



Faculty of

Science

RESEARCH PROJECTS

Molecular Mechanism of Metallothionein Gene Regulation

- ✉ CHAN King Ming
- ☐ 1 December 1997
- ❖ CUHK Research Committee Funding

To understand the molecular mechanisms underlying the regulation of metallothionein (MT) gene expression, the researcher has chosen fish MT genes as a model to investigate the cis- & trans-acting elements that are required for the activation of MT gene expression. The primary objectives of this project are to (1) dissect the 5'-flanking promoter region of MT gene *in vitro* when fused to reporter gene, and (2) identify the trans-acting factors that are responsible for mediating constitutive expression and metal induction of MT gene expression. Using the common carp MT gene promoter, the studies will be carried out in primary cell cultures of hepatocytes. These information are crucial to our understanding of how the carp MT gene is being regulated at the level of transcription.
(BL97018)

Investigation of Mechanisms of Cholesterol-Lowering Effect of Green Tea Epicatechin Isomers

- ✉ CHEN Zhen Yu • FONG Wing Ping
- ☐ 1 September 1997
- ❖ Research Grants Council

The proposed research describes several experiments to study the mechanism of plasma cholesterol-lowering effect of green tea epicatechins. Several epidemiological studies have shown that effect of drinking green tea decreases plasma low-density lipoprotein cholesterol and increases high-density lipoprotein cholesterol. However, the mechanism involved remains unclear. Therefore, the proposed project will test the speculation that green tea epicatechins decrease plasma cholesterol probably by either one or combination of the following possibilities: (1) decreasing activity of 3-hydroxy-3-methyl glutaryl coenzyme A (HMG-CoA) reductase, a key enzyme in cholesterol synthesis; (2) increasing activity of cholesterol 7 α -hydroxylase, a regulatory enzyme in conversion of cholesterol to bile acids; (3) decreasing absorption and reabsorption of dietary cholesterol and bile acids; and (4) decreasing activity of acyl CoA: cholesterol acyltransferase, which is believed to play an important role in intestinal cholesteryl esterification before cholesterol is absorbed and assembled in the chylomicrons. The researchers propose to use hamsters as an animal

model because the plasma lipid profile in hamster is very similar to that in humans.
(CU97307)

Xanthine Oxidase: Enzyme Inhibition Studies

- ✉ CHENG Hon Ki Christopher
- ☐ 1 January 1998
- ❖ CUHK Research Committee Funding

Gout is a common disease which affects a substantial percentage of the adult population. Uric acid concentration in the blood increases causing accumulation of urate in joints and in kidneys, leading to recurring attacks of acute arthritis as well as other renal diseases. One therapeutic approach to treat gout is the use of xanthine oxidase inhibitors such as allopurinol. Xanthine oxidase plays an important role in purine metabolism, oxidizing hypoxanthine and xanthine to uric acid. However, the use of allopurinol is associated with a number of undesirable side effects. Thus there is a need to develop compounds with potent xanthine oxidase inhibitory activities which can substitute allopurinol as a therapeutic for gout. This project aims at studying the inhibition of xanthine oxidase by compounds of natural and synthetic origin.
(BL97019)

Preclinical and Clinical Validation of Fructus Crataegi and Green Tea in Lowering Blood Lipids

- ✉ HO Walter K. K. • CRITCHLEY Julian A.J.H. (Medicine & Therapeutics) • MARK Tony* • TOMLINSON Brian (Medicine & Therapeutics) • CHEN Zhen Yu • WONG Nai Ching Henry (Chemistry) • WAN David Chi Cheong • LAM Wai Kei Christopher (Chemical Pathology) • ZHU Min (Pharmacy)
- ☐ 1 October 1997
- ❖ Industrial Support Fund, Industry & Technology Development Council

In recent years a window of opportunity has opened up for development of natural and TCM products as licensed therapeutics. For example, by virtue of the Dietary Supplement health and Education Act of 1994 (DSHEA), the U.S. FDA is now considering licensing of crude natural product extracts as indication for treatment of disease as long as food safety and efficacy in human have been proven. This change in policy can provide significant savings in cost and time in developing a drug. To position Hong Kong and China's TCM industry for this window of opportunity, the present proposal aims to develop a workable scheme whereby TCM products can be sold as therapeutics under these new guidelines. In order to achieve this objective, it is needed to work out a detail scheme whereby the

researchers can bring one or two targeted TCM formulations with clear therapeutic end point as examples for development and commercialization. The need to have a clearly defined therapeutics end point is of parameter importance because without it, clinical efficacy cannot be objectively defined and measured. Because of this reason, the present proposal aims to focus only on TCM with cholesterol lowering properties. The selection of this target is two folds. First, cholesterol lowering drugs are in high demand and TCM offers an attractive alternative to medication for treatment of high blood cholesterol. Second, the testing of cholesterol activity can be objectively defined and is less likely to be misled by variables such as placebo effect, ill-defined end point (e.g. ageing) and unknown mechanism of action.

At the Chinese University the researchers have been actively involved in TCM research for over 30 years. Their investigation on cholesterol lowering compounds in Chinese herbs was initiated in the mid-80's and at moment, they have at least three research groups working in this area. To achieve the objective of this proposal, they will utilize their expertise to develop their leads in cholesterol lowering compounds so that they can be clinically validated. Using this as a solid example, the researchers hope to develop a pilot scheme for upgrading Hong Kong's TCM industry in research and development as well as validating its products for licensing in the U.S. and European markets. A multidisciplinary team encompassing experts from departments in the basic sciences and clinical subjects of the Chinese University have been assembled to tackle this task.
(BL97006)

Metabolic Activation of Nicotine-Derived Metabolites in Rat Microsomes by Cytochrome P450

✉ HO Wing Shing John

☐ 1 December 1997

❖ CUHK Research Committee Funding

N'-nitrosornicotine (NNN), a suspected smoke constituent, is a potent tobacco-specific carcinogen and has been demonstrated to induce tumours in animals. NNN is also suspected to be a human carcinogen. Cytochromes P450 are the major enzymes responsible for the activation of NNN in microsomes from the liver of rat. Thiocyanate is believed to be a major detoxification product of the smoke component hydrogen cyanide, which catalyzes the endogenous formation of nitrosamines. The enzymatic conversion of nicotine is believed to contribute to the carcinogenic potential of cigarette smoke via reactive intermediates. Biochemical data in the literature support the notion that NNN contributes significantly to the carcinogenic activity

through metabolic activation. Reactive metabolites of nicotine results in carcinogenicity. The present study will investigate an *in vitro* study of the individual pathways of nicotine metabolism in the rat in the presence of specific inhibitors. The proposed study will provide information on the NNN metabolism and allow us to get a better understanding of its carcinogenic potential through metabolic activation in the liver.

(BL97020)

Nuclear Calcium - Storage, Mobilisation and Cytosolic Linkage

✉ KONG Siu Kai

☐ 1 October 1997

❖ CUHK Research Committee Funding

Cells have many activities-they grow, they divide, they secrete and they die. Biochemists have long recognized many of the stimuli that prompt these activities. Yet, they are only now beginning to understand how cell senses these stimuli and converts them into signals that in turn elicit the appropriate responses.

Cellular calcium (Ca^{2+}) is one of the most important signal transducers that help regulate many physiological processes. In the past decade, much has been learned about how Ca^{2+} intervenes in cell surface-receptor mediated processes including the stimulation / inactivation of cytosolic enzymes and other protein activities. Relatively little is known about the role played by Ca^{2+} in transmitting signals between the nucleus and cytosol. Early wisdom allowed free passage of Ca^{2+} in and out of the nucleus with the nuclear pores providing an easy route. A number of recent experimental reports on the observation that a steep Ca^{2+} gradient occurs between the two compartments and on the existence of a nuclear phosphoinositol system, however, would seem to indicate that Ca^{2+} movement between the nucleus and cytosol is regulated. The how and why of the inferred regulatory process deserves study.

The researcher plans to examine the pathway and regulation of Ca^{2+} transport in the nucleus with emphasis on the gating system and the cross-talk with cytosolic Ca^{2+} , using a number of techniques such as confocal microscopy and fluorescence imaging. At the end of this project, he expects to have acquired information on: (1) the location and the activities of nuclear Ca^{2+} store(s) and (2) the molecules and processes needed to regulate Ca^{2+} transport between the cytosol and the nucleus. This will help better understand how information flows between compartments of the cell and specifically how it is processed within the nucleus to initiate and facilitate various nuclear activities, not the least of which is gene activation in cell growth, cell development and cell death.

(BL97021)

Development of Over-the-Counter Pharmaceutical Product Based on Local Medicinal Plants

- ✉ KONG Yun Cheung • KWAN Hoi Shan (Biology)
 ☐ 1 May 1998
 ❖ Industrial Support Fund, Industry & Technology Development Council

The aim of the research is to develop 2 over-the-counter (OTC) pharmaceutical products based on local medicinal plants: (1) These plants will initially be collected from Hong Kong country side and stock cultures will be maintained as sustainable source of supply for industrial production will be established in Hong Kong and One word, (2) The efficacies of these plant extracts and later the OTC products will be supported by a battery of bioassays that also monitor the industrial production, (3) Formulation of the OTC products will be developed, and manufacturing protocols will be developed and made available to the private sector through licensing. (BL97039)

Production of Transgenic Mice Lacking the Fatty Acid-Activated Receptor: An Animal Model to Study Adipose Cell Differentiation and Obesity

- ✉ LEE Susanna Sau Tuen • CHAN Wood Yee (Anatomy) • CHEUNG Wing Tai
 ☐ 1 October 1997
 ❖ Research Grants Council

Obesity is the cause of many major diseases including heart disease and diabetes and is characterized by an excessive accumulation of adipose tissue that requires *de novo* differentiation of adipocytes from preadipocytes. A detailed understanding of the molecular events that control adipocyte differentiation is essential for development of strategies for treatment and prevention of obesity. Experimental evidence has shown that the fatty acid-activated receptor (FAAR) mediates the conversion of preadipocytes into adipocytes upon activation by fatty acids *in vitro*. However, the precise roles of FAAR in regulating adipocyte differentiation and maintaining lipid homeostasis *in vivo* are still not clear. This is due to lack of suitable transgenic animal models for testing the involvement of FAAR in adipocyte differentiation *in vivo*. The aims of the proposed research are: (1) to develop a transgenic mouse model which lacks FAAR by specific blockade of FAAR production by targeted disruption of the FAAR gene; and (2) to analyze the possible effects of FAAR deficiency on the adipocyte differentiation and lipid homeostasis in this animal model. The animal model to be developed in the present proposed research might help to understand

the molecular mechanism underlying the adipogenic effects of overfeeding. (CU97318)

Studies on the Signalling Mechanisms in Cytokine-Induced Monocytic Differentiation of Myeloid Leukemia Cells

- ✉ LEUNG Kwok Nam
 ☐ 1 November 1997
 ❖ CUHK Research Committee Funding

The proliferation and differentiation of blood cells are tightly regulated by a group of hormone-like soluble factors collectively known as “cytokines” which mediate their actions by binding to specific receptors on the cell surface. Leukemia occurs when the white blood cells escape from the checks and controls normally exerted over growth, division and differentiation. In myeloid leukaemia there is an uncoupling of cell proliferation and differentiation, resulting in the accumulation of immature granulocyte/macrophage precursors. The researcher’s earlier works have shown that myeloid leukemias stop to proliferate and differentiate in response to a wide range of cytokines, thus providing a useful means of dissecting the proliferation and differentiation signals. In this project, a clonally-derived and biologically well-characterized mouse myeloid leukemia cell line (WEHI-3B JCS) will be used as an experimental cell model for studying the post-receptor events and signalling mechanisms by which cytokines can exert their anti-proliferative and differentiative activities on myeloid leukemia cells. The main objective of this project is to elucidate some of the intracellular signalling pathways that might be involved in cytokine-induced monocytic cell differentiation, with particular references to the involvement of different types of protein kinases. In addition, the participation of second messenger molecules such as cyclic nucleotides, nitric oxide and calcium ions in the differentiative process will also be investigated. It is anticipated that this study will lead to better understanding of the molecular mechanisms whereby the growth and differentiation of leukemia cells can be regulated. In particular, it is hoped that the unravelling of the complex signalling pathways involved in cytokine-induced leukemic cell differentiation might lead to the development of more specific and less toxic therapeutic strategies for some forms of myeloid leukemia. (BL97023)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition Title/Investigators

1995-96 On the Use of Fish Metallothionein Levels as Biomarker(I): Development of Sensitive Immunoassay and Polymerase Chain Reaction Based Assay to Detect Metallothionein Gene Expression in Tilapia Tissues (CU95305)
✉ CHAN King Ming

1995-96 Metabolic Fate of Trans/Cis Fatty Acids Present in High-Trans Milk and Their Effect on Metabolism of Essential Fatty Acids (CU95302)
✉ CHEN Zhen Yu • GULDAN Georgia

1996-97 Breastmilk Fatty Acid Composition in Chinese (BL96001)
✉ CHEN Zhen Yu • LEUNG Suk Fong Sophie (Paediatrics)[#]

1996-97 Identification and Evaluation of Biologically Active Compounds Present in Chinese Green Tea (BL96030)
✉ CHEN Zhen Yu • FONG Wing Ping • FUNG Kwok Pui • HUANG Yu (Physiology) • KWOK Tim Tak • LEUNG Kwok Nam

1990-91 Comparative Endocrinology of Prolactin, Growth Hormone, and Their Receptors (BP88031)
✉ CHENG Hon Ki Christopher • NG Tzi Bun • WONG Chun Cheung (Physiology)

1995-96 Molecular Cloning and Functional Expression of the Growth Hormone Receptor cDNA from Dace (*Cirrhinus molitorella*) Liver (CU93305)
✉ CHENG Hon Ki Christopher • SHAW Pang Chui • TSIM Karl W. K.*

1996-97 Structure-function Studies on Fish Growth Hormone and Prolactin: A Protein Engineering Approach (CU96320)
✉ CHENG Hon Ki Christopher • CHAN King Ming • NG Tzi Bun

1996-97 Regulation of Hepatic Growth Hormone Receptor and Serum IGF-I in Guinea Pig (BL96002)
✉ CHENG Hon Ki Christopher • NG Tzi Bun

1995-96 Adoptive Immunotherapy of Tumour-Bearing Mice Using Natural Polysaccharides (CU94318)
✉ CHOY Yuen Min • LEUNG Kwok Nam

1995-96 Immunopotentiating and Anti-Tumour Effect of Klebsiella K7 Capsular Antigen (CU95315)
✉ CHOY Yuen Min • FUNG Kwok Pui

1996-97 Monoclonal Antibodies against Polysaccharides in Herbal Medicines: Production and Development of Affinity Chromatography and Immunoassay (CU96315)
✉ CHOY Yuen Min • NG M. H.* • FUNG Kwok Pui

1995-96 Formation of a Task Force in The Development of Enzyme Immunodiagnostic Tests (BL95010)
✉ HO Walter K. K. • LAM Wai Kei Christopher (Chemical Pathology) • LEUNG Kwok Nam • CHOW Hak Fun (Chemistry) • FONG Wing Ping • WONG Patrick C. L.* • TAM Joseph W. O.*

1995-96 Application of Recombinant Fish Growth Hormone in Fish Culture (BL95029)
✉ HO Walter K. K.

1995-96 Expression of Recombinant Proteins in Baculovirus and the Application of Recombinant Fish Growth Hormone in Fish Culture (BL95015)
✉ HO Walter K. K. • KWONG Simon*

1995-96 Effects of Pesticides and Herbicides on Proton Flux Through the CFO.CF1 Complex in Chloroplasts (CU95321)
✉ HO Wing Shing John

1996-97 Cytotoxicity of Herbicides by Fibroblasts (BL96003)
✉ HO Wing Shing John

1995-96 Studies on the Regulation of Nuclear Calcium in C6 Glioma Cells (BL95028)
✉ KONG Siu Kai • TSANG David Sau Cheuk

1996-97 Signal Transduction in Normal Macrophages and Macrophages Cell Line (BL96004)
✉ KONG Siu Kai

- 1996-97 New Drug for Breast Cancer (MD95264)
 ✎ KONG Yun Cheung • LEUNG Wai Tong Thomas (Clinical Oncology)
- 1996-97 Use of Developed Gene Knockout Transgenic Mouse Models for Identification, Evaluation, and Define the Mechanisms of Chemical Toxicity and Human Diseases (BL96026)
 ✎ LEE Susanna Sau Tuen • TSANG David Sau Cheuk • WAN David Chi Cheong • CHAN Wood Yee (Anatomy)
- 1996-97 Production of Transgenic Mice Lacking the Fatty-Acid Activated Receptor: An
- Animal Model to Study Adipocyte Differentiation and Obesity (BL96006)
 ✎ LEE Susanna Sau Tuen
- 1995-96 The Mechanism of Action of Tumour Necrosis Factor- α on Taurine Transport in Cultured Rat Astrocytes (CU95322)
 ✎ TSANG David Sau Cheuk • LEUNG Kwok Nam • STADLIN Alfreda (Anatomy)
- 1996-97 Effect of Tumour Necrosis Factor on Intracellular Calcium Mobilization in Glioma Cells (BL96007)
 ✎ TSANG David Sau Cheuk

RESEARCH OUTPUTS AND PUBLICATIONS

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RESEARCH PROJECTS

Study on the Suitability of Ping Chau to be Established as Marine Park or Marine Reserve

✍ ANG Put Jr. • CHU Ka Hou • CHU Lee Man • WONG Chong Kim • WOO Norman Ying Shiu

☐ 1 October 1997

❖ Agriculture & Fisheries Department

The objectives of this study are:

- (1) to provide physical and ecological baseline information of Ping Chau Island;
- (2) to assess the suitability of Ping Chau Island for designation as a marine park or a marine reserve;
- (3) to make recommendations on the boundary of proposed marine park or marine reserve with regard to their conservation and education value;
- (4) to identify major potential sources of impact upon the ecology and habitats of Ping Chau Island;
- (5) to provide recommendations on the protection and management of Ping Chau Island and the resources requirements; and
- (6) to assess the possible reaction from different sectors of the community towards the proposed designation.

(BL97008)

Reproductive Seasonality and Recruitment of Scleractinian Corals in Tung Ping Chau, New Territories, Hong Kong

✍ ANG Put Jr.

☐ 1 December 1997

❖ CUHK Research Committee Funding

Dominant species of Scleractinian corals, e.g. *Goniopora* spp., *Pavona* sp. and *Platygyra sinensis* found in the coral communities in Tung Ping Chau, New Territories, Hong Kong, will be examined for their reproductive phenology. Recruitment plates will be laid in the field to collect settling coral larvae. The fecundity of the dominant coral species as well as the success rates of their recruits will be correlated with their dominance in the community. This information is critical in evaluating the potential of preserving the coral communities around the island if the island is to be designated as a marine reserve or a marine park in the near future.

(BL97025)

Development of Manufacturing Protocols for Improved Production of Standardised Quality Mushroom Nutraceuticals from *Ganoderma Lucidum*

✍ BUSWELL John Anthony • CHANG Shu Ting • LIU Wing Keung Ken (Anatomy) • HSIAO Wen Luan Wendy*

☐ 1 October 1997

❖ Industrial Support Fund, Industry & Technology Development Council

The objective of the project is to develop a manufacturing process for the increased production and retrieval of bioactive polysaccharide/polysaccharopeptide substances of reproducible quality from the mushroom, *Ganoderma lucidum* (Ling Zhi).

The project plan is to cultivate *G. lucidum* in the laboratory and pilot-scale bioreactors under a series of different nutritional and physiological conditions to determine which factors play a key role in fungal polysaccharide/polysaccharide-peptide production. This class of materials exhibits anti-tumour and immunoenhancing activity. The physiological and nutritional parameters tested will be selected on the basis of data accrued from previous experiments conducted with other mushroom fungi. Key physiological and nutritional parameters identified at the bench and pilot-scale levels will then be extrapolated to develop an industrial-scale process for the manufacture of high-quality polysaccharide/polysaccharide-peptide materials in high yield. In addition, different downstream protocols will be examined in order to reduce adverse effects on product activity caused by, for example, unnecessary harsh extraction methods, and to maximise product retrieval. At each step in the process development, biological activity levels will be monitored using chemical analysis and cell-based assay systems.

(BL97004)

Production and Distribution of Cellulolytic Enzymes in the Edible Straw Mushroom, *Volvariella volvacea*, during Substrate Colonisation and Fruit Body Morphogenesis

✍ BUSWELL John Anthony

☐ 1 November 1997

❖ Research Grants Council

The proposed research will investigate the changes in cellulolytic enzyme patterns that occur during different stages of fungal growth and fruit body morphogenesis in the edible straw mushroom, *Volvariella volvacea*, and will compare the cellular distribution patterns of different cellulases in 'vegetative' hyphae (i.e. hyphae involved in the colonisation and degradation of the growth substrate) and hyphae of fruit body primordia which eventually lead to, and form part of, the fruit body. It is expected that the information accrued will help explain how cell behaviour is regulated during fungal

morphogenesis and fruit body initiation, and will lead to the development of strategies for maximising degradation of substrate, increasing biological efficiency and improving mushroom yields. (CU97329)

Isolation, Identification and Biotechnological Characterisation of Hyperthermophilic Bacteria from Hot-Spring Environments in China

✉ BUSWELL John Anthony • WILLIAMS R.A.D.*

☐ 1 January 1998

❖ CUHK Research Committee Funding

Hyperthermophilic bacteria form a major sub-group of the class of microorganisms known collectively as extremophiles which grow in unique physical environments (e.g. temperatures of or exceeding 100°C, pH values of below 1.0 or above 12, 35-40% salinity). The experimental objectives of this research are (1) to isolate and identify hyperthermophilic bacteria from selected hot spring environments in the People's Republic of China and Taiwan, (2) to determine the biodiversity of isolates using modern molecular biological techniques, (3) to evaluate the biotechnological potential of isolates as a source of novel restriction enzymes, and (4) to examine isolates for production of thermostable enzymes for use in industrial processes. (BL97026)

Chemical Quality Control of Chinese Medicines as a Support for Export of Proprietary Chinese Medicines

✉ BUT Paul Pui Hay • LAU Oi Wah (Chemistry) • CHAN Tak Wah Dominic (Chemistry) • WANG Mu-zhou*

☐ 1 December 1997

❖ Industrial Support Fund, Industry & Technology Development Council

Quality control of Chinese medicines and health foods by monitoring the bioactive chemical components in such products is a must; but it is an expensive cost to manufacturers. A feasible way to cover such costs is to increase the sales volume of the Chinese medicines and health foods, particularly through export to China which has a huge market receptive of good products from Hong Kong and also to other Asian and Western countries, including the USA which has passed a Dietary Supplement Act in 1994 to allow more flexible introduction of nutraceutical products derived from herbs. A key requirement for obtaining an import permit to China and other countries is to establish good chemical quality control of the products. The objective of this project is to assist the local manufacturers to set up

protocols and specifications for quality control of their products intended for export and to establish a mechanism to help the manufacturers in using these protocols and specifications in seeking approvals for exporting their products to China and other countries. The mechanism is to make use of the *Laboratory for the Quality Control of Chinese Medicines and Health Foods Based on Chemical Components* (LQCCMHF) to offer such service and to liaise direct with China's National Institute for the Control of Pharmaceutical and Biological Products (NICPBP) which is in charge of approving the quality control specifications for importing products and is experienced in offering assistance in quality control of Chinese medicines to help meet the requirements of other countries.

The project will help upgrade the standard and quality of products intended for export by local manufacturers of Chinese medicines and health foods and also help them in setting up protocols and specifications to meet import requirements for quality control in China and other countries. (BL97003)

The Development of Chinese Medicines and Dietary Supplements for Treating Gastrointestinal Disorders and Coughing

✉ BUT Paul Pui Hay • FUNG Kwok Pui (Biochemistry) • CHAN Tak Wah Dominic (Chemistry) • HO Yee Ping (Pharmacy) • WOO Jean (Medicine & Therapeutics) • CHOW Hee Lum Albert (Pharmacy) • LI Chi Keung Ronald (Pharmacy) • ZHU Min (Pharmacy) • KWAN Yiu Wa (Pharmacology) • LIN Ge (Pharmacology) • CHAN Hsiao Chang (Physiology) • KO Wing Hung (Physiology)

☐ 1 March 1998

❖ Industrial Support Fund, Industry & Technology Development Council

This project is to support the local Chinese medicine manufacturing industry in developing the scientific rationale and upgrading the technology for the strategic development and reformulation of Chinese medicines and dietary supplements for treating gastrointestinal disorders and coughing. To execute the project, an operation team under the Chinese Medicinal Material Research Centre will be set up to integrate together the expertise in Chinese medicine, medicine, pharmacy, pharmacology, physiology, biochemistry and chemistry available at the Chinese University of Hong Kong. Priority will focus on 6-10 proprietary products/formulas selected from local manufacturers. (MD97131)

International Ginseng Conference '99 – Biotechnology, Medicinal Uses and Marketing of Ginseng

✉ BUT Paul Pui Hay • SHAW Pang Chui (Biochemistry) • LIU Wing Keung Ken (Anatomy)

☐ 1 June 1998

❖ Industrial Support Fund, Industry & Technology Development Council

This project aims to organise and host in 1999 an international conference together with an exhibition on the biotechnology, medicinal uses and marketing of ginseng.
(BL97042)

Characterization of Pharmacologically Active Substances and Nutritional Evaluation of Selected Seaweeds in Hong Kong

✉ CHEUNG Chi Keung • OOI Vincent E. C. • ANG Put Jr.

☐ 1 September 1997

❖ Research Grants Council

Seaweeds (marine macroalgae) have been very popular in the Oriental regions for use as food item and as traditional medicinal materials. The central aim of this proposal is to evaluate the nutritional values of selected local seaweeds and to identify and characterize some pharmacologically active substances of seaweed origin. The researchers have carried out an extensive assessment of seaweed seasonal resources and marine algal species diversity and community structure throughout Hong Kong waters. The nutrient composition of a number of local seaweeds has already been investigated and preliminary data has shown the potential food uses of some of these seaweeds. Their ongoing preliminary studies on the biological/medicinal properties of many seaweed species have demonstrated some interesting potential extracts of seaweeds. These pharmacological properties include blood pressure-lowering and blood clotting activities. Moreover, polysaccharides of seaweeds have been well-known for their antitumor, immunomodulatory, cholesterol-lowering and many other biological activities. As the laboratories have been extensively involved in the search of antitumor polysaccharides and proteins (especially lectins) from mushrooms, the researchers will in this proposed study more fully identify and characterize the novel active substances from selected seaweeds which may be potent candidates with antitumor, immunomodulatory, hypotensive and cholesterol-lowering properties. It is anticipated that the proposed study will give a deeper insight towards understanding the biologically active components in seaweeds and developing selected marine algal species into better nutraceutical or pharmaceutical products.
(CU97314)

Structural Elucidation of the Polysaccharides Isolated from *Pleurotus Tuber-Regium*

✉ CHEUNG Chi Keung

☐ 1 December 1997

❖ CUHK Research Committee Funding

Fruiting bodies of most basidiomycetes contain β -D-glucans consisting mainly of (1-3)-linkages having O-6 substitutions with single D-glucosyl groups such as lentinan and schizophyllan, were found to inhibit the growth of certain tumors, through stimulation of the host-immunosystem. Other antitumor (1-3)- β -D-glucans with different branches have been isolated from various mushrooms. In the course of studies on the structural diversities of fungal polysaccharides, and the interrelationship of their structures and antitumor activities, attention has been drawn to polysaccharide components of a lesser known edible mushroom, called *Pleurotus tuber-regium*). Recently polysaccharides isolated from some *Pleurotus spp.* (*P. ostreatus* and *P. sajor-caju*) have been shown to exhibit high antitumor activity. As an initial step to the investigation of structure-activity relationships in fungal polysaccharides the researcher will aim at finding the chemical structures of different types of polysaccharides (mainly (1-3)- β -D-glucans), isolated from *P. tuber-regium* by successive fractionation using water and alkali under different conditions. It is anticipated that the isolated mushroom polysaccharides will be used for a comparative study of their antitumor activities later on.
(BL97027)

A Study of Some Fascinating Insects of Hong Kong

✉ CHEUNG Wai Kuen Wilkin

☐ 17 November 1997

❖ CUHK Research Committee Funding

The book "Hong Kong Insects" (written by Dennis S. Hill and Wilkin W.K. Cheung, 1977) was a classic and pioneering book on common local insects published in coloured photographs and brief descriptions upon the invitation of the Urban Council and Urban Services Department, Hong Kong Government (a non-profit enterprise). This book began with an introduction of what an insect is its significance in Nature, and its impact to Man and his possessions. Then, there was a brief description of what basic entomology (the study of insects) is all about. The bulk of the book was devoted to half-page size coloured photographs (professional in production) and half-page brief description of interesting points about the illustrated insects. After that, there was a glossary of entomological terms explained in simple English to those unfamiliar with the discipline. This

was followed with an index of scientific-cum-common names of the mentioned insect species.

The researcher feels that a second edition is necessary so that this book can contain the most accurate description of an important part of our nature's heritage, and we, as well as our future generations, may appreciate the beauties and intricacies of our natural environment. The educational, economic, and aesthetic values of these common insects are immeasurable. They are important as well as relevant to our daily lives. Upon revision, a draft will be submitted to the Urban Council and Urban Services Department for consideration of a revised printing of the book. The researcher convinced that this book does contain gorgeous illustrations of local insect examples and it can definitely promote the image of the Chinese University for its authorship as well as the overall Hong Kong for any nature lovers travelling to this region.

(BL97028)

Screening Natural Populations of Chinese Shiitake Strains for Present and Future Commercial Potential

✉ CHIU Siu Wai • MOORE David* • LIN Fang Can*

☐ 1 October 1997

❖ Research Grants Council

China is the major producer and exporter of shiitake (*Lentinula edodes*), which is one of the most popularly cultivated mushrooms. Shiitake is also native to China. The researchers propose here: first, to survey the genetic diversity in wild Chinese shiitake using molecular and conventional tools; Second, to screen for isolates with present desirable characters such as: short cultivation time, good yield and high pathogen resistance; and potential desirable characters such as: high pesticide-degradative ability. The results will be put on as informative database. These characters may not be possessed by the same isolate. Yet through conventional or advanced breeding strategy, the introduction of desirable genotypes into the current cultivated strains is feasible. Also, through this study, they could reveal the population genetics of and provide a baseline genotype diversity for wild shiitake and thus enabling further assessment of the impact of industrialization in developing China. This germplasm resource will be preserved as a conservation practice *ex situ*.

(CU97326)

A Confocal Laser Scanning Microscopic Analysis on the Gill Development of a Mushroom

✉ CHIU Siu Wai • MOORE David*

☐ 1 April 1998

❖ UK/Hong Kong Joint Research Scheme, the British Council

Cell death is widely encountered in diverse developmental pathways. Gills are the most important functional structure of a mushroom. Yet such development in nature is mostly unseen as it occurs inside a mushroom. This project proposes to examine this pathway in mushroom *Coprinus cinereus* by confocal laser scanning microscopy. This mushroom carries out synchronous meiosis, and this can be used as a physiological marker. The use of this technology offers the advantages of preservation of the cellular architecture and absence of sectioning artifacts. Thus it can reliably be applied to determine whether the cells in differentiation for gills show any characteristics of cell death. Also, this technique can perform optical sectioning of a live specimen and enables 3-dimensional reconstruction of digital images. Therefore, such a study can enable an objective visualization of the gill development in a digital movie format.

(BL97016)

Molecular Studies on Shellfish Allergens: Cloning, Sequencing, Expression and Immunological Responses

✉ CHU Ka Hou • LEUNG P.S.C.* • KWAN Hoi Shan • FUNG Ming Chiu

☐ 1 November 1997

❖ Research Grants Council

Hypersensitive reactions to crustaceans and mollusks is one of the most common food allergies. Recently, the researchers have cloned, sequenced and identified the cDNA coding for the major heat stable shrimp allergen as tropomyosin. Research on T-cell responses to shrimp tropomyosin is in progress. They have also demonstrated that tropomyosin in crustaceans and mollusks are cross-reactive among shellfish allergic subjects. In this project, they plan to clone and characterize allergens in mollusk to further understand the molecular basis of shellfish allergy. The allergens will be identified and characterized by molecular cloning, nucleotide sequencing and expression in plasmid vectors. The cross-reactivity between crustacean and mollusk allergens will also be investigated at the antibody and T-cell level. Furthermore, the cross-reacting and non-reacting T-cell epitopes will be mapped and the lymphokine profiles compared. The results will be useful in understanding the cellular signals involved in food allergy and lay the groundwork for development of diagnostic and immunotherapy tactics in shellfish allergy.

(CU97321)

Sediment Pollution and Purification Potential of Gei Wais at the Mai Po Marshes Nature Reserves

✉ CHU Lee Man

☐ 1 November 1997

❖ CUHK Research Committee Funding

The Mai Po Marshes Reserves is a unique site of special scientific interest in Hong Kong and a significant wetland with great biological importance and conservation value locally regionally and internationally. However, with the decline in water quality, the fauna and flora in the mudflats and the adjacent shallow shrimp ponds (gei wais), are seriously threatened. The assimilative potential of gei wais has been suggested. An assessment of the pollution status and purification ability of gei wais at the Mai Po Marshes is therefore proposed. The project attempts to verify the self-cleansing capability of gei wais by (1) examining the change in quality of water after being retained in gei wai, (2) determining the loadings of nutrients and heavy metals in the sediments in gei wais, and (3) studying the pollutant mobility and toxicity of sediments from gei wais. It is hoped that gei wais can be used as a natural purification system to alleviate pollution burden and serve as a low-cost solution for environmental conservation.

(BL97029)

Studies on the Volatile Components in Salted-Dried Fishes Prepared by Two Traditional Methods

✉ CHUNG Hau Yin

☐ 1 November 1997

❖ CUHK Research Committee Funding

Among various fish preservation processes, salting and drying of fish is the most common and has a long history. Though public health studies have related the risk of cancer to the consumption of these preserved products, yet consumers in Hong Kong are attracted by the products mainly due to their characteristic flavor rather than their nutrients. There is little information in the scientific literature on the volatile components of salted-dried fishes and their differences when prepared by different methods.

The objectives of the experiment are to qualify, quantify and compare the volatile components of the salted-dried fishes prepared by different methods. It is hoped that the research findings will provide the basis for further investigation into the mechanisms of flavor formation and subsequent utilization of the information to process fishes into products with good flavor and with the highest nutritional quality.

(BL97030)

Studies of the Novel Genes Differentially Expressed During Myeloid Cell Differentiation and Embryo Development

✉ FUNG Ming Chiu

☐ 1 January 1998

❖ CUHK Research Committee Funding

Blood cell formation (hematopoiesis) is tightly controlled by a group of factors called cytokines. The blood stem cells respond to differentiation signals generated by the cytokines will turn on or off the appropriate genes and finally convert the proliferating, undifferentiated cells into nonproliferating, highly specialized differentiated cells. Lesions in these controller genes will lead to the formation of tumor. Recently, the researcher has identified several genes that were differentially expressed during the differentiation of a mouse myeloid cell line. The expression of these genes were also regulated during the mouse embryo development at the time that coincided with the formation of fetal blood cells. DNA sequences of these isolated gene fragments do not have any significant homology with any known sequences in the Genbank database, except for one gene fragment which partly contains a MT repetitive sequence. The results suggested that these novel genes may play important roles in controlling myeloid cell differentiation and embryo development. The specific issues addressed in this project include: (1) Cloning the full length cDNAs of these controller genes; (2) Elucidate the functions of these genes in myeloid cell differentiation; and (3) Delineate the functions of these genes in embryo development. These studies will not only enhance the understanding of the molecular mechanism of myeloid cell differentiation, but also will provide insight into the formation of myeloid tumor.

(BL97031)

Distribution of Activin Type II and Type IIB Receptors in the Goldfish Pituitary

✉ GE Wei

☐ 1 November 1997

❖ CUHK Research Committee Funding

Activin is a dimeric growth factor that plays critical roles in the regulation of reproduction and many other physiological and developmental processes in vertebrates. Activin initiates its actions by binding to specific receptors. Two types of activin receptors have been identified and termed type I and type II, respectively. According to the current hypothesis, the type II receptors specifically recognize activin and form a heterodimeric complex with the type I receptors upon binding of activin, an important step in activin signaling. Two subtypes of activin type II receptors, type II and IIB, have been cloned in several vertebrate species including goldfish. The purpose of the proposed study is to examine the distribution of the type II and IIB receptors in the

pituitary using goldfish as the model. The general question addressed in the project is: why do animals need two activin type II receptors with similar binding affinity for activin? The proposed research will enhance the understanding of the involvement of the type II and IIB receptors in activin actions and differential regulation of their gene expression. (BL97033)

Yeast Complementation Analyses of Signal Transduction Genes Isolated from Early Fruit Body Development of Shiitake Mushroom *Lentinula edodes*

✉ KWAN Hoi Shan

☐ 1 October 1997

❖ Research Grants Council

The long term objective of this proposal is to elucidate the molecular aspects of fruit body development, the most important and conspicuous developmental process in the life cycle of the cultivated mushroom *Lentinula edodes*. The specific aims are (1) to clone and sequence full-length cDNAs for signal transduction genes that have been isolated from early stages of fruit body (mushroom) development of *Lentinula edodes*, by Rapid Amplification of cDNA Ends (RACE) and complementation cloning of yeast mutants, and (2) to examine the biochemical and physiological functions of the cloned genes by transformation into yeast mutants and complementation test. Two cDNA libraries will be constructed, one with *E. coli* vector and one with yeast expression vector. The main analytical method to be used is complementation of yeast mutants. The functions of the *L. edodes* signal transduction genes will be elucidated if they can functionally complement known yeast mutants. Verification of the functions of these genes as signal transduction genes will provide the first evidence for the importance of the signal transduction pathways in *L. edodes* fruit body development. (CU97322)

Reclaiming the Salty Lands for Agriculture

✉ LAM Hon Ming

☐ 15 September 1997

❖ Ho Sin-Hang Education Endowment Fund

Salinisation of the agricultural land has imposed a severe problem to crop yield. In China, more than 7 million hectares have become saline land due to centuries of irrigation. High salt conditions inhibit the growth of many plant species and reduce their productivity. However, certain plant species such as mangroves and marine algae have developed specific mechanisms for salt tolerance. The researchers propose to clone the salt tolerant genes from

mangroves and marine algae and "transfer" them to salt-sensitive important crop plants by the newly developed transgenic plant techniques. The improved salt-tolerant crops can then be cultivated in the lands currently unusable because of high salt conditions. The ultimate goal is to "reclaim" the salty lands for agriculture. This research will thus serve a dual purpose (1) to solve a long-standing agricultural problem and to contribute to the food security of China in the coming decade, and (2) to bring in the advanced plant molecular biotechnologies to an educational institute and hence improve its research quality. (BL97002)

Cloning of Salt Inducible Promoters from *Arabidopsis thaliana*

✉ LAM Hon Ming

☐ 15 December 1997

❖ CUHK Research Committee Funding

Salinisation is an alarming environmental problem in agricultural countries such as China. The long-term goal is to use molecular techniques to manipulate salt tolerance of higher plants and thus will contribute to lessen the impact of salt inhibition on crop yield. Previous reports by others showed that overexpressing metabolic genes which encode the target proteins of salt inhibition (i.e. salt sensitive proteins) lead to an increase in salt tolerance. Since overexpression of metabolic genes may cause adverse effects on plant growth under normal unstressed conditions, it is more desirable to overexpress these genes only when the plants are under salt stress. To achieve this end, the researcher proposes to clone the salt-inducible promoters from the genetic model plant *Arabidopsis thaliana*. Salt-inducible cDNAs will first be cloned by differential display techniques. These cDNA clones will then be used to generate probes to screen for their corresponding genes from a genomic library. The putative promoter regions will be identified and their salt inducibility will be tested by expressing reporter genes in transformed host plants. (BL97032)

Developmental Alteration of the Expression and Kinase Activity of Cyclin-Dependent-Kinase 5 (Cdk5)/p35 in the Rats with Neonatal Unilateral Eye Removal

✉ OOI Vincent E. C. • CHAN Sun On (Anatomy)

☐ 1 November 1997

❖ CUHK Research Committee Funding

While most of the cdc2-like protein kinases are cell cycle regulators, some cdc2-like kinases may have major functions unrelated to cell division. Cdk5 is one that does not have any known cell cycle function.

On the other hand, evidence has been accumulating to suggest that cdk5 has important neuronal functions. The cdk5 protein is enriched in neurons of adult brain whereas cdc2 and cdk2 are essentially absent. Cdk5-associated kinase activity has been demonstrated only in mammalian brains. P35, a cdk5 regulatory subunit, derived proteolytically from a 35kDa brain and neuron-specific protein, is essential for the kinase activity of cdk5. Many scientists indicated that P35 is neuron specific and physiological activator of cdk5 in immature neurons. The changes in cdk5/P35 expression appear to correlate with the terminal differentiation neurons of the mouse embryonic brains, developing rat brain, cerebellum and retina, transfection of culture neurons with dominant negative cdk5 mutants or P35 antisense DNA may reduce neurite growth suggesting that cdk5/P35 kinase may play key roles in neuronal maturation, synaptic formation and neuronal plasticity. In this case, probably cdk5/P35 may play a role in neuronal plasticity in the development of the rat's retinotectal pathway. The proposed study aims to investigate alteration of the expression and kinase activity of cdk5/P35 in rats with neonatal unilateral eye removal so as to understand the possible functions of these kinases in the development and plasticity of the central nervous system.
(BL97034)

Characterization and Expression of Ribosome Inactivating Proteins in Plants and Mushrooms

- ✉ OOI Vincent E. C. • SUN Sai Ming Samuel • NG Tzi Bun (Biochemistry)
- ☐ 1 December 1997
- ❖ Research Grants Council

Ribosome inactivating proteins (RIPs) constitute a family of proteins which possess a highly specific N-glycosidase activity and are capable of catalytically inactivating eukaryotic ribosomes. Most RIPs have antiviral properties and other diverse pharmacological activities. They are elaborated by flowering plants belonging to different families. Recently, the researchers have focused their research on the isolation of RIPs from non-Cucurbitaceae plants such as *Narcissus tazetta*, and mushrooms such as *Volvariella volvacea*, and elucidation of their pharmacological actions. They have detected the presence of RIPs in these plants by virtue of the molecular weights (approximately 30K), and N-glycosidase and cell-free protein synthesis inhibitory activities. However, whether these RIPs also possess similar pharmacological activities is not known. Furthermore, knowledge about the physiological role(s) of RIPs in plants is limited to their antiviral (self-defense) activities. Little information is available regarding the spatial and developmental expression of the RIP genes in plants. The researchers now propose to (1) isolate new RIPs from

previously unexamined species, including a medicinal plant *Polygonum cuspidatum*, and mushrooms *Ganoderma lucidum* and *Tricholoma lobayense*, (2) elucidate the pharmacological activities of these RIPs, (3) clone the gene(s) of RIP from *Narcissus tazetta* which has been partially characterized, and study its expression during plant development, and (4) search particularly for novel antiviral substances which may be developed as potential candidates for use in antiviral therapy, for instance, against hepatitis B virus (HBV) or human immunodeficiency virus (HIV). Hopefully the investigation would also shed light on the physiological roles of these RIPs in plants.
(CU97325)

Genetic Engineering of Sweet Protein Mabinlin for Increased Stability

- ✉ SUN Sai Ming Samuel • WONG Yum Shing
- ☐ 1 December 1997
- ❖ Research Grants Council

Several health problems, for example, obesity and tooth decay, are known to associate with excess calorie (sugar) consumption. Because of this, the demand for alternative low or non-caloric sweeteners is exceedingly great and increasing. Several plant proteins with a taste hundreds to thousands of times sweeter than sucrose have been identified, representing a potential source of alternative sweeteners. Most of these sweet proteins, however, are heat sensitive, rendering them not suitable for use in foods or beverages that require heat treatment. The researchers have cloned the genes encoding a novel sweet protein called mabinlin (MBL) from a subtropical Chinese herbal plant. This 14KDa sweet protein, comprising of two polypeptide chains linked by disulfide bonds, is 400 times sweeter than sucrose and relatively heat stable, i.e. still sweet after 48 hours at 85°C. However, when their disulfide bonds are broken, MBL will lose its sweet activity. They propose to study the structural elements involve in the heat stability and sweet activity of MBL, and to engineer the two-chain MBL into a single chain protein for increased stability/renaturability and sweet function. In spite of an enormous amount of research, the mechanism involved in taste perception is still not clear. The proposed study should also contribute useful information to this area of basic science.
(CU97327)

An *in situ* study of the phytoplankton-zooplankton trophic transfer in the Zhujiang River estuary

- ✉ WONG Chong Kim
- ☐ 1 November 1997
- ❖ Research Grants Council

Fishery productivity in an estuary is partly determined by phytoplankton primary production and the efficiency with which energy moves up the food chain. The Zhujiang River estuary is an area of high productivity. Because copepods feed on phytoplankton and many fish larvae are planktivores of copepods, exploitation of phytoplankton primary production by copepods may play a pivotal role in the flow of energy in the estuarine system. This study investigate phytoplankton-zooplankton trophic transfer and factors affecting it in the Zhujiang River estuary. The specific objectives are: (1) to study the spatial and temporal patterns of phytoplankton primary productivity, (2) to measure the grazing rate of size classes of copepods using the gut fluorescence method, (3) to relate variabilities in copepod grazing rates to biological and physico-chemical parameters in the water column, and (4) to assess the efficiency of phytoplankton-zooplankton trophic transfer by calculating the amount of daily primary production grazed by the copepod community. (CU97313)

Effects of Oxygen and Temperature on the Sensitivity of *Moina Macrocopa* to Chemical Pollutants

✉ WONG Chong Kim

☐ 1 December 1997

❖ CUHK Research Committee Funding

The use of aquatic organism toxicity tests for estimating the environmental impact of effluents, sediments and chemical pollutants has been emphasised by both the U.S. EPA and the Environmental Protection Department, Hong Kong. The freshwater cladoceran *Moina macrocopa* is sensitive to a variety of chemical pollutants. It has been used successfully cultured in the laboratory, and methods for conducting acute and chronic tests with it have been well established. However, additional information on the effects of temperature and oxygen on sensitivity is still needed to make *M. macrocopa* an effective and standard tool for assessing the impact of pollutants. The objectives of this proposed research are: (1) to identify the optimal temperature and oxygen regimes for the culture of *M. macrocopa* and, (2) to determine the effects of temperature and oxygen on the sensitivity or response of *M. macrocopa* to reference chemical pollutants such as heavy metals, pesticides and hydrocarbons. (BL97035)

Incorporation of Biosorption to Enhance Photocatalytical Oxidation of Synthetic Dyes

✉ WONG Po Keung

☐ 1 November 1997

❖ CUHK Research Committee Funding

Dyeing and textile industries discharges large quantity of dye-containing effluent into the sewage treatment plants or directly into aquatic environment. There are numerous reports indicate that synthetic dyes such as azo dyes are toxic and even mutagenic to living organisms in sewage treatment plants and the contaminated aquatic environments. The toxicity of synthetic dyes to the living organisms, mainly microorganisms, reduce the treatment efficiency of sewage treatment plants and result in producing poor quality effluent discharged into nearby aquatic environments. Some of these toxic dyes are synthetic and are difficult to be degraded biologically and chemically in the natural environment. The recalcitrant and toxic properties of the synthetic dyes make them to be very hazardous to our environment even only low concentration discharged from dyeing and textile industries. And the synthetic dyes in industrial effluents have to be reduced before discharge into sewage treatment plants or directly aquatic environment.

There are a number of physical and chemical methods to remove or treat synthetic dyes from industrial effluent. Physical methods such as membrane filtration and electrolysis, and chemical methods such as precipitation and oxidation are commonly used to reduce the concentration of synthetic dyes in industrial effluent. However, these physicochemical methods are suffer from one or more of the following problems: expensive or toxic materials used, energy intensive, not effective at low dye concentration, or generating solid waste. On the other hand, many studies on the application of biological methods such as biosorption and biodegradation to remove or treat dye-containing effluents have been initiated. The production solid waste renders the use biosorption to remove synthetic dyes by adsorption on biomass. Biodegradation can complete detoxify the synthetic dyes but required a relatively long time. (BL97036)

Enhancement of Metal Bioremediation by Rhizospheric Plant and Microbial Components

✉ WONG Po Keung • OW David*

☐ 1 March 1998

❖ CUHK Mainline Research Scheme

Metal pollution is one of the major problems in aquatic and terrestrial environments. Many studies indicate that biological methods are superior than physical and chemical methods to remove metals from contaminated environment. Biosorption by microorganisms has been the major focus in metal bioremediations. Recently, phytoremediation of metal (i.e. using metal hyperaccumulator plants to remove metal) from soil has been rapidly developed. The use of metal hyperaccumulator plant to remove metal from soil is superior than using microorganisms since

the collecting minute size metal-laden microbial cells from treated soil is extremely difficult. Studies indicate that microorganisms are more appropriate to be used in removal of metals from aquatic environment since the metal-laden microbial cells can be separated by filtration or centrifugation. Some studies apply immobilized microbial cells for the ease of collecting metal-laden microbial cells. In the proposed study, the feasibility of using metal hyperaccumulating aquatic plant(s) with the aid of its rhizospheric microorganism(s) to remove metal from aquatic environment will be studied. The advantages of using this microbe-plant system to remove metal from aquatic environment is the separation of metal-laden microbe-plant biomass requires less capital, labor and energy than using microorganism(s) alone. The objectives of the proposed study include: selection of metal hyperaccumulating aquatic plant(s), determine the roles of rhizospheric microorganisms in the phytoremediation of metal by aquatic plant(s) and the feasibility to enhance metal removal ability of aquatic plant(s) by introducing selected rhizospheric microorganisms.
(BL97014)

An Evaluation of the Nutritional Value and Potential Food Use of Some Underutilized Asiatic Pulses

- ✉ WONG Yum Shing • CHEUNG Chi Keung
 ☐ 1 October 1997
 ❖ CUHK Research Committee Funding

Legumes are next to cereals in terms of their economic and nutritional importance as human food resources. They are important sources of dietary protein and carbohydrate. The ability of legumes to fix atmospheric nitrogen in the soil-crop ecosystem is one of their unique and beneficial characteristics among all plant species. While, oilseed legumes such as soybean and peanuts are also valued for their oil content, legume pulses which have very little oil content are excellent sources of fibre, vitamins (B group), and minerals. Pulses are also known for their health-promoting effects as well as their physiological and nutritional qualities. Besides being consumed directly by humans as food, pulses are important potential raw materials for the production of food ingredients such as starch, protein isolate, pigments and fibre supplement in the processed food industry. However, among legumes, pulses lag behind oilseeds in both production and consumption. This is particularly the case in a lot of Asiatic pulses. This phenomenon could be partly due to the lack of the scientific and nutritional information of the pulses themselves which leads to their underutilization. A comprehensive evaluation of the chemical and biological nutritional values such as nutrient contents and their bioavailability, functional properties of the chemical constituents, and beneficial physiological

effects of the underutilized pulses is necessary to provide the significant information to justify and promote programmes which advocate increased production and consumption of pulses.
(BL97037)

Evaluation of Novel Microencapsulated Formulations for the Improved Survival and Development of Cultured Marine Fish Larvae

- ✉ WOO Norman Ying Shiu • COLLINS Peter M.*
 ☐ 1 November 1997
 ❖ Research Grants Council

High larval mortality has always been a "bottleneck" in the development of marine larval fish culture. Conventional larval rearing techniques mimic the natural food chain of fish larvae by providing a succession of live zooplankters as food items but this approach has met with only limited success. The chief disadvantages of feeding live zooplankters are (1) their limited spatial and temporal availability, (2) size limitations, (3) deficiency in several major dietary requirements including unsaturated fatty acids which form the bulk of cell membranes. The present research aims to develop artificial plankton in the form of microencapsulated diets as the main food item for rearing sea bream larvae. Microcapsules have the following advantages: (1) they can be made in to the correct critical size for various stages of larvae, (2) their composition can be manipulated to suit changing dietary requirements, (3) additives such as hormones, enzymes and other growth promoters can be incorporated. The aims of the present proposal are: (1) to evaluate the effectiveness of novel alginate microencapsulated diets over the traditional methods for culturing sea bream larvae, (2) to evaluate the effectiveness of cortisol and triiodothyronine in promoting larval survival and growth, (3) to study in detail the ontogenesis of various organs and body systems in developing sea bream larvae, (4) to establish whether a combination of salinity dilutions and proper diet will enhance larval survival and growth. Knowledge thus gained would provide a sound basis for the development of improved larval rearing technology.
(CU97302)

A Pioneering Study on Gene Regulation During Larval Development of the Sea Bream, *Sparus Sarba*

- ✉ WOO Norman Ying Shiu • DEANE Eddie
 ☐ 1 December 1997
 ❖ CUHK Research Committee Funding

Marine fish larvae hatch at a very under-developed state and thus high larval mortality is not uncommon. Marine fish larval development is accompanied by

dramatic morphological, physiological and biochemical changes. During these ontogenetic processes, many genes are differentially expressed (and then repressed) at strategic time intervals so as to produce an overall concerted developmental process. Despite the apparent understanding of the morphological and physiological processes, relatively little is known about the molecular mechanisms of development. The researcher therefore propose to launch a pioneering study on the differential gene expression of the sea bream (*Sparus sarba*) larva as it develops from hatching to metamorphosis. The proposed study will include the use of the powerful molecular techniques of differential display and RNA arbitrary primed PCR. It is envisaged that certain differentially expressed genes will be identified which will shed light on the underlying morphological and physiological changes. These results can be applied to implement ways to improve larval survival in practical fish culture. (BL97038)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition Title/Investigators

1995-96 Phenology of the Red Algae *Hypnea charoides* and *H. japonica* in Ping Chau Island, New Territory and an Experimental Verification of Their Taxonomic Identity (BL95025)
✉ ANG Put Jr.

1996-97 Dynamics of the Brown Alga *Sargassum* Populations in Ping Chau Island, New Territory and an Assessment of Variations in Their Morphological Characteristics (CU96316)
✉ ANG Put Jr.

1996-97 Reproductive Ecology of the Green Alga *Ulva* Spp. in Tolo Harbour and Channel, New Territories, Hong Kong (BL96009)
✉ ANG Put Jr.

1990-91 *Elucidation of Biochemical Events Regulating Secondary Metabolism in the Ligninolytic Fungus Phanerochaete chrysosporium* (BP91015)
✉ BUSWELL John Anthony

1991-92 Enzymic Evaluation of Starch Availability in Foodstuffs (BP92007)
✉ BUSWELL John Anthony

1993-94 Establishment of an International Network of Institutions in Developing Countries and Centres for Research,

Development and Training to Advance Mushroom and Bioconversion Technologies (BP94011)
✉ BUSWELL John Anthony

1995-96 Production and Secretion of Cellulolytic Enzymes by the Edible Mushroom, *Volvariella Volvacea*, and Their Significance to the Utilization of Lignocellulosic Substrates and Mushroom Growth Yields (CU95328)
✉ BUSWELL John Anthony • PEBERDY John Frederick*

1996-97 Evaluation and Characterisation of the Anti-oxidant Potential of Edible Mushrooms and Mushroom Products for Use in Dietary Repression of Cellular Sensitivity to Ionizing Radiation and to Oxidative DNA Damage (BL96022)
✉ BUSWELL John Anthony • STRAIN J. J.*

1995-96 A Floristic Study on the Biodiversity of Bryophytes in Hong Kong (CU94302)
✉ BUT Paul Pui Hay

1995-96 Laboratory for Quality Control of Chinese Medicines and Health Foods Based on Chemical Components (MD95056)
✉ BUT Paul Pui Hay • LAU Oi Wah (Chemistry) • CHAN Tak Wah Dominic (Chemistry)

1996-97 Research and Development of a Standard Set of Medical Subject Headings for Indexing and Searching Information in Database of Traditional Chinese Medicine Literature (CS96020)
✉ BUT Paul Pui Hay • KAN Wing Kay (Computer Science & Engineering) • CHEN C. F.* • HSIEH Richard* • SIU Yuk Tai (Chinese Medicinal Material Research Centre)

1996-97 Chemical Composition and Nutritional Evaluation of Hong Kong Seaweeds (BL96010)
✉ CHEUNG Chi Keung

1995-96 *A Molecular Analysis on the Ecological Impact of an Introduced Isolate on the Natural Population of Armillaria* (BL95011)
✉ CHIU Siu Wai • ANDERSON James B.*

- 1996-97 Dissecting the Carbon Metabolism in Fruiting of Oyster Mushroom (BL96011)
✉ CHIU Siu Wai
- 1996-97 Evolutionary and Population Genetics and Penaeid Shrimps in the Indo-West Pacific: Allozyme and Mitochondrial DNA Analyses (CU96327)
✉ CHU Ka Hou
- 1995-96 Reclamation of Fly Ash Lagoons: An Ecological and Microbiological Approach (CU94304)
✉ CHU Lee Man • CHAN Wing Kuen*
- 1996-97 Ecological Studies of Completed Landfills for Enhancing Natural Succession on the Man-made Habitats (CU96324)
✉ CHU Lee Man • WONG M. H.*
- 1996-97 Potent Odorants in Fermented Soybean Curds (BL96012)
✉ CHUNG Hau Yin
- 1995-96 Molecular Cloning and Expression of the Helminth Excretory/Secretory Antigen (and Interleukin-5 Like Molecule) (CU95326)
✉ FUNG Ming Chiu • MAK Nai Ki*
- 1996-97 Molecular Cloning of the Chitinase Gene from a Local Fungal Strain (BL96014)
✉ FUNG Ming Chiu
- 1996-97 *Activin Regulation of Pituitary Gonadotropin Gene Expression and Oocyte Development in the Goldfish, Carassius auratus* (CU96308)
✉ GE Wei
- 1996-97 Molecular Cloning of Activin β A Subunit in the Goldfish, *Carassius auratus* (BL96020)
✉ GE Wei
- 1995-96 Molecular Cloning and Time Course Studies of Genes Specially Expressed During Fruit Body Development in Shiitake Mushroom *Lentinula Edodes* (CU95314)
✉ KWAN Hoi Shan
- 1996-97 *Molecular Analysis of Anaerobic Ribonucleotide Reductase, nrdD, in Salmonella Typhimurium* (BL96023)
✉ KWAN Hoi Shan
- 1996-97 Development of a Species Genetic Linkage Map of the Shiitake Mushroom *Lentinula edodes* with Sequence-tagged-site, Expressed-sequence-tag, and Gene Markers (CU96310)
✉ KWAN Hoi Shan
- 1995-96 Studies on Cardiovascular, Hepatoprotective and Cytokine Potentiating Activities of the Cultured Mycelial Products of Selected Mushroom Species (CU94325)
✉ OOI Vincent E. C. • CHIU Kam Wai# • FUNG Ming Chiu • CHANG Shu Ting
- 1996-97 Studies on the Antiviral Properties of Bioactive Polysaccharides and Proteins Isolated from Mushrooms (CU96330)
✉ OOI Vincent E. C. • NG Tzi Bun (Biochemistry) • YAO Qi-Zhi* • CHANG Shu Ting
- 1996-97 Characterization of Hypotensive Substances from Selected Medicinal Herbs (BL96015)
✉ OOI Vincent E. C.
- 1996-97 Genetic Engineering of Rapeseed for Enhanced Nutritional Quality (CU96301)
✉ SUN Sai Ming Samuel
- 1996-97 Development of a Plant Bioreactor for the Production of High Value Proteins (BL96016)
✉ SUN Sai Ming Samuel
- 1995-96 Study of Magnetite-immobilised Bacterial-cell System for Removal and Recovery of Metals from Electroplating Effluent (CU95309)
✉ WONG Po Keung • CHUA Hong*
- 1995-96 Integration of Biosorption and Biodegradation for the Treatment of Synthetic Dyes in Industrial Wastewater (BL95034)
✉ WONG Po Keung
- 1995-96 Characterization of Polycyclic Aromatic Hydrocarbons in Waste Engine Oil (BL95037)
✉ WONG Po Keung • JIA Chongrong (Centre for Environmental Studies)#
- 1995-96 Characterization of Organic Lead in Air (BL95038)
✉ WONG Po Keung • WANG Yonghua (Centre for Environmental Studies)#

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| 1996-97 | Ecotoxicology of Organic Metals in Waste Engine Oil (BL96017)
✍ WONG Po Keung | 1989-90 | Induced Spawning and Larval Rearing of Marine Fish (BP89042)
✍ WOO Norman Ying Shiu |
| 1995-96 | A Study of the Nutritional Quality and Potential Food Use of Some Underutilized Legumes (BL95043)
✍ WONG Yum Shing | 1990-91 | The Rearing of Marine Fish Larvae (BP89060)
✍ WOO Norman Ying Shiu |
| 1996-97 | A Study of <i>Vigna Unguiculata</i> Pigment as Natural Food Color (BL96018)
✍ WONG Yum Shing | 1995-96 | An Iso-osmotic Marine Fish Factory (CU95303)
✍ WOO Norman Ying Shiu |
| 1989-90 | Environmental Physiology of Marine Teleosts (BP77001)
✍ WOO Norman Ying Shiu | 1996-97 | Cloning and Tissue Specific Expression Studies of the Genes Encoding the Na ⁺ -K ⁺ -ATPase α and β Subunits in the Sea Bream, <i>Sparus Sarba</i> (BL96019)
✍ WOO Norman Ying Shiu |
| 1989-90 | General Biology and Culture of Pomacanthids (BP88021)
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RESEARCH PROJECTS

Asymmetric Catalysis via Chiral Pyridyl Phenols

- ✍ CHAN Kin Shing
 ☐ 1 March 1998
 ❖ CUHK Research Committee Funding

Molecular chirality is a principal element in nature and plays an important role in the context of biological activity. A wide range of biological and physical functions that result from precise molecular recognition involve strict matching of chirality. Therefore designed synthesis of chiral molecules in a predictable and controllable manner is very important in academics and industry for both the basic understandings and applications of these chiral recognition processes.

Catalytic stereospecific synthesis of optically pure compounds offers a unique and efficient feature of chiral multiplication. Under the right condition, thousands of chiral product molecules can be produced by one molecule of catalyst.

Chiral pyridyl phenols will be synthesized and utilized as chiral ligands and catalysts to explore highly efficient catalytic asymmetric carbon-carbon bond forming reactions of (1) dialkylzinc additions into aldehydes and (2) Lewis acid catalyzed aldol type reactions. The optimization of the efficiency of this process by steric, electronic and chelation fine-tuning of catalysts as well as the understanding of the mechanistic perspectives of the chiral induction will be investigated.

(PS97019)

Chiral Recognition in Mass Spectrometry

- ✍ CHAN Tak Wah Dominic
 ☐ 1 September 1996
 ❖ Research Grants Council

The objectives of the proposed project are to apply the increasingly-popular technique of tandem mass spectrometry to the studies of collision-induced dissociation of diastereomeric ions which are formed in situ from chiral compounds and a chiral reagent, to explore and develop sensitive non-chromatographic methods of chiral recognition based on any diastereospecific fragmentation observed, to investigate in detail the mechanistic basis and ion chemistry of such fragmentation, and to extend the developed technique to the chirality determination of trace components in biological specimens.

(CU95598)

Optically Active, Axially Chiral, Bi-naphthol-based Conjugated Oligomers: Synthesis, Characterization, Properties and Applications

- ✍ CHOW Hak Fun
 ☐ 1 September 1997
 ❖ Research Grants Council

Conjugated organic oligomers and polymers are useful materials for electronic, electroluminescence and non-linear optical applications. Optically active oligomers and polymers, on the other hand, can be used to prepare ferroelectric liquid crystals, and chiral polymeric catalysts for asymmetric synthesis. This proposal plans to investigate the chiral, conjugated and catalytic properties of a series of optically active conjugated oligomers. The chiral element used in the synthesis of these oligomers is an axially chiral, optically active binaphthol unit. The chiroptical and conductive properties of these oligomers will be investigated. The use of these optically active binaphthol oligomers in asymmetric synthesis will also be investigated.

(CU97726)

Interaction of Low Energy Ions and III-V Semiconductors

- ✍ KWOK Wai Man Raymond • BELLO Igor* • LAU Woon Ming (Physics)
 ☐ 1 August 1997
 ❖ Research Grants Council

In the project, a unique mass-separated low energy ion beam facility which delivers to a surface a pure chemical species with a precise kinetic energy will be coupled to a multi-techniques surface analytical instrumentation to solve two frontier research problems in the field of III-V semiconductors. The first problem concerns the passivation of undesirable defects on III-V semiconductor surfaces, one of the bottle-necks in the current device development. The low energy ion beam facility will be used to deliver a known sulfide/polysulfide species at a time with a precise dosage and energy to a semiconductor surface, and the analytical techniques will be used to examine systematically the reaction mechanisms. The second problem concerns the residual damage left by reactive ion etching which is now the preferred dry etching technique in microelectronics. In this technique, ion bombardment provides the desirable anisotropy but imposes undesirable defect formation. To understand and minimize the problem, the new facility will be used to examine the defect formation and associated surface reactions as a function of ion species, energy and dosage.

(CU97705)

Functional Models of Catechol 2,3-Dioxygenase

- ✍ LEE Hung Kay
 ☐ 1 January 1998
 ❖ CUHK Research Committee Funding

Two families of catechol dioxygenases, namely, *intradiol* and *extradiol* dioxygenases, have been isolated from many soil bacteria. They catalyze the oxidative cleavage of catechol to muconic acid or muconic semialdehyde. These non-heme enzymes play a vital role in the degradation of aromatic compounds in the biosphere. The iron(II)-containing intradiol-cleaving enzymes have received extensive studies in the past decade, whilst little is known about the iron(III)-containing extradiol enzymes owing to the limited spectroscopic information for the high-spin iron(II) centers ($S = 2$) in the latter enzymes.

The objective of the proposed research work is to develop functional models of extradiol dioxygenases and study their reactivities toward dioxygen by employing various spectroscopic techniques such as EPR, NMR, and UV-Vis. In addition to iron(II)-, manganese(II)-catecholate complexes are to be synthesized as mimics to the active metal centers of the recently reported manganese(II)-dependent extradiol dioxygenases. A substrate activation mechanism for catalysis is to be proposed for the extradiol dioxygenases.

(PS97007)

Synthesis of Metal Complexes Containing Optically Active N-functionalised Alkyl Phosphines

✉ LEUNG Wing Por Kevin

☐ 1 July 1997

❖ CUHK Research Committee Funding

This project involves in the synthesis of novel phosphine compound containing a chiral substituent group and an N-functionalised group. The work will anticipate to resolve the racemic forms of the phosphine compound prepared. The N, P-chelate type optically active phosphine compounds synthesised will be used for the preparation of some rhodium and palladium complexes. The stereoselective catalytic activity of these metal-phosphine complexes in hydrogenation of olefinic bonds will be explored.

(PS97002)

First Principle Molecular Dynamics Study on the Reaction Mechanisms of Thermal Dissociation for Molecules and Energetic Materials

✉ LIU Zhifeng • TSE John S.*

☐ 1 August 1997

❖ Research Grants Council

The researchers propose to study the mechanism of unimolecular dissociation at high temperature by computer simulation, using First Principle Molecular Dynamics (MD) method. First Principle MD can simulate molecules in real time and at finite

temperature, by calculating the total energy and its derivatives within the framework of Density Functional Theory (DFT) and integrating the atomic motion by Newtonian mechanics. It offers great potential to probe the dynamics of chemical reactions. They plan to implement conjugate gradient optimization for the calculation of total electronic energy within DFT, using plane wave basis sets and Vanderbilt ultrasoft pseudopotential. The method is essential for the high temperature (2000-4500K) simulation of the dissociation of organic molecules, containing H, C and O atoms. The researchers plan to study three sets of systems. In the first one, they plan to simulate the dissociation of carbonium ions CH_5^+ and C_2H_7^+ , which are important reaction intermediates with considerable internal scrambling, to understand the correlation between such scrambling and their dissociation and to test the conjugate gradient method. In the second set, they will attempt to understand the mechanism of the coupling among various vibrational modes at high temperature and the detailed dissociation mechanisms for acetic acid (CH_3COOH). The final set is on RDX, hexahydro-1,3,5-trinitro-s-triazine, which has important applications as explosives and rocket propellants. By simulating its dissociation upon heating in solid phase, they hope to understand the molecular mechanisms underlying its explosion.

(CU97711)

Synthesis and Structural Studies of New Betaine Ligands and Their Metal Complexes

✉ MAK Thomas Chung Wai

☐ 1 August 1997

❖ Research Grants Council

Betaines are zwitterionic compounds each having a carboxylate group and a quaternary ammonium group. Recent studies in our laboratory have shown that the prototype betaine, $\text{Me}_3\text{NCH}_2\text{CO}_2$, and its derivatives provide ready synthetic access to (1) coordination compounds with varied metal-carboxylate molar ratios, (2) stable and soluble heavy-metal carboxylates, and (3) complexes with the metal center bearing additional anionic ligands. Spectroscopic and X-ray analysis of these complexes have greatly expanded the structural database of carboxylate complexes and revealed several new structural varieties.

A double betaine contains two betaine moieties in the same molecule, and accordingly exhibits a dicarboxylate-like character in its chemical behavior. The proposed research sets its goal at:

- (1) the synthesis of complexes of double betaines and related ligands with both main group and transition metals, and
- (2) structural characterization, mainly via X-ray crystallography, of these compounds in order to

establish the coordination modes and novel bonding features.

Particular attention will be paid to the synthesis and structural characterization of binuclear and polynuclear complexes, as well as coordination polymeric networks, that are consolidated by polyfunctional betaines and co-existing bridging anions such as the common monocarboxylates, azide, and nitrate.
(CU97702)

Structural Studies on Silver Acetylide and Its Double Salts

✉ MAK Thomas Chung Wai

☐ 1 October 1997

❖ CUHK Research Committee Funding

Silver acetylide (also known as silver carbide) was first reported by Berthlot in 1866, and since then its structure and properties have been investigated by various workers. The chemical properties of silver acetylide are far different from those of ionic carbide compounds such as CaC_2 , Na_2C_2 etc. Not only is it high explosive when dry, but also it does not react with water. Up to now the linear structure of silver acetylide was inferred from its properties, which are consistent with that of a molecular compound. There is as yet no X-ray crystal structure information because of the low solubility of silver acetylide in solvents. Several double salts of silver acetylide with other silver compounds are known, but only $\text{Ag}_2\text{C}_2 \cdot 6\text{AgNO}_3$, which contains a cage-like cationic $[\text{Ag}_8\text{C}_2]^{6+}$ moiety, was structurally characterized. Recently, the researcher found another fully encapsulated coordination mode of the C_2^{2-} entity in the novel compound $\text{Ag}_2\text{C}_2 \cdot 8\text{AgF}$. In the present project, he plans to synthesize a range of *stable* double salts of silver acetylide with other silver compounds and determine their crystal structures, so as to shed some light on the nature bonding between the dicarbide and silver(I) ions.
(PS97009)

Synthetic Studies of 2,3-Anthracocyanines and 2,3-Tetracocyanines

✉ NG Kee Pui Dennis

☐ 1 January 1998

❖ CUHK Research Committee Funding

2,3-Anthracocyanines and 2,3-tetracocyanines are phthalocyanine's analogs with linear annelation of benzene rings onto the macrocycle. According to recent theoretical studies, these compounds, having delocalized π electrons, absorb strongly in the near-infrared region and exhibit superior electrical properties relative to those of phthalocyanines. These chromophores are thus prospective materials for

electronic and optical devices such as semiconductors, electrochromic displays, optical storage media, and optical limiters. To date, only a few examples of these classes of compounds have been reported and most of them are ill-characterized. Literature data on physical properties of these compounds are extremely limited. A substantial barrier to the development of their chemistry is the shortage of convenient synthetic routes to the precursors 2,3-dicyanoanthracenes and 2,3-dicyanotetracenes. This proposal seeks to secure funds to explore the chemistry of these novel materials. The proposed work includes the development of general synthetic pathways to substituted 2,3-dicyanoanthracenes and 2,3-dicyanotetracenes, the conversion of these dinitriles to metal-free and zinc(II) 2,3-anthracocyanines and 2,3-tetracocyanines, and the investigation of their aggregation behavior and spectroscopic and electrochemical properties.
(PS97008)

Enantiospecific Total Syntheses of Anticancer Agents Simalikalactone D and Quassamarin

✉ SHING Kung Ming Tony

☐ 1 September 1997

❖ Research Grants Council

Simalikalactone D and quassamarin have attracted the attention of synthetic and medicinal chemists for about 20 years because of the formidable challenge in the fabrication of their highly oxygenated pentacyclic carbon framework and of their selective antitumour properties. Chemical preparation (synthesis) of the material may present an easier or a more economical procedure than isolation from plant, but most importantly, synthesis will yield structurally related compounds for biological testing which is essential to continuing progress in cancer chemotherapy. In summary, the successful research results are (1) important for the advancement of the science of synthetic organic chemistry, (2) useful for the pharmaceutical industry which may employ the synthetic methods for the preparation of chemicals of pharmaceutical interest and (3) contribution to the antitumour drug discovery efforts.
(CU97708)

The Use of Chiral Furanboronates in Organic Synthesis

✉ WONG Nai Ching Henry

☐ 1 August 1997

❖ Research Grants Council

Furan skeletons play an eminent role in heterocyclic chemistry. They are found in many chiral naturally occurring molecules and enjoy broad employment in a variety of commercially influential products such as

pharmaceuticals and fragrance compounds. Moreover, they are versatile synthetic intermediates, serving as diene components in the Diels-Alder reaction, and as latent, 1,4-diketones and butenolides. In view of such importance, efficient syntheses of furan with a homochiral substituent continue to be of considerable significance. Upon quenching of the resulting dichlorofuranylborane with chiral diols, the silicon-boron protocol recently developed in our laboratory can be expanded to the preparation of substituted furanoid compounds in diastereomeric forms which are chromatographically separable. Subsequently, standard palladium-catalyzed cross coupling reactions such as Suzuki reaction will be employed to convert these diastereomerically pure furanboronates into enantiomerically pure furanoid compounds, ready for use as chiral intermediates in organic syntheses. This proposal concerns the research on: (1) furan-substituted alcohols as chiral building blocks, (2) chiral precursors for furanoguaianoid sesquiterpenes synthesis, and (3) chiral furanboronates for asymmetric Diels-Alder reaction. (CU97701)

Total Synthesis of Plakortones A and B

- ✉ WONG Nai Ching Henry
□ 1 November 1997
❖ CUHK Research Committee Funding

The Plakortones were isolated recently from the EtOAc extract of sponge *Plakortia halichondrioides*. Plakortones A (1) and B (2) belong to a new class of activators of cardiac SR-Ca²⁺-pumping ATPase at μ M concentrations.

In the continuation of the researcher's interest in the synthesis of naturally occurring molecules using furans as precursors, he would like to propose the synthesis of compounds 1 and 2. It is hoped that by synthesizing various C-10 stereomers of 1 and 2, the absolute structures of these compounds can be substantiated. (PS97010)

Flow Field-flow Fractionation Studies of Biodegradable Polymers

- ✉ WU Chi • KULICKE W. -M.*
□ 10 August 1997
❖ Germany/Hong Kong Joint Research Scheme

The problem of disposing plastic wasters has become global. This is why biodegradable polymers have recently attracted much attention. Moreover, biodegradable polymers are also useful in medical applications. The researchers propose to use a combination of light-scattering and flow field-flow fractionation (FFF) to study the rate and the

mechanism of biodegradation of commonly used synthetic polymers under different bio/chemical environments and conditions. (PS97001)

Laser Light-Scattering Studies on Biodegradable Polymers

- ✉ WU Chi
□ 1 January 1998
❖ Research Grants Council

Synthetic polymers have totally changed human life. It is not exaggerated to say that nowadays we see or touch synthetic polymers from the first second we come to this world to the last moment of our life. Not only in all industrialized countries, but also in China, a developing country, more than one million metric tons of disposable plastic materials are produced each year. The disposal problem has become global because most synthetic polymers cannot be decomposed under natural conditions. Burning the wastes releases toxic gases and burying them occupies land which is particularly treasured in Hong Kong. This is why biodegradable polymers have recently attracted much attention. Moreover, biodegradable polymers are also useful in medical applications, such as materials for implant and controlled drug release. There are two interconnected research aspects to this proposal: one is to synthesize biodegradable polymers; and the other is to study the biodegradation process. The researchers propose to combine a number of modern *in situ* optical methods, such as laser light scattering, Fraunhofer diffraction and interferometry, to study the rate and the mechanism of bio-degradation of three commonly used synthetic polymers, namely poly(vinyl alcohol), poly(ϵ -caprolactone), poly(ethylene oxide) and their segmented copolymers, under a variety of bio-/chemical environments. They also intend to develop a fast and accurate optical method to evaluate the biodegradability of a given polymer. The success of this proposed research project will provide a basis for future development of better environmentally friendly bio-medical materials. (CU97704)

Novel Fast Response Polymers and their Biomedical Applications

- ✉ WU Chi • LEUNG Ping Chung (Orthopaedics & Traumatology)
□ 1 April 1998
❖ Industrial Support Fund, Industry & Technology Development Council

Gels are one kind of synthetic or natural materials which consist of a three-dimensional macromolecular networks swollen by a large amount of water, e.g.,

jelly and Tofu in our daily life. The study of gels, especially the so-called "smart gels" which can response to stimuli, such as temperature, pH and ionic strength, have attracted much attention. A lot of effort has been spent on the development of their novel applications. However, the success is very limited, only one product in the market so far has been produced for shoe industry because of their low strength and their low response speed.

Recently, the researchers accidentally found that a novel way to make a thermal sensitive polymer gel shrinking more than 1000 times fast at 37°C, and at the same time make the gel stronger. Both preliminary *in-vitro* and *in-vivo* experimental results showed several very promising applications in biomedicine, such as in surgery and controlled drug releasing. They intend to develop this kind of novel gels into some real products used in surgery. (BL97009)

Lanthanacarborane Complexes: Synthesis, Structure and Reactivity

✉ XIE Zuwei

☐ 1 September 1997

❖ Research Grants Council

The chemistry of lanthanacarborane complexes, especially those with dicarbollide dianion ($C_2B_9H_{11}^{2-}$) has just begun to be explored. Dicarbollide ion and its derivatives possess an open pentagonal face and can act as a six π -electron donor isoelectronic with the cyclopentadienyl. This bonding face, however, is substantially larger than that of cyclopentadienyl, and has a higher formal negative charge. Both these features could make this area of chemistry very rich, exciting and interesting. In fact, $C_2B_9H_{11}^{2-}$ has shown to have an extensive coordination chemistry with d-block transition metal ions analogous to metallocenes of cyclopentadienide. It is remarkable, however, only four lanthanide dicarbollide compounds are known to date. In this proposal, a series of new chiral and achiral dicarbollide derivatives is proposed. With these new ligands, a large number of new lanthanacarborane chloro, hydrocarbyl, amido, alkoxyl, hydride complexes would be synthesized. Some of them may be good chiral catalysts for olefin transformations. It can be speculated that substituents on the dicarbollide cage may control the chemical and physical properties of the complexes by changing their stability and solubility via intramolecular coordination bonds or α -agostic interactions. It would help us to understand the structure/reactivity relationships within this series via this research. The plan to explore and develop this new chemistry of dicarbollide dianion with lanthanide elements is presented in this proposal. (CU97706)

Development of New Methods for the Direct Determination of Heavy Metals in Atmospheric Particulate Matter by Graphite Furnace Atomic Absorption Spectrometry

✉ YU Chai Mei

☐ 1 September 1997

❖ Research Grants Council

The most common procedure for the determination of heavy metals in air is to collect the particulates onto a filter, digest the filter with an acidic solution, and then analyse the solution for its metal contents. This standard approach is often time-consuming, and is prone to sample loss and contamination during preparation. The proposed methods avoid the tedious and problematic acid digestion steps by introducing the air particulates directly into the graphite furnace of an atomic absorption spectrometer. The first method collects particulates on a small graphite plate filter, which is then inserted into a graphite tube forming a platform for atomisation. In the second method, particulates are first collected on a porous-membrane filter, and then dislodged and suspended in decanol to form a slurry mixture which is injected into the graphite furnace for analysis. The effectiveness of these new methods will be studied. (CU97710)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

<u>Edition</u>	<u>Title/Investigators</u>
1995-96	Construction of Cobalt (III) Porphyrin Based Coordination Polymers and Its Application to the Synthesis of the Dimensional Organic Conductors (CU95726) ✉ AU-YEUNG Chik Fun Steve
1994-95	Asymmetric Catalysis by Metal Complexes of Chiral Pyridyl Phenols and Their Derivatives (PS94010) ✉ CHAN Kin Shing
1995-96	Synthesis and Properties of Non-bridged Rhodium[II] and Iridium[II] Metal Dimers (BP94001) ✉ CHAN Kin Shing
1995-96	Determination of Transition-Silyl Bond Dissociation Energies (CU94707) ✉ CHAN Kin Shing
1996-97	Mechanistic Studies of 1,2-Rearrangement of Alkyl Rhodium Porphyrins (CU96702) ✉ CHAN Kin Shing

- 1996-97 Oxidation Catalyzed Ruthenium Porphyrins (PS96005)
✍ CHAN Kin Shing
- 1996-97 Asymmetric Metal-Catalysed Polymerisation (PS96003)
✍ CHAN Kin Shing • HOLMES Andrew B.*
- 1995-96 Studies of Chemical Dynamics of Ultraviolet Laser-induced Desorption/Ionization of Oligonucleotides (CU95727)
✍ CHAN Tak Wah Dominic
- 1996-97 Development of New Methods to Perform Matrix-assisted Laser Desorption/Ionization (MALDI) Experiments in Fourier-Transform Ion-Cyclotron-Resonance Mass Spectrometer (CU96727)
✍ CHAN Tak Wah Dominic
- 1996-97 Sequence Analysis of Natural and Modified Oligonucleotides using Ultra-high Resolution Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (PS96004)
✍ CHAN Tak Wah Dominic • DERRICK Peter J.*
- 1995-96 Expanding the Uses of A New Version of the Ramberg-Backlund Reaction in Organic Synthesis (CU93714)
✍ CHAN Tze Lock
- 1996-97 Further Exploration of a Recently Developed One-flask Ramberg-Backlund Reaction (CU96712)
✍ CHAN Tze Lock
- 1995-96 Catalytic Dendrimers - Artificial Enzyme Mimics (CU95723)
✍ CHOW Hak Fun
- 1996-97 Synthesis and Properties of Novel Metallodendrimers: Controlling the Redox Behaviour of Metal Complexes by Dendritic Modification (CU96710)
✍ CHOW Hak Fun
- 1996-97 Synthesis of Extremely Large Macrocycles by Transition Metal Catalyzed Metathesis (PS96006)
✍ CHOW Hak Fun
- 1989-90 Study of Oxygen Chemisorption on Zr(0001) by LEED (BP89043)
✍ HUI Ka Chung
- 1996-97 Studies of Ultrathin SiO₂/Si Using Surface Charge Spectroscopy (PS96007)
✍ KWOK Wai Man Raymund
- 1995-96 Assessment of the Quality and Curative Effects of Epimedium Species by Chemical Pattern Recognition Techniques (PS95019)
✍ LAU Oi Wah • YEUNG Hin Wing (Biochemistry)[#] • NG Tzi Bun (Biochemistry)
- 1990-91 Synthesis of Novel Transition-Metal Alkyls (BP90039)
✍ LEUNG Wing Por Kevin
- 1990-91 Synthesis of Organometallic Compounds of Alkali Metals (BP90040)
✍ LEUNG Wing Por Kevin
- 1995-96 Synthesis and Reactivities of N-Functionalised and Sterically Hindered Metal Alkyl Complexes (CU94717)
✍ LEUNG Wing Por Kevin • MAK Thomas Chung Wai
- 1996-97 Synthesis and Application of Organotransition Metal and -Lanthanide Compounds in Olefin Polymerisation and Asymmetric Catalysis (CU96720)
✍ LEUNG Wing Por Kevin
- 1995-96 *Ab initio* and Semi-empirical Studies of Novel Molecular Species (PS95034)
✍ LI Wai Kee • SO Suk Ping
- 1989-90 X-Ray Analysis of Crystal Structures (BP72001)
✍ MAK Thomas Chung Wai
- 1989-90 Metal Coordination by Betaines (BP88025)
✍ MAK Thomas Chung Wai
- 1995-96 Synthesis, Structures and Properties of Binuclear and Polynuclear Complexes (CU94722)
✍ MAK Thomas Chung Wai • YOU Xiao Zeng* • KANG Bei Sheng*
- 1995-96 Studies in Host-guest Chemistry (CU95711)
✍ MAK Thomas Chung Wai • WONG Nai Ching Henry
- 1995-96 Exploratory Studies in Solid-state and Hydrothermal Synthesis (PS95036)
✍ MAK Thomas Chung Wai • KWOK Wai Man Raymund

- 1996-97 Synthesis and Characterization of Functional Rare Earth Complexes with Organic Ligands (CU96705)
✉ MAK Thomas Chung Wai • ZHANG Hong-jie* • NI Jia-zuan*
- 1995-96 High-valent Oxo- and Thio-tungsten Complexes - Models for the Active Sites of Tungsten-containing enzymes (CU95721)
✉ NG Kee Pui Dennis
- 1995-96 Studies on the Construction of O-heterocycles from Carbohydrates via Intramolecular Nitrene Cycloaddition (CU95712)
✉ SHING Kung Ming Tony
- 1996-97 Syntheses and Biological Evaluation of Pseudo-disaccharides as Potential Glycosidase Inhibitors (CU96711)
✉ SHING Kung Ming Tony
- 1996-97 Enantiospecific Synthesis of Antifertility Agent Zoapatanol (PS96008)
✉ SHING Kung Ming Tony
- 1989-90 Theoretical Studies of (a) Aluminium-Ethylene Complexes (b) CH_3SOH^+ (c) Ge Compounds (d) HPOH and HNOH (BP89048)
✉ SO Suk Ping
- 1989-90 Synthesis of Novel Aromatic Compounds (BP83001)
✉ WONG Nai Ching Henry
- 1995-96 3, 4-Bis(trimethylsilyl)- and 3, 4-Bis(trialkylstannyl)-furans, Pyrroles and Thiophenes: Versatile Building Blocks of 3, 4-Disubstituted Five-Membered Heterocycles (CU93701)
✉ WONG Nai Ching Henry
- 1995-96 Regiospecific Conversion of 3,4-Bis(trimethylsilyl) Furan to 2,3-Disubstituted, 2,4-Disubstituted, 2,3,4-Trisubstituted, and 2,3,5-Trisubstituted Furans (CU94701)
✉ WONG Nai Ching Henry
- 1995-96 Synthesis of Sesquiterpenoids Furanoedesmanes by Utilizing a 3, 4-Disubstituted Furan as a Pivotal Precursor (CU95704)
✉ WONG Nai Ching Henry
- 1995-96 The Adsorption of Polyelectrolytes on Nanoparticles (CU95707)
✉ WU Chi
- 1996-97 Development of a Portable Fiber Optical Particle Sizing Sensor for Local Industrial Applications and Environmental Protection (PS96002)
✉ WU Chi
- 1996-97 Light-Scattering Studies of Optically Active Sugar-Containing Polyacrylates (PS96009)
✉ WU Chi • SHING Kung Ming Tony
- 1996-97 Diffusion Inside Nanocavities of Polymer Gel Networks (CU96707)
✉ WU Chi • AU-YEUNG Chik Fun Steve • LIN Ge (Pharmacology) • HUNG Leung Kim (Orthopaedics & Traumatology)
- 1996-97 The Chemistry of Highly Electrophilic Cationic Organolanthanide Complexes (CU96708)
✉ XIE Zuwei
- 1996-97 Activation of Saturated Hydrocarbon C-H Bonds by Transition Metal Complexes (PS96022)
✉ XIE Zuwei
- 1996-97 Pilot Investigations of a Photocatalytic System for the Degradation of Indoor Volatile Organic Compounds (PS96010)
✉ YU Chai Mei

RESEARCH OUTPUTS AND PUBLICATIONS

- <P964063> **Lam, Sik-Lok and Steve C.F. Au-Yeung.** "The J-Coupling Restrained Molecular Mechanics (JrMM) Protocol - An Efficient Alternative for Deriving DNA Endocyclic Torsion Angle Constraints. Part II: Experimental Application of the JrMM Protocol". *Journal of Biomolecular Structure & Dynamics* vol.13 no.5, pp.815-825. USA, 1996.
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RESEARCH PROJECTS

Bifurcation of the Caustic of Off-Center Reflection

- ✉ AU Kwok Keung Thomas
- 2 January 1998
- ❖ CUHK Research Committee Funding

In [AL], the researcher proved that the caustic of a generic off-center reflection has at least four cusp points. It is also proved that the number of cusp points is exactly four when the reflection is a diffeomorphism of the circle. Based on some experimental findings, they conjectured that the first bifurcation of the caustic occur when the reflection becomes non-diffeomorphic and there may be subsequent bifurcations thereafter. This is also supported by the study of the mode-locking behavior of the maps in the same article.

It is commonly believed that there is a general theory which is also true for generic reflections on any convex curve, or even convex surface, [A2]. However, only particular cases of the theory have been established. The study is long term and it involves nontrivial theory of symplectic topology. At this stage, the researcher proposes to study typical examples such as the off-center reflection so that the situation of bifurcation will be more understood.

The study will be both mathematical and computational. Mathematically, deformation of the Lagrangian cylinder of the caustic will be investigated, [A1, AL]. Hopefully, variational methods may shine light on the bifurcation situation. they will also produce experimental results of caustics which requires a certain amount of graphical computation. Moreover, a generic caustic may run to infinity, it usually is better shown under stereographic projection and 3-D graphics are involved. (PS97023)

Fast Iterative Methods for Integral Equations

- ✉ CHAN Hon Fu Raymond
- 1 September 1997
- ❖ Research Grants Council

Integral equations arise in a variety of scientific, medical and engineering applications. Their solutions can be found by solving linear systems $Ax = b$, where the coefficient matrices A are usually dense and large. The preconditioned conjugate gradient method is proposed as the main tool in solving these systems. If A is Toeplitz, i.e. the integral equation is of convolution type, then the researchers' method with circulant-type preconditioners is known to be faster than any existing ones by at least an $O(\log n)$ factor, where n is the size of the matrix A . The purpose of this

research is to develop and implement fast iterative methods for integral equations that are not of convolution type and hence A has no special structure. Two approaches will be taken. For integral equations of the second kind, where the systems are well-conditioned, the researchers will develop and improve their new fast dense matrix technique to approximate the matrices better so as to obtain faster and more accurate multiplication schemes. For ill-conditioned first kind integral equations, they will focus on constructing good preconditioners to make the preconditioned systems well-conditioned. Parallel version of their methods will be implemented on existing parallel machines in Hong Kong. The researchers will apply their results to solving partial differential equations and to image processing problems.

(CU97730)

Fast Dense Matrix Methods for Integral Equations of the Second Kind

- ✉ CHAN Hon Fu Raymond
- 1 February 1998
- ❖ CUHK Research Committee Funding

Solution of integral equations of the second kind is a much studied subject and various direct and iterative methods have been proposed for their numerical solutions. However, one overriding drawback of these methods is the high cost of working with the associated dense matrices. In recent years, a number of algorithms for the fast numerical solutions of integral equations have been developed. They all based on the compression of data using the smoothness of the kernel. One successful scheme is from B. Alpert, (it et. al.) using interpolation. However, their scheme is unstable for polynomial interpolation of high degree. In this proposal, the researcher will use the general idea of "Mosaic Ranks and Skeletons" proposed by Prof. Tyrtyshnikov. He will first write the discretized dense matrix as the sum of a sequence of block matrices where the blocks are of increasing size. Then he uses polynomial interpolation for each of the block matrix. The researcher uses new basis interpolation polynomial and by these basis, the numerical algorithm is stable even the degree of interpolation is large. Analysis of the accuracy of the method and comparison of their method with well-known method will be carried out. (PS97022)

Multifractal Structure and Self-similarity

- ✉ LAU Ka Sing
- 1 September 1997
- ❖ Research Grants Council

Self-similarity is a new geometry concept which is used to describe complex shapes that have repeated patterns down to microscopic scales. The mathematical models are multifractal measures obtained from iteration function systems (IFS). Such measures describe the distributions of the singularities that characterize the chaotic behavior. However a major setback of the present theory is that one has to assume a rather strong separation condition on the IFS, which excludes many important cases. Recently the principal investigator has introduced a new condition on the IFS called the Weak Separation Property, he was able to retrieve a good number of the important cases and is leading a new direction of research. In this proposal the investigator outlines a program to continue this research. Extension to nonlinear IFS and other dynamical systems are also proposed.
(CU97703)

Representation Theory of Finite Groups and Group Algebras

- ✉ SHUM Kar Ping
- ☐ 1 July 1997
- ❖ CUHK Research Committee Funding

The research on the structure of finite in recent years focused on:

- (1) Solvable groups (including nilpotent groups and supersolvable groups);
- (2) the influence of subgroups, quotient groups and automorphism group on finite groups;
- (3) the structure of finite simple groups; and
- (4) the representation theory of finite groups.

Many significant results, including J.G. Thompson's conjecture on finite groups have been solved and obtained by the Chinese during the past 10 years. In this project, the researcher plans to give a systematic study to the representation theory of finite groups, in particular, the tensor product of the matrix elements in the system of representation and their applications. Related results obtained in Ring Theory will be adopted to study the representation theory of groups and group algebras.
(PS97003)

General Theory of Morita Equivalence for Rings, Semigroups, General Classical Groups and Their Applications

- ✉ SHUM Kar Ping
- ☐ 22 September 1997
- ❖ Research Grants Council

This project is to establish a general theory of Morita equivalence for infinite matrix rings and semigroups by using the technique of replacement. Other

algebraic structures of modules and semigroups will also be investigated.
(CU97720)

Some Contributions to Linear & Nonlinear Analysis

- ✉ TAM Ping Kwan • TAN Kok Keong*
- ☐ 1 February 1998
- ❖ CUHK Research Committee Funding

In this project, the researchers will:

- (1) characterize linear transformations on the family of all self-adjoint operators on a Hilbert space which possesses some properties.
- (2) characterize non-compact operators on an infinite-dimensional Hilbert-space. Generalizations to Banach space setting will also be investigated.
- (3) renorm a given Hilbert norm on a Hilbert space so that a given single operator (resp., family of operators or semigroup of operators) will become a particular type of operator (resp., a family or a semigroup in which all operators become the same type of operators).

(PS97025)

Harmonic Maps and Structures of Manifolds

- ✉ WAN Yau Heng Tom
- ☐ 1 September 1997
- ❖ Research Grants Council

The project is planned to study:

- (1) The Dirichlet boundary value problem at infinity of quasiconformal harmonic diffeomorphisms between hyperbolic 2-spaces and its application to the parameterization of the universal Teichmuller space.
- (2) The theory of harmonic maps between higher dimensional Cartan-Hadamard manifolds especially for real and complex hyperbolic n -spaces ($n \geq 3$).
- (3) The existence and non-existence problems for harmonic diffeomorphisms from the complex plane into convex subsets of the hyperbolic 2-space.

(CU97722)

On the Effect of Domain Geometry and Topology in Nonlinear Elliptic Equations

- ✉ WEI Juncheng
- ☐ 26 November 1997
- ❖ Research Grants Council

This research project is intended to study the effect of domain geometry and domain topology on the existence, multiplicity and the profile of solutions of

boundary value problems associated with nonlinear elliptic partial differential equations or systems of equations. These equations arise from diverse branches of physical and mathematical sciences, to name just a few, they include the well-known Cahn-Hilliard equation in phase transition, Ginzberg-Landau equation in superconductor, nonlinear Schrödinger equations in mathematical physics and the Yamabe problem in conformal geometry. The researcher's main interest is to investigate how the techniques and results in differential geometry and algebraic geometry can be applied to solve these nonlinear equations.
(CU97723)

Mathematical Methods in Phase Transitions and Biology

- ✉ WEI Juncheng • WINTER Matthics*
- ☐ 1 February 1998
- ❖ Germany/Hong Kong Joint Research Scheme

The aim of this project is a mathematical investigation of models which exhibit pattern formation and arise in phase transitions and biology. The researchers will study three reaction-diffusion systems: Cahn-Hilliard equation, S. Muller's equation in martensite theory and Gray-Scott model in biology. They are particularly interested in understanding the existence, multiplicity and the profile if solutions creating spiky patterns.
(PS97005)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1995-96	Parallel Iterative Methods for Large Scale Scientific and Engineering Computing (CU94710) ✉ CHAN Hon Fu Raymond • HUANG Hong Ci* • SHIH Tsi Min*
1995-96	Calculus of Variations via Exterior Differential Systems (PS94014) ✉ CHAN Hon Fu Raymond • CHEUNG Wing-Sum*
1996-97	Fast Iterative Methods for Wiener-Hopf Equations (PS96016) ✉ CHAN Hon Fu Raymond
1996-97	Curvature Flows for Curves and Surfaces (CU96722)

	✉ CHOU Kai Seng
1996-97	Equivariant K-Theory and Equivariant REAL K-Theory (PS96025) ✉ LAM Siu Por
1996-97	Dilation Equations and Fourier Transformation (PS96017) ✉ LAU Ka Sing
1995-96	Invariants and Classification of Compact Strongly Pseudoconvex CR Manifolds (CU94714) ✉ LUK Hing Sun • YAU S. T. Stephen*
1996-97	Decoding Algorithms of Algebraic Geometric Codes (PS96026) ✉ LUK Hing Sun
1996-97	Second-Order Generalized Derivatives of Nonsmooth Functions (CU96706) ✉ NG Kung Fu
1996-97	Mathematical Theory of Option Pricing (PS96018) ✉ SHUM Kar Ping
1996-97	Analytic Problems on Complete Manifolds (CU96704) ✉ TAM Luen Fai
1994-95	Non-Commutative Analysis (PS95011) ✉ TAM Ping Kwan
1995-96	Harmonic Maps between Hadamard Surfaces and Universal Teichmuller Space; Function Theory and Structures of Complete Manifolds (CU94708) ✉ WAN Yau Heng Tom • TAM Luen Fai • AU Kwok Keung Thomas
1996-97	Concentration Phenomena in Nonlinear Elliptic Equations (CU96721) ✉ WEI Juncheng • CHOU Kai Seng
1996-97	Modern Numerical Methods for Industrial/Engineering Problems: Electromagnetic Field, Oil Reservoir/Aquifer Simulations, and Queuing Networks (CU96513) ✉ ZOU Jun • HON Benny Y.* • CHAN Hon Fu Raymond

RESEARCH OUTPUTS AND PUBLICATIONS

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- <P972031> **Ren, Xueming; K.P. Shum and Yuqi Guo.** "On Spined Products of Quasi-Rectangular Groups". *Algebra Colloquium* vol.4 no.2, pp.187-194. China, 1997.
- <P972044> **Chen, Y.Q. and K.P. Shum.** "Quasi-Direct Sums of Rings and Their Radicals". *Communications in Algebra* vol.25 no.9, pp.3043-3055. USA, 1997.
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RESEARCH PROJECTS

Large Scale Flow and Heat Flux in Turbulent Convection

- ✉ CHING Shuk Chi Emily
- ☐ 1 February 1998
- ❖ CUHK Research Committee Funding

Thermal convection is the flow of a fluid enclosed in a cell with bottom and top boundaries kept at fixed temperatures, the bottom being warmer than the top. As boundary conditions are well defined and the flow can be changed from laminar to turbulent in a control manner, thermal convection is a model system for studying turbulence, which is one of the greatest challenges in physics for which a satisfactory theory remains to be developed. Two main features have been observed in turbulent convection. They are a power-law dependence of the heat flux on Rayleigh number and a persistent large scale circulating flow. In this project, the researcher proposes to study the relation between these two features. She will particularly focus on how the large scale flow affects the shape of the mean temperature profile which in turn determines the heat flux.
(PS97011)

General Relativistic Astrophysics: Coalescences of Neutron Star Binaries

- ✉ CHU Ming Chung • LEUNG Pui Tang • SUEN Wai Mo*
- ☐ 1 November 1997
- ❖ Research Grants Council

General Relativistic Astrophysics is an emerging field expected to see rapid developments the coming few years, with large scale multi-institute research projects being put forth in Europe, Japan and the U.S. The researchers propose to launch a major program in this direction, as part of an international collaboration. Together with institutes in Europe and the U.S., they propose to study as the first project of their program the coalescences of binary neutron star systems, using numerical general relativity simulations on supercomputers. The study of such coalescences is important to the understanding of observations in gravitational wave astronomy and gamma ray astronomy, two important new areas in astrophysics. The research team will focus particularly on the nuclear physics input, and the coupling of neutron star structure with general relativistic effects in the coalescences. The dependences of the gravitational radiation on the properties of nuclear matter at high densities will be investigated using massively parallel computation.
(CU97712)

Vehicular Traffic Flow Problems: Statistical Physics Approaches

- ✉ HUI Pak Ming
- ☐ 1 September 1997
- ❖ Research Grants Council

Vehicular traffic flow problems will be investigated with the recently proposed cellular automaton type of models. The effects of defects on the road will be studied. These defects include: junctions on highway, slower traffic in parts of the road, overpasses, rotary, random delay (driver's behaviour), etc. These problems will be studied both numerically and analytically by computer simulations and mean field theories, respectively.
(CU97714)

Effects of Electron-Electron Interactions in Quantum Dots

- ✉ HUI Pak Ming • DENG W.*
- ☐ 16 December 1997
- ❖ CUHK Research Committee Funding

Quantum dots are strongly correlated electron systems with competing energy scales. These energy scales include the particle interaction, the Zeeman energy in the presence of a magnetic field, and the energy due to the parabolic confining potential. Interesting properties in these quantum dots include the existence of preferred values of the angular momentum quantum number, usually referred to as the magic numbers, for the energy eigenstates. The researchers propose to study the origin of these magic numbers both analytically and numerically. While the bare electrons interact via the Coulombic interaction, it is believed that the interaction between electrons is modified in a quantum dot due to the effects of image charges. Numerically, they will study the energy spectrum of this interacting system through the diagonalization of the Hamiltonian for different forms of the interacting potential between electrons. Analytically, the origin of the magic numbers will be investigated by studying the implication of the antisymmetric requirement of the wavefunction together with the help of the Virial theorem.
(PS97012)

Financial Markets as Complex Dynamical Systems

- ✉ HUI Pak Ming • JOHNSON Neil F.*
- ☐ 16 February 1998
- ❖ UK/Hong Kong Joint Research Scheme, the British Council

This project aims at applying techniques of theoretical physics, especially those of statistical

physics and the emerging field of complexity, to understand the dynamics of financial markets. Two microscopic models, the “reaction-diffusion model” and the “El-Farol model”, of the dynamics of trading behaviour will be studied. By introducing various realistic features of trading markets into the two models, this project aims at developing (1) reliable numerical simulations for the two models, and (2) simple, analytic models for the global macroscopic behaviour emerging from numerical results. (PS97006)

Grain Refinement in Undercooled Metals

- ✉ KUI Hin Wing
- 2 January 1998
- ❖ CUHK Research Committee Funding

Grain refinement in metals is important for two reasons. First, the phenomenon has been discovered more than 30 years ago. The underlying mechanism is still unknown. Academically, this is a very challenging problem. Second, the phenomenon can be used to strengthen alloy for practical use. Indeed, if combined with other methods, it is apparent that very refined microstructure can be obtained. Recently, the researcher discovered some very interesting microstructures related to the grain refinement process. Indeed, he believed that he can solve this problem within the next two to three years. (PS97020)

Surface Reactions with Hyperthermal SO_2^+ on Ag (110) and Cu (100)

- ✉ LAU Woon Ming
- 1 December 1997
- ❖ CUHK Research Committee Funding

Reduction of the emission of sulfur dioxide is an important environmental issue. Hence, adsorption and subsequent reactions of sulfur dioxide on metal and metal oxide surfaces have drawn much research attention. In the proposed project, the approach of using the kinetic energy of a sulfur dioxide molecule to promote its dissociative absorption is examined. Silver (110) is chosen as the model surface because adsorption of thermalised sulfur dioxide on this metal surface has been shown to be non-dissociative. In view of this, a hyperthermal sulfur dioxide ion beam will be delivered to a clean and ordered silver (110) surface in ultrahigh vacuum with an existing unique mass-separated ion beam system. The resultant surface reaction products as a function of ion kinetic energy and substrate temperature will be studied by *in situ* x-ray photoemission spectroscopy. Furthermore, the roles of surface defects in this reaction system will be studied by *in situ* scanning tunneling microscopy. The project will generate

some new fundamental information on the transfer of kinetic energy to chemical potential, and some technical data for the designing of novel routes in the reduction of sulfur dioxide emission. (PS97013)

Experimental Study of Dye-Doped Sol-Gel Derived Silica as Tunable Solid State Laser Materials

- ✉ LAW Yam Kuen Dennis
- 11 August 1997
- ❖ Research Grants Council

In this proposed research, laser devices based on sol-gel derived materials will be fabricated and their properties characterized. Depending on the organic dye molecules to be used as dopants, tunable solid state laser materials or nonlinear optical substrate can be prepared using the sol-gel technique. As *solid state dye laser* materials, sol-gel silicate glass retains the desired capabilities such as broadband tunability and high gain on the one hand, while doing away with the volatile solvent, poor thermal and optical quality that plague common liquid phase dye lasers on the other. The researchers recently also demonstrated wave-mixing in dye-doped sol-gel in their lab. In the initial phase of this work, doped sol-gel silica of good optical quality will be fabricated, relying on the sol-gel technique that they have used with good success. In subsequent tasks, the laser-relevant properties of these sol-gel samples will be studied by means of spectroscopic techniques. Lasing of the sol-gel devices will be attempted using another laser as the excitation source. Later, pumping by flash-lamp will also be explored. For all the above tasks, they will concentrate on the near UV spectral region (330 nm to 400 nm) where relatively little study has been performed. Finally, some nonlinear properties pertinent to lasing of the sol-gel samples will be determined. (CU97504)

Studies of Interferences of High-Order Rainbows

- ✉ LEE Wing Kee
- 1 November 1997
- ❖ CUHK Research Committee Funding

A high-order rainbow is formed by a light beam which suffers reflections many times, so called order number, inside a liquid drop. About a year ago, the researcher was able to form many high-order rainbows (up to the 213th-order using a pendant drop and a 50 m W laser while the previous world record was the 17th-order). As so many rainbows of different order numbers are formed, many of them overlap to some extent and therefore interfere with one another. The researcher proposes to study time and spatial

variations of these interference patterns with the aim of extracting physical information about surface vibrational modes, asymmetry, and optical properties of a pendant drop. The researcher anticipates that new methods for measuring size, asymmetry, optical, and thermal properties of liquid drops will emerge through these studies, which may have applications in aerosol and environmental sciences.
(PS97014)

Quantum Monte Carlo Simulations of Three Band Hubbard Model

- ✉ LIN Hai Qing • GUBERNATIS J.E.*
☐ 1 August 1997
❖ Research Grants Council

The researchers propose to apply a new and powerful quantum Monte Carlo simulation method, the constrained path Monte Carlo method, to the two-dimensional three band Hubbard model describing many-body interactions of novel electronic materials such as high T_c superconductors. They will perform quantum Monte Carlo simulations for computing ground-state energies and wave functions of systems of interacting electrons in order to determine the phase diagram of the three band Hubbard model and explore the possibility of phase separation. Pairing correlation functions associated with different symmetries will also be computed so as to address the question whether this model exhibits the superconductivity absent in the standard, well-known one band Hubbard model.
(CU97713)

Electronic Structure and Magnetic Properties of Quasi One-Dimensional Organic Ferromagnet

- ✉ LIN Hai Qing
☐ 1 November 1997
❖ CUHK Research Committee Funding

The researcher proposes to study electronic structure and magnetic properties of organic ferromagnet theoretically, by using a generalized Peierls-Hubbard model which consisting of electron-electron and electron-phonon interactions, as well as phonon dynamics. Techniques to be used are Green's function method, exact diagonalization of model Hamiltonian on finite lattices, and an iterative algorithm based on Hartree-Fock and adiabatic approximations. This studies will enable the researcher to gain more physical insights on many-body correlations and give hints to molecule design of better materials.
(PS97004)

Electronic Structure and Magnetic Properties of Quasi One-Dimensional Organic Ferromagnet II

- ✉ LIN Hai Qing
☐ 1 January 1998
❖ CUHK Research Committee Funding

The researcher proposes to continue his theoretical studies of electronic structure and magnetic properties of organic ferromagnet, by using a generalized Peierls-Hubbard model which consisting of electron-electron and electron-phonon interactions, as well as phonon dynamics. Techniques to be used are Green's function method, exact diagonalization of model Hamiltonian of finite lattices, and an iterative algorithm based on Hartree-Fock and adiabatic approximations. This studies will enable the researcher to gain more physical insights on many-body correlations and give hints to molecule design of better materials.
(PS97021)

Option Valuation of Constant Elasticity of Variance Process with Absorbing Boundaries and Its Applications to the Hong Kong Equity Market

- ✉ LO Chi Fai • HUI Cho Hoi*
☐ 1 October 1997
❖ CUHK Research Committee Funding

Over the last several years the equity markets in the United States and Hong Kong have witnessed periods of dramatic volatility, including the 1987 equity crash and the recent instability in the South East Asia equity markets. This leads exotic options especially the barrier options to be used extensively for hedging and investment in equity markets. Since the payoffs of the barrier options depend on the sample path of the prices, a rigorous modelling of the underlying asset price process which can appropriately describe the sample paths is therefore critical for pricing barrier options. Here the researchers propose a study of the constant elasticity of variance (CEV) process in the valuation of barrier options. The results can be compared with the conventional Black-Scholes model and the application to the Hong Kong equity market will be studied.
(PS97015)

Oxygen Effects in Colossal Magnetoresistance Materials

- ✉ WONG Hong Kuen
☐ 1 October 1997
❖ Research Grants Council

The researcher studies the effects of oxygen on the magneto-transport properties of (La,Ca)MnO_δ and related perovskite oxides.
(CU97718)

Light Scattering Study of the Solution Form of the Electrode-Proton Exchange Membrane Assembly of Fuel Cells

- ✉ XIA Keqing
- ☐ 1 January 1998
- ❖ CUHK Research Committee Funding

A fuel cell is an energy conversion device that operates almost identically like a battery. The only difference is that a fuel is continuously fed to a fuel cell, while in a battery the “fuel” -charge carriers are stored inside its casing. During its operation, a fuel cell creates electricity by electrochemically converting hydrogen (the fuel) and oxygen (the air) into pure water without burning, therefore achieving zero emission.

The perfluoro-sulphonated ionomer (PFSI) is a good candidate for the proton exchange membranes (PEM) used in a fuel cell. However, it is very difficult to process these perfluorinated ionomer (polymer containing ionic clusters) membranes, which is needed in solution form for the electrode-membrane assembly. The present proposal is aimed at investigating the properties of the ionic clusters of the liquefied PFSI dissolved under various conditions and seeking the best casting environment in which the ionic clusters are maintained. (PS97016)

Waterproofing Materials for Roofs and Lift Pits for Domestic Blocks

- ✉ YAU Kwok Fung
- ☐ 15 June 1998
- ❖ Hong Kong Housing Authority

Currently, mastic asphalt is specified as waterproofing materials for roofs and lift pits for domestic blocks by the Housing Authority of Hong Kong. This research is undertaken to study the environmental impact and the requirements of the Environment Protection Department on the preparation and on-site application of these materials. An out-look of skilled labour and materials supplies has also been reviewed. Application and quality of proprietary waterproofing materials also have been investigated. (PS97024)

Quantum Confined Stark Effects in Novel Electronic Systems

- ✉ YU Kin Wah
- ☐ 1 November 1997
- ❖ CUHK Research Committee Funding

The researcher studies the absorption coefficient and refractive index variation due to the quantum-

confined Stark effect (SE) in novel low-dimensional electronic systems, where further lateral periodic modulations are introduced into two-dimensional electronic systems by interfaces separating the well and barrier materials of the systems. When electric fields are applied normally to the superlattices, electrons (or holes) will be shifted towards the interfaces, leading to a sensitive dependence of optical absorption and a large refractive index variation on the field strength. The results will provide a better understanding for the mechanisms of SE as well as offer a new concept for device designs. (PS97017)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

<u>Edition</u>	<u>Title/Investigators</u>
1995-96	Statistics of Fluctuations in Turbulent Fluid Flows (CU95715) ✉ CHING Shuk Chi Emily
1996-97	Model Study of Fracture Propagation in Solids (CU96718) ✉ CHING Shuk Chi Emily • NAKANISHI Hiizu* • LANGER James S.*
1996-97	Theoretical and Computational Study of Sonoluminescence (CU96715) ✉ CHU Ming Chung • LEUNG Pui Tang
1996-97	Coalescences of Neutron Star Binaries: Effects of Nuclear Physics (PS96011) ✉ CHU Ming Chung
1993-94	Novel Optical Materials for Photonics Technologies (BP94012) ✉ HARK Sui Kong • HUI Pak Ming • LEE Wing Kee • LAW Yam Kuen Dennis • NG Hang Leung Dickon • WONG King Young • CHAN Kam Tai (Electronic Engineering) • HSU Chung Chi (Electronic Engineering)
1989-90	Microstructure of Undercooled Ge and Si (BP87003) ✉ KUI Hin Wing
1989-90	The Viscosity of Easy Glass Formers (BP87004) ✉ KUI Hin Wing
1996-97	Properties of Undercooled Molten Eutectic Alloys (CU96719) ✉ KUI Hin Wing

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| 1996-97 | Synthesis of Glassy Spinodals in Eutectic Alloys (PS96012)
✉ KUI Hin Wing | 1995-96 | The Corrosion Protection of NdFeB Magnets by Al, Al-based Alloys and Ni Coatings (PS95040)
✉ NG Hang Leung Dickon |
| 1996-97 | Negative Conductivity in Weakly Ionized Gases (CU96701)
✉ LAW Yam Kuen Dennis | 1996-97 | Aluminium Metal Matrix Composite Materials Reinforced by Intermetallic Compounds and Alumina Whiskers (PS96031)
✉ NG Hang Leung Dickon |
| 1996-97 | Vacuum Ultra-Violet Spectroscopic Study of F ₂ , X ₂ , Kr ₂ Generated by Fast Discharge Excitation (PS96014)
✉ LAW Yam Kuen Dennis • WONG R.* | 1996-97 | The Study of Rare-Earth Transition-Metal Based Permanent Magnets (PS96023)
✉ NG Hang Leung Dickon |
| 1995-96 | Studies of Variations of Phase Conjugation Beam Induced by Another Laser Beam in Photorefractive Crystals (PS95038)
✉ LEE Wing Kee • SHE Wei-long* | 1995-96 | Facing-target Sputtering Guns: Characteristics and Applications (CU95720)
✉ WONG Hong Kuen |
| 1995-96 | Laser Interaction with Micrometer-sized Droplets and Fibres (CU95716)
✉ LEUNG Pui Tang • LAI Hon Ming | 1995-96 | Interplay of Magnetic and Superconducting Properties of Oxide Multilayers (PS95016)
✉ WONG Hong Kuen |
| 1995-96 | Mechanism of Photo-emission in Rapidly-oscillating Micrometer-size (PS95039)
✉ LEUNG Pui Tang • CHU Ming Chung | 1996-97 | High Pressure Effects in Single-Crystal (La, Ca) MnO ₃ Thin Films (PS96015)
✉ WONG Hong Kuen |
| 1995-96 | Quantum Monte Carlo Simulation of a Three-band Hubbard Model for High-T _c Materials (PS95017)
✉ LIN Hai Qing • GUBERNATIS J.E.* | 1995-96 | Investigation of Relaxation Mechanisms of the Second Order Nonlinear Optical Activity in Polymeric Materials (CU95702)
✉ WONG King Young |
| 1996-97 | Many-Body Physics of Novel Electronic Materials in Reduced Dimensions (CU96714)
✉ LIN Hai Qing | 1993-94 | Study of Statistical Nature of Particle Motion in Fluids (BP00101)
✉ XIA Keqing |
| 1996-97 | Theoretical Studies of CMR Materials (PS96024)
✉ LIN Hai Qing | 1994-95 | Experimental Studies of Turbulent Convection (PS94012)
✉ XIA Keqing |
| 1996-97 | Bosons in Confining Potentials (PS96013)
✉ LIU Kwok Leung • LO Chi Fai | 1995-96 | Testing of Scaling Laws for Polymer Solutions Near Criticality (PS95041)
✉ XIA Keqing |
| 1995-96 | Correlated Squeezed-State Approach for the Ground State of Strongly Correlated Electrons Coupled to Local Holstein Phonons (PS95022)
✉ LO Chi Fai | 1996-97 | Measurements of Boundary Layer Properties in Turbulent Convection (CU96724)
✉ XIA Keqing |
| 1995-96 | Development of Magnetic Methods for the Non-destructive Inspection of Steel Structures (CU94721)
✉ NG Hang Leung Dickon • KUI Hin Wing | 1995-96 | Wave Phenomena in Open Systems (CU95706)
✉ YOUNG Kenneth • LEUNG Pui Tang • CHING Shuk Chi Emily • SUEN Wai Mo* |

1995-96 Transport and Optical Properties of
Nonlinear Inhomogeneous Media
(CU95718)

✉ YU Kin Wah • HUI Pak Ming

RESEARCH OUTPUTS AND PUBLICATIONS

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RESEARCH PROJECTS

Statistical Matching Using Multiple Imputations Survival Analysis for Residents in Hong Kong 1991-1995

- ✉ LAU Tai Shing • LI Kim Hung • WONG Tze Wai (Community & Family Medicine)
- 1 November 1997
- ❖ CUHK Research Committee Funding

The aim of this project is to study the effect of certain socioeconomic indicators on the survival distributions of different causes of death for the residents in Hong Kong during the period 1991-1995. Unfortunately, the information that can be obtained from the Census and Statistics Department of Hong Kong suffers from two weaknesses. First, the required information is contained in two separate data files. The census data of 1991 provide the information on the socioeconomic variables and certain characteristics of individuals. The 1991-1995 mortality data provide information, such as causes of death and the month of death, on the individuals who died during this period. Second, because of confidentiality reason, the census data obtainable from the Census and Statistics Department are coarsely grouped. Method of multiple imputation will be used to solve both problems and produce a complete data set, on which survival distribution will be built. The value of this study is not only on the resulting survival functions, but also on the new methods that the researchers propose as they can be applied to other studies which have similar problems. (PS97018)

Analysis of Structural Equation Models via the Bayesian Approach

- ✉ LEE Sik Yum • POON Wai Yin
- 1 October 1997
- ❖ Research Grants Council

The main objective of this project is to investigate structural equation modelling with a Bayesian approach. Under this approach, the useful prior information of the parameters can be incorporated into the analysis, hence better results may be achieved. Moreover, it will be shown that the information carried by the latent variables can be utilized as well. Therefore, when combined with the advanced Monte-Carlo simulation techniques, this approach will yield a substantial arsenal of new, powerful and flexible tools to attack problems in structural equation models as well as other areas in psychometrics. (CU97217)

Multiple Forecasts and Causality Analysis in Time Series Modelling

- ✉ WU Ka Ho Eden • CHEUNG Siu Hung • CHAN Ping Shing Ben
- 1 September 1997
- ❖ Research Grants Council

A time series is an ordered sequence (with respect to the time dimension in most cases) of observations. The corresponding statistical techniques are widely applied to a variety of fields such as business, economics, sociology, physics and engineering. In recent years, multivariate time series methods which handles a group of related time series have received tremendous attention. An obvious practical example is the investigation of the current economic situation which can be reflected by a group of closely related time series such as GNP, unemployment rate and inflation rate. There are two major objectives of this project. The first one is to develop statistical procedures to cope with multiple forecasts for multivariate time series models. Here is an excellent example for the necessity of multiple forecasts. In Italy, the Italian National Bureau of Statistics released the data of the Italian National Accounts with a two-quarters delay. Hence, based on available early indicators, one-step and two-step ahead forecasts of economic activities will be crucial for the understanding of the current economy. The second objective of this project is to provide the mathematical skills which examine the relationship (causality analysis) among different variables in a multivariate time series. The proposed procedures will be constructed for a wide spectrum of time series models such as ARCH non-linear time series model and models with non-Gaussian error terms. (CU97401)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1996-97	Interval Estimation of Parameters of Life Based on Record Values (PS96020) ✉ CHAN Ping Shing Ben
1996-97	Simultaneous Pairwise Multiple Comparisons in a Two-Way Design with Fixed Covariates (PS96027) ✉ CHEUNG Siu Hung
1989-90	Analysis of Continuous and Polytomous Variables (CS85001) ✉ LEE Sik Yum • POON Wai Yin
1989-90	Analysis of Incomplete Data (CS88002) ✉ LEE Sik Yum • POON Wai Yin

1989-90	Analysis of Structural Equation Models with Correlated Data (CS89006) ✉ LEE Sik Yum • POON Wai Yin	1995-96	Decision Analysis with Fuzzy Variables (PS95043) ✉ POON Wai Yin
1996-97	Bayesian Analysis of Structural Equation Models (PS96028) ✉ LEE Sik Yum	1996-97	Conformal Normal Curvature and Assessment of Local Influence (PS96029) ✉ POON Wai Yin
1995-96	Bayesian Computation (CU95713) ✉ LI Kim Hung • WONG Wing Hung	1996-97	On Minimax Variance L-Estimation of Location in Kolmogorov Neighbourhoods of the Normal Distribution (PS96030) ✉ WU Ka Ho Eden
1989-90	Analysis of Fuzzy Data (CS89005) ✉ POON Wai Yin • LEE Sik Yum • LEUNG Y. P.*		

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