. Dr Smith's interest in zoonoses and veterinary microbiology was continued at this time by a student, G.W. Tannock, who made important contributions to the epidemiology of salmonellosis. Dr Tannock has since returned as a lecturer to this department. In recent years, research has also been initiated on opportunistic mycoses - an increasingly important field in medical microbiology - and on the pathogenesis of dermatophytosis (ringworm) using a locally developed experimental guinea pig system. These ongoing research projects are supported by the Medical Research Council of New Zealand.

Dr Smith has just completed a monograph for CRC Press on "Opportunistic Mycoses of Man and Lower Animals" which is to be published in mid-1980. He is also on the editorial board

of Sabouraudia, the official journal of the International Society for Human and Animal Mycology (ISHAM), and on the standing committee of ISHAM for the nomenclature of mycoses.

STREPTOCOCCAL

BACTERIOCINS

J. R. TAGG PhD



The streptococcal diseases, particularly the non-suppurative sequelae rheumatic fever and acute nephritis, still represent significant public health problems. Although considerable progress has been made in our understanding of the significance of the various components and products of streptococci, many gaps remain and the details of the pathogenesis of the streptococcal sequelae remain obscure.

Dr Tagg's research has largely been concerned with the investigation of streptococcal bacteriocins with the ultimate

aim of evaluating the significance of bacteriocinogeny either as a virulence determinant, by virtue of toxicity for eukaryotic cells, or as an ecological determinant, by contributing to the competitive ability of producer strains.

The production of bacteriocins by group A -haemolytic streptococci was described first by Tagg in 1972 in the course of Ph.D. studies at Monash University. These investigations were continued at the University of Minnesota in collaboration with Dr Lewis Wannamaker. Dr Tagg joined the present department in mid-1975.

Observations that many strains of streptococci appear capable of producing bacteriocin-like substances prompted the recent development of a new typing scheme for streptococci, based upon the combined testing of both bacteriocin production and bacteriocin sensitivity of the test strains. This "fingerprinting" scheme has been found to be applicable to strains belonging to a wide variety of Streptococcus species, and in addition, it has been found useful for the labelling of strains of the genera Staphylococcus, Lactobacillus and Actinomyces.

Since joining the present department, Dr Tagg has initiated several studies relating to the investigation of the role of bacteria in the development of dental caries and periodontal disease.

Strains of Streptococcus salivarius have been isolated that produce bacteriocin-like substances active against S. sanguis and S. mutans, two species that have been strongly implicated

as aetiological agents in the development of caries. Studies using an artificial mouth model have indicated that certain bacteriocinogenic strains of S. salivarius are capable of suppressing the growth of S. sanguis strains in developing plaque. The possibility of a relationship between the carriage by individuals of bacteriocinogenic S. salivarius strains and low dental caries activity is being examined.

ELECTRON MICROSCOPE
UNIT

C. N. A. TROTMAN PhD



A well-equipped unit provides the department with the facilities of Hitachi HU-11A and Siemens 102 transmission microscopes together with the supporting technology. In addition to providing freely for the day-to-day needs of the department, the unit fosters collaborative ventures with other departments

of the university and welcomes contacts with outside organisations.

Dr Trotman's personal research interests are in the interface between cell and molecular biology. He has developed an isolated gastric-cell model for studying adverse effects of antibacterial and other drugs on protein biosynthesis in gastrointestinal mucosa, where orally administered drugs can exist in much higher transient concentrations than are achieved in the circulation. He has also, since coming to New Zealand in 1978, taken an active interest in the brine shrimp Artemia sauna. This fascinating organism thrives in brine lagoons at Lake Grassmere solar saltworks, near Blenheim. New Zealand, where the salt concentration is four or more times that of seawater and little else can survive. Many salt lakes around the world support Artemia, which is widely adopted as a model system for the study of eukaryotic development and differentiation. Dr Trotman is studying the sequence of intracellular events by which the desiccated and ametabolic embryo of Artemia resumes development upon rehydration.

VIRUS RESEARCH UNIT

The Virus Research Unit was established by the Medical Research Council of New Zealand in 1947 to provide a diagnostic service to hospitals and to conduct research into viruses which cause human disease. Early research was concerned with viral haemagglutination, first with myxoviruses and later with arboviruses. In 1955 staff of the Unit carried out a serological survey for poliovirus antibodies to provide data on which the Health Department could base a Salk vaccination programme for New Zealand.

F. J. AUSTIN PhD

Acting Director



In recent years work has been directed towards studies on the

epidemiology and ecology of arboviruses, hepatitis viruses and influenza viruses. A project on scrub typhus was also undertaken.

The studies on arboviruses have involved a search for indigenous viruses in New Zealand and investigations into arbovirus diseases in the South-west Pacific region.

The New Zealand studies have resulted in the isolation and identification of one mosquito-borne arbovirus (whataroa virus, an alphavirus) and two viruses from Ornithodoros capensis ticks (Johnston Atoll virus and one belonging to the Hughes group). Whataroa virus is unique to New Zealand and appears to be maintained in a cycle between indigenous mosquitoes and introduced passerine birds in a man-modified habitat at a mean temperature somewhat lower than that in which other mosquito-borne arboviruses occur. The two tick-borne viruses, which infect migratory seabirds, occur elsewhere in the Pacific basin. None of these viruses is known to cause disease in humans or domestic animals.

Investigations of arbovirus infections in the Pacific have involved a serological survey of Fijian residents, and field and laboratory studies during two dengue epidemics and an epidemic of polyarthrititis due to Ross River virus infection.

The first dengue epidemic occurred in 1971-72. It was a classical outbreak of dengue fever in which at least 20,000 people were infected with type 2 dengue virus. The second epidemic in 1975 was caused by type 1 dengue virus and involved more than 100,000 people. A number of cases of haemorrhagic

dengue occurred and it was possible to show that the theory associating this syndrome with prior exposure to another dengue virus type is not correct in all cases.

An outbreak of epidemic polyarthrititis in Fiji in 1979 was shown to be due to infection with Ross River virus. The disease spread rapidly through the population in which few if any of the people were immune. This epidemic almost certainly resulted from the introduction of a virus into a population which had had no prior exposure to it.

During the last two epidemics people arriving in New Zealand from Fiji have developed disease. As some of these people were viraemic it is fortunate that indigenous mosquitoes do not appear to be efficient vectors of dengue virus or Ross River virus.

Studies on the infection of mosquito vectors by arboviruses using fluorescent antibody to locate virus antigen revealed that whataroa virus (an alphavirus) spreads more rapidly and widely through the tissues of Aedes australis than does the flavivirus type 2 dengue. However when natural dengue vectors such as A. albopictus and A. aegypti were infected, dengue virus spread to the cerebral ganglia and salivary glands within three days.

T. MAGUIRE
PhD



Studies on viral hepatitis have involved the preparation of serological reagents and their utilisation in surveys. Serological surveys have shown that the incidence of H6sAg is low in the New Zealand Caucasian population (0.01% - 0.001%), considerably higher in Maoris and other Pacific Islanders living in New Zealand (up to 5%) and remarkably high in certain Pacific Island populations (more than 30% in one Fijian group). The reasons for these differences are not known, but may relate to climate, vectors, genetic predisposition, cultural practices or virus virulence. Studies on the resident population of a psychiatric hospital near Dunedin over a period of five years

revealed only 10 asymptomatic HBsAg carriers in a population of 1300 patients and 73 staff. This low prevalence in a population, of the mentally ill is possibly related to the reduced patient contact resulting from the isolated villa type of accommodation at this hospital.

Many of the antigens detected in these surveys have been sub-typed. In New Zealand and Pacific Islands with Polynesian populations the prevalent subtype is ayw, but subtype adr predominates in Melanesian island groups from Fiji west to New Guinea.

Attempts to grow hepatitis viruses in human embryonic liver and intestine cultures have been unsuccessful, so current work includes attempts to grow hepatitis 3 virus in homokaryons and heterokaryons produced by fusing cells with inactivated Sendai virus. Based on the assumption that the virus may be unable to absorb onto the surface of, or penetrate, cultured cells, virus is added at the time of fusion in an effort to get it into these unique cells. Fluorescent antibody staining, a method which has been used successfully to demonstrate HBsAg in liver sections, is being used to detect virus antigen in the cells.

Currently the Unit is collaborating in a world-wide W4 study of the ecology of animal influenza viruses. Specimens from aquatic birds in New Zealand and the Ross Dependency have been tested for influenza viruses. Seven influenza A viruses were isolated from wild Anas platyrhynchos ducks. On the basis

of their surface antigens there are three different strains, Hav4Nav1; Hav3Nav2; H?Nav2. Similar viruses have been isolated from the same duck species in North America so it is probable that the viruses were introduced into New Zealand with the ducks.

In the scrub typhus project studies on sera, rat tissues and trombiculid mites collected in the Northern New Hebrides and the Eastern Solomon Islands showed that the disease is endemic in several areas there. Rickettsia tsutsugamushi was isolated from rat tissues (9 strains) and Leptotrombidium akamushi (4 strains). Antibody to R. tsutsugamushi was demonstrated in 18% of 72 human sera from the Banks Group in the Northern New Hebrides and in 49% of 335 sera from the Eastern and Central Solomon Islands.

Recently a collaborative study with Dr M.W. Loutit has been begun on the detection of viruses in water. A method involving virus adsorption to and elution from clay particles by pH adjustment has been shown effectively to concentrate low levels of poliovirus seeded to oxidation pond effluent.

LIST OF THESES FOR WHICH DEGREES AND DIPLOMAS HAVE BEEN GRANTED

SINCE 1969

Doctor of Philosophy

- Anderson, M.J.D. (1977) Cell mediated immunity in cestode infections.
- Bilimoria, S. L. (1975) The replication of iridescent viruses in cell culture.
- Booker, R. J. (1973) A study of chromosome(s) of Pseudomonas aeruginosa strain 1.
- Bowie, I. S. (1971) Taxonomy of pleomorphic bacteria.
- Chittasohhon, N. (1979) Ecological aspects of dermatophytosis.
- Crawford, A. (1977) Ecology of wiscana baculoviruses: host virus interaction in the pasture habitat.
- Davey, G. P. (1975) A study of endotoxins of some phycomyces.
- Edwards, M. (1977) Distribution, nutrition and taxonomy of photosynthetic bacteria.
- Featherston, D. W. (1970) Some aspects of the in vitro culture and the ultrastructure of Taenia hydatioena-Pailass, 1766) a taeniid tapeworm.
- Jennings, L. C. (1976) A study of acute respiratory disease in the community of Port Chalmers.
- Line, M. A. (1972) Non-symbiotic nitrogen fixing organisms from some New Zealand tussock grasslands.
- Mercer, A. A. (1979) Genetic transformation in Pseudomonas aeruginosa.
- Millard, R. M. (1975) Genetic regulation of isoleucine-valine biosynthesis in Pseudomonas aeruginosa.
- Moore, S. G. (1973) Virus diseases of two insect pests of pastures: potential for biological control.
- Musgrave, D. R. (1977) Temperature sensitive mutants of Pseudomonas aeruginosa.
- Parkinson, A. (1976) Radioimmunoassay of antiviral antibody.

- Patrick, F. M. (1976) The passage of heavy metals through aquatic food chains.
- Roach, S. (1979) Indigenous microorganisms and resistance to Salmonella typhimurium infections in mice.
- Tan, Eng Lee (1977) Rhizosphere bacteria and metals.
- Tan, R.J.S. (1973) Studies on mammalian mycoplasmas.
- Tannock, G. W. (1971) Some microbiological aspects of salmonellosis in New Zealand.
- Wilkins, R. J. (1970) Action of x-rays, alpha-rays and mitomycin C on Escherichia coli.
- Williams, B.R. G. (1976) Induction of the antiviral state.

Master of Science

- Barnett, G. R. (1978) Antibody coated bacteria in the urine of infants and children with renal infection and renal scarring.
- Brockett, M. A. (1978) Dietary influences on the microbiota of the gastrointestinal tract of mice.
- Chong, S. Y. (1977) Some aspects of the microbiology of the gastrointestinal tract of guinea pigs.
- Cooke, B. C. (1974) An investigation into existing and possible alternative methods for the detection of bacteria in milk.
- Davey, G. P. (1971) The pathogenesis of mucormycosis.
- Deacon, A. C. (1973) The development and use of techniques for the isolation of oxygen-sensitive anaerobes from the faeces of infants.
- Duncan, A. (1978) Survival of E. coli in oxidation ponds.
- Jennings, L. C. (1972) Viral respiratory tract infections of children.
- Johnson, D. W. (1978) The relationship between the production of a bacteriocin-like inhibitor by M-type 4 T-type 4 group A streptococci, and the pathogenesis of post-streptococcal sequelae.

- Lowry, P. D. (1978) Studies of the genetic basis ad inter-bacterial transfer of streptococcin A-FF22 determinants.
- Okech-L-P'Atemajo, N. (1971) Human adenovirus infections.
- Ross, M.G.R. (1972) Studies on the oncogenic properties of certain papovaviruses.
- Sandler, W.J.0 (1971) Studies on dermatophyte spores.
- Smillie, R. H. (1975) The isolation and activity of lytic enzymes from various Actinomycetales species.
- Tate, J. A. (1971) Studies on viral hepatitis.
- Tiong, S. K. (1973) Comparative studies of radioimmunoassay, passive haemagglutination, complement fixation and counter immunoelectrophoresis for the detection of HB antigen and antibody.

Bachelor of Science (Hons)

- Aislabie, J. (1979) Marine bacteria and chromium.
- Boaden, R. (1979) Interaction of staphylococcal protein A with gammaglobulin in the RIA technique.
- Bilimoria, S. L. (1971) Analysis of arbovirus and Aedes aegypti ribonucleic acid species by polyacrylamide gel electrophoresis.
- Booker, R. J. (1970) The replication of three genetic markers on the chromosome of Pseudomonas aeruginosa.
- Cameron, J. F. (1977) A serological study of H.A.I. antibody titres in sera from Pacific Basin communities of varying degrees of antigenic isolation.
- Chisholm, A. K. (1975) Cell mediated defence to mycotic agents.
- Dons, C. L. (1976) An investigation of bacteriocin-like substances produced by a group E and a group F streptococcus.
- Edwards, R. M. (1972) The biodeterioration of wool.

- Ewen, M. (1976) Evaluation of a pyrolysis-gas-liquid chromatography technique for the identification of the photosynthetic bacteria.
- Farrell, D. (1977) Identification and antibiotic susceptibility testing of anaerobic bacteria isolated from human infections.
- Gallagher, P. F. (1978) Calculation of the indirect association constant and heterogeneity coefficient.
- Garland, D. (1976) Coelomomyces opifexi (Pillai & Smith) infection and development in pupae and adults of Aedes australis (Erichson).
- Graeme-Holder, R. (1972) Bacteriological studies on the Waikouaiti River.
- Graham, R. M. (1978) The distribution of lymphoid cells in non-tonsillar areas of the nasopharynx.
- Heffernan, H. M. (1973) An investigation of Col I plasmids that succeed in intergeneric transfer.
- Hemmingsen, P. (1973) The heat resistant bacterial flora in some milk supplies.
- Hessian, P. A. (1978) Candida albicans: dimorphism and antigenicity.
- Hunt, V. S. (1975) The contribution of avian faecal matter to the presumptive coliform and faecal coliform/E. coli estimates in water.
- Hussin, Zaiton (1979) The effect of vaccination on dermatophyte lesions.
- Jenkinson, C. (1979) Iron, bacteria and the gastrointestinal tract of rats.
- Johnson, D. W. (1976) Streptococcal bacteriocins.
- Johnson, I. (1978) Effect of Klebsiella pneumoniae and Enterobacter aerogenes on the confirmed faecal coliform test.
- Latham, D. J. (1973) The isolation and characterisation of a bactericidal agent from seawater.
- Lau, C. H. (1973) Comparative studies on making labelled double-stranded RNA's.

- Lum, S. P. (1974) Immune response of NZB and NZB/W mice to streptococcal antigen and development of auto-immunity.
- Mackenzie, A. L. (1972) An ecological investigation of the nitrogen fixing non-sulphur bacteria in Tomahawk Lagoon.
- Maskill, W. J. (1974) An investigation of avian pox viruses.
- Miller, J. (1975) The typing of dengue viruses.
- Morris, A. J. (1978) In vitro challenge of human nasopharyngeal organ cultures with rhinovirus type 2.
- Ng, A. J. (1972) Isolation and characterisation of transfer derepressed mutant of Col I plasmids.
- Niak, C. T. (1972) The FP plasmid of Pseudomonas aeruginosa.
- Nixon, M. (1970) Investigations of plasmid-conferred UV protection.
- Osborne, T. M. (1975) Pre-eclamptic toxæmia in pregnancy.
- Parkinson A J (1973) Labelling immunoglobulin with iodoacetic acid-2-H³
- Patrick, F. M. (1972) The concentration of heavy metals by five strains of bacteria isolated from the Tokomairiro River, Milton.
- Preston, J. (1978) Inhibitory substances produced by indigenous bacteria isolated from mice.
- Rawstorn, S. R. (1975) Bifidobacterium bifidum: an alternative indicator organism for detecting faecal pollution in water.
- Reid, D. (1977) Antibiotic resistance among enteric bacteria isolated from sewage.
- Roach, S. (1975) Lactobacilli indigenous to the mouse stomach.
- Sharp, P. (1977) Characterisation and purification of sheep anti-mouse serum to produce a functional biological reagent.

- Schroeder, B. A. (1977) Partial characterisation and comparison of human and calf rotaviruses.
- Simmonds, R. S. (1978) Studies of cell fusion in group A streptococci.
- Simpson, W. J. (1979) A bacteriocin-like inhibitor produced by M-type 57 group A streptococci.
- Sinclair, E. B. (1970) Some immunological studies on Taenia hydatigena.
- Tan, E. L. (1973) Molybdenum concentration by some rhizosphere bacteria.
- Teh, S. H. (1974) Coelomomyces opifexi infection in Aedes australis and the role of adults in the dispersal of the parasite.
- Thorpe, S.M.A. (1975) Detection of bacteroides in histological sections of mouse caecum using horseradish peroxidase-labelled antibodies.
- Wade, C. R. (1977) The characterization of five insect viruses by polyacrylamide gel electrophoresis.
- Wards, B. J. (1979) Variants of the plasmid FP2 in Pseudomonas aeruginosa.
- Wesney, E. (1977) Comparative study of lactobacilli isolated from the gastrointestinal tract of mammals.
- Williams, B.R.G. (1972) Studies on the physical characteristics of Col 1b-P9 plasmid DNA.
- Williamson, S. I. (1974) A study of the human nasal secretory immune response to a live attenuated influenza vaccine.
- Wilson, A. (1976) The immune response of inbred male mice to live syngeneic testis cells.

- Wilson E.R.L. (1970) The production of phytohormones by some rhizosphere bacteria.
- Wong, B. (1978) Production of anti-murine B lymphocyte antiserum.
- Wong, H. K. (1979) Streptococcin F-T29, a bacteriocin-like substance produced by a group F streptococcus.
- Wong, T. L. (1974) Ecology of Coelomomyces opifexi infected supra-littoral pools and the role of copepod Trigriopus angulatus in C. opifexi infections.
- Wright, L. R. (1978) The extraction and properties of nasopharyngeal lymphocytes.
- Yap, K. L. (1973) Use of a plaque assay system to determine the survival of poliovirus in sewage and natural waters.
- Yap, M. Y. (1979) Extracellular and cell wall carbohydrates of lactobacilli and their role in adhesion to tissue surfaces.
- Yong, W. K. (1971) Indirect fluorescent antibody technique on filarial infection of wuchereria bancrofti.

Bachelor of Medical Science

- Andrew, J. H. (1970) Studies on meningo-encephalitis with particular reference to the coxsackie virus B group.
- Forde, A. M. (1978) Enterotoxigenic Escherichia coli and diarrhoeal illness in children.
- Roy, D. (1979) Cell mediated immunity to casual and deep-seated mycotic infections.

Diploma in Science

- Anderson, M.J.D. (1971) Some studies in cestode immunology: The use of two in vitro techniques to investigate the involvement of cell mediated immune responses in metacestode infections.

- Barnett, G. R. (1973) Studies of the secretory immune system of the murine gut.
- Brockett, M. A. (1976) The effect of diet on starch-hydrolysing Bacteroides populations in the mouse caecum.
- Chong, S. Y. (1975) An investigation of certain aspects of water bacteria.
- Connell, M. C. (1971) The use of dehydrogenase zymograms in bacterial taxonomy.
- Cooke, B. (1973) Comparison of bacterial types in the presumptive coliform test on raw milk at 30 C and 37 C.
- Crawford, A. M. (1973) Electrophoretic analysis of the DNA of the nuclear polyhedrosis virus of the silkworm Bombyx mori.
- Deacon, A. G. (1971) Some aspects of the normal flora of neonatal infants.
- Dempster, R. P. (1979) Inhibitors of S. salivarius.
- Duncan, A. (1976) Contribution of protozoa to die-off of E. coli.
- Fleming, S. B. (1977) Virus assay in Porina.
- Furniss, G.W.G. (1972) The heterotrophic bacteria in peat soils.
- Gillies, J. J. (1972) A study of naturally acquired and vaccine induced immunity against rubella virus.
- Gulliver, L. (1977) Detection of viruses in waste waters.
- Hodge, C. A. (1975) Aspects of depressed cell-mediated immunity in compromised patients.
- Jennings, L. C. (1971) Studies on the aetiology of lower respiratory tract infections of infants.
- Johnson, A. T. (1979) Attempted introduction of F'Lac in Pseudomonas aeruginosa.

- Khan, M. A. (1974) The isolation of anaerobic bacteria from clinical material.
- Lamb, E. A. (1974) The immunology of infertility: A murine model.
- Lowry, P. D. (1976) Genetic analysis of Streptococcin A-FF22 production.
- Mercer, A. A. (1974) Conjugal gene transfer by Pseudomonas aeruginosa.
- Musgrave, D. R. (1972) The incorporation of radioactive pyrimidines into the deoxyribonucleic acid of Pseudomonas aeruginosa.
- Poore, J. R. (1979) Studies of inhibitor production by P-type 777 group A streptococci.
- Ramsay, A. (1979) Plasma cell activity in the human nasopharynx.
- Saravani, G. (1979) Endogenous protease activity of the nuclear and cytoplasmic polyhedrosis viruses of the silkworm, B. mcri.
- Shirer, M. (1979) Epiphytic bacteria and metal accumulation.
- Tiong, S. K. (1972) Epidemiology of Australia antigen in the British Solomon Islands Protectorate.
- Welch, D. M. (1975) Nitrogen fixation in photo-synthetic bacteria from Tomahawk lagoon.

Diploma of Science (Immunology)

- Aldwell, F. E. (1979) A brief study of the role of immune complexes and cell mediated immunity in the immunopathology of recurrent uveitis.
- Baird, M. A. (1978) Antigen-induced proliferation of mouse lymphocytes.

- Beagley, K. W. (1978) The effect of immunological adjuvants on antibody production to human gamma globulin in random bred mice.
- Buchan, G. S. (1978) A comparative approach to immune responsiveness in random, inbred and autoimmune mice.
- Elliott, G. S. (1978) Stimulation and in vitro assessment of cell mediated immunity in mice.
- Gurusinghe, C. J. (1978) Cell mediated immunity in sheep immunised intranasally with parainfluenza-3 virus.
- Penfold, M. A. (1978) A pilot study on the characterisation of lymphoid cells in the synovial fluids of rheumatoid arthritis patients.
- Watters, J.W.F. (1978) Responses of lymphoid tissue in the naso-pharyngeal region of sheep to antigenic stimulation with parainfluenza type 3 virus.

Diploma in Microbiology

- Brackett, M. A. (1976) The effect of diet on starch hydrolysing bacteroides populations in the mouse caecum.
- Buddle, B. M. (1974) The possible role of volatile fatty acids in the susceptibility of mice to Salmonella infection.
- Chaudry, M. A. (1970) Some characteristics of a poxvirus isolated from Zosterops lateralis.
- de Lisle, G. W. (1974) Some aspects of microbiological quality control of meat.
- Kane, D. W. (1971) The fate of an intranasal inoculum of Salmonella typhimurium in the mouse.
- Netisingha Pongpant (1979) serological detection of Escherichia coli enterotoxin.

Parker, G.W.H. (1974) Immunity and pregnancy.

Robinson, A. J. (1970) Studies on bovine virus diarrhoea.

Tiong, S. K. (1971) The isolation of a virus from white foci-kidneys of a sheep.

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- Bell, R. G. (1974) Waste-bark - a furnace fuel? Trans. NZ Inst. Eng. 29-32.
- Bell, R. G. (1974) Porous ceramic soil moisture samplers, an application in lysimeter studies on efficient spray irrigation. NZ J. exp. Agric. 2,
- Bilimoria, S. L. & Kalmakoff, J. (1971) Serological relationship of an RNA coliphage isolated from Dunedin sewage to coliphages F2 and O9. Proc. Univ. Otago med. Sch. 49, 3-4.
- Bilimoria, S. L., Parkinson, J. & Kalmakoff, J. (1974) Comparative study of ^{125}I and [^3H] Acetate-labelled antibodies in detecting iridescent viruses. Appl. Microbiol. 28, 133-137.
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- Booker, R. J. & Loutit, J. S. (1975) The replication of the chromosome of Pseudomonas aeruginosa strain I. II. Sequential mutagenesis of synchronized cultures. Genet. Res. 25, 215-228.
- Bowie, I. S., Grigor, M. R., Dunckley, G. G., Loutit, M. W. & Loutit, J. S. (1972) The DNA base composition and fatty acid constitution of some gram-positive pleomorphic soil bacteria. Soil Biol. Biochem. 4, 397-412.
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