Research in the Department of Chemistry

**Research Areas**
The research areas in the Department of Chemistry, listed below, are wide-ranging, and most are of widespread and current interest. Within some areas there are topics of direct local relevance.

- Bauxite chemistry
- Chemical education
- Computational chemistry
- Environmental analytical chemistry
- Food chemistry
- Inorganic reaction mechanisms
- Liquid crystals
- Materials chemistry
- Metal–organic frameworks for hydrogen storage
- Microbial chemistry
- Nanochemistry
- Natural products (terrestrial, marine and fungal)
- Synthetic organic chemistry
- Theoretical chemistry

**Collaboration**
There is good collaboration between faculty members within the department and with other researchers at Mona in Biochemistry, Biotechnology, the International Centre for Environmental and Nuclear Sciences (ICENS), the Discovery Bay and Port Royal Marine Laboratories and at the Natural Products Institute. Basic instrumentation to support much of the research activity is in place in the Department of Chemistry and the other units mentioned.

**Research Degrees**
The department offers research programmes leading to the M.Phil. and Ph.D. degrees, and the greater part of the research output of the department is based on original research carried out by graduate students under supervision. Members of the department publish in total approximately 20 refereed papers per year. Over the past five years 64% of these papers are based on work carried out by graduate students. Approximately 50% of the papers from the FPAS which are on the Web of Knowledge database originate from the Department of Chemistry.
CHEMISTRY

Fabian Banton
Programme: MPhil in Natural Products Chemistry
Supervisors: Dr. Roy Porter and Dr. Petrea Facey

I was born in Mandeville, Manchester. I am the holder of a BSc degree with a double major in Chemistry and Electronics from UWI (Mona) and am currently pursuing an MPhil in Natural Products Chemistry, (also known as Pharmacognosy) which is a sub-division of organic chemistry research done within the department.

I have been doing phytochemical analyses of two plants of the *Bursera* genus that are endemic to Jamaica; namely, *Bursera lunanii* and *Bursera aromatica*. The *Bursera* genus is known in the literature for containing species which produce fragrant essential oils. Additionally, triterpenic resins are a keynote feature of representative species. Medicinal, commercial and sacramental usages of plants in the genus are reported in the literature.

I am currently in the process of isolating and characterizing the secondary metabolites produced by two strains of endophytic fungi isolated from *Bursera lunanii*. The relatively untapped resource of compounds produced by endophytic fungi is a subject of avid interest and justifies the need for research in this area, given that there are no reports in the literature on endophytes from *Bursera lunanii*.

I am an active member of the Chemistry Association of Postgraduate Students (CAPS). My recreational activities include reading, listening to music, and playing computer games.

Oscene Vernet Barrett
Programme: PhD in Chemistry
Supervisors: Professor Yvette A. Jackson and Dr. Nadale K. Downer-Riley

I was born in Catadupa, St. James, Jamaica and have recently migrated to the United States. In 2006 I completed a BSc double major in Chemistry and Food Chemistry (Food Science) at the University of the West Indies (Mona). I immediately joined the graduate program in the Department of Chemistry, where I am now in the sixth year of my PhD program in Organic Synthesis. In 2009 I was awarded a prestigious UWI Postgraduate Scholarship, which has been extended to 2012.

My research focuses on three general areas, namely:

- Synthesis of novel analogs benz-fused five-membered heterocycles
- Development of new reactions and methodologies for the preparation of various benz-fused-azoles and their analogs, and
- Reaction mechanisms.

These areas of research have immediate applications within medicinal and pharmaceutical chemistry. Benz-fused-azoles, including benzothiazoles and benzoxazoles are heterocyclic compounds, which are known to demonstrate selective and potent anticancer and antitumor activity. Some of these compounds also display anti-trypanosomal, anti-tuberculosis, anti-influenza activity, while others are used as tracers in
Alzheimer disease studies. A few compounds of this class are already being used directly as drugs in cancer therapy or as precursors in the synthesis of cancer drugs. It is in this area that the development of new reactions and methodologies, as well as the preparation of new analogs will have greatest influence.

Apart from this research, I am heavily involved in outreach activity, including being an instructor in Caribbean Advanced Proficiency Exam (CAPE) Chemistry workshop, and various faculty and department outreach programmes. I am also the founder and former president of the Chemistry Association of Postgraduate Students and a former executive member of the Chemical Society, University of the West Indies, Mona.

Samantha Brown-Dewar
Supervisor: Professor Tara Dasgupta
Co-Supervisor: Dr. Paul Maragh

My research project is entitled “Furan - Studies of residual levels in Caribbean foods and its mechanisms of interaction with common body fluid constituents”.
CHEMISTRY

Theresa Campbell
Programme: PhD in Chemistry
Supervisor: Dr. Camille Bowen-Forbes

I graduated from the UWI Mona campus with a Bachelor of Science degree in General Chemistry and Food Chemistry. I later obtained a Master of Science degree from the St. Augustine campus in Food Science and Technology and am now enrolled in a Doctor of Philosophy programme in Chemistry at the Mona campus. The area of research I am currently involved in is an exciting aspect of Food Chemistry which is known as Nutraceutical Science. This area of research involves assessing the health beneficial properties of fruits so as to treat and possibly prevent diseases. It is known that populations that consume a large proportion of certain plant-based foods have a lower incidence of cardiovascular diseases and certain types of cancer. This is the basis on which functional foods and nutraceuticals have been developed and these are the areas which her research is intended to impact. The results of my research are expected to contribute greatly to this area as I explore the nutraceutical properties of *Rubus rosifolius*, a locally grown raspberry.

Ching Chin Lee
Programme: MPhil in Chemistry
Supervisor: Dr. Donna Minott-Kates

I am a second year MPhil student in the Department of Chemistry. I am currently doing research in the area of Food Chemistry on the effects of changes in chemical properties of canned ackee (*Blighia sapida*) on the hypoglycin content during the shelf-life period of the product. I am also exploring other *Blighia* species.
Graduates in Action

CHEMISTRY

Errol Dakin
Programme: PhD in Chemistry
Supervisors: Dr. Winklet Gallimore and Dr. Emma Ranston

My research involves the identification and culturing of Ciguatera Associated Dinoflagellates (CAD), specifically the *Gambierdiscus* genus in order to determine their possible toxicity and the compounds responsible, using the mouse bioassay along with chemical methods such as HPLC, NMR and LCMS. This is in an effort to better understand the role each individual species plays in causing Ciguatera Fish Poisoning (CFP), which has been a major Public Health problem in Jamaica and the wider Caribbean region. There are five known CAD, four of which are found in Jamaican waters. These include the genus *Ostreopsis*, *Coolia*, *Procentrum* and *Gambierdiscus*.

The *Gambierdiscus* genus particularly *Gambierdiscus toxicus* are known producers of Ciguatoxin, the major toxin involved in Ciguatera Fish Poisoning (CFP).

Flemoi Dario Gordon
Programme: MPhil in Chemistry
Supervisors: Prof. Yvette A. Jackson and Dr. Nadale K. Downer-Riley

I was born in Spring Garden, St. James and later moved to Savanna la Mar in Westmoreland, Jamaica. In 2009 I completed a double major in Biochemistry and General Chemistry at the University of the West Indies (Mona). I immediately joined the graduate program in the Department of Chemistry, where I am now in the third year of the MPhil program in Organic Synthesis.

My main area of research is towards the synthesis of analogs of the natural product violatinctamine. Violatinctamine is an alkaloid which was isolated from the tunicate *Cystodytes cf. violatinctus* in 2004. It has an unusual heterocyclic skeleton comprising of a benzothiazole and a dihydroisoquinoline unit. Violatinctamine has no reported bioactivity, however benzothiazoles demonstrate pharmacological activity such as antimicrobial and cytotoxicity. The dihydroisoquinoline unit found in violatinctamine is related to the tetrahydroisoquinoline ring which is found in many natural products and is associated with biological activities such as potent antibacterial, antimalarial, antiviral, anti-HIV activities and often selective cytotoxicity. It seemed then that the analogs of violatinctamine may have bioactivity. Additionally, the research group has done substantial work on the construction of a variety of benzothiazoles. Thus the aim is to explore the synthesis the analogs of violatinctamine. It is hoped that the synthesis of the analogs will lead to the synthesis of 1 and that structure activity relation studies will eventually be done thus giving us leads on the requirements for bioactivity in these systems; hence giving insight into approaches toward the development of viable drugs of this kind. This will be beneficial to the pharmaceutical industry.
Apart from my research, I am heavily involved in student development, student leadership and outreach activities. I am currently a member and a former executive member of the Chemical Society, University of the West Indies, Mona.

Janese Henderson
Programme: MPhil in Inorganic (Lanthanide) Chemistry
Supervisor: Professor Ishenkumba Kahwa

I am in the third year of my programme. My research focuses on lanthanide (III) complexes of chelates derived from 1-aziridineethanol. The lanthanides are of particular interest because of their unique physical properties and their far-reaching applications. My aim is to use these lanthanide clusters as precursors to form rare earth oxide materials with novel photophysical, catalytic and other properties including metal-metal interactions. I hope to generate new materials with enhanced properties that can be evaluated for potential use in fluorescence imaging, diagnostics and sensing. I am a member of The Chemical Society (ChemSoc) where I serve on the executive committee. I am involved in organising social events as well as other activities including exciting laboratory demonstrations for ChemSoc. I am also actively involved in the Chemistry Association of Postgraduate Students (CAPS).

I am currently completing a semester at the University of Gothenburg in Sweden. This exchange is made possible through the Linnaeus-Palme grant. Through the program I am able to complete an integral part of my research, gain international experience, and acquire a greater understanding of the Nordic culture.

Phylget Hill
Programme: MPhil in Chemistry
Supervisor: Dr. Vaughn Rattray

I am an MPhil student in the Department of Chemistry student specializing in the area of Environmental Chemistry. My research seeks to determine the types and concentration of Polycyclic Aromatic Hydrocarbons present in our Jamaican soil. Emphasis is placed on soil located near high traffic areas, industries and farm lands.
Jheanell James  
Programme: MPhil in Analytical Chemistry  
Supervisors: Dr Anthony Greenaway, Dr Michael Coley and Dr Robin Rattray

As Aristotle says, “We are what we do repeatedly. Excellence, then, is not an act, but a habit”. As a research student in the Department of Chemistry, I take this approach in my research; if you want to do excellent research, you need to make research a habit.

My research is focused on identifying and classifying chromium and zinc species in Jamaican bauxites. It forms part of on-going work exploring the impact and behaviour of trace metals in bauxites processed in local Bayer plants.

In the next few years, much of the bauxite slated to reach Jamaican Bayer refineries will have higher concentrations of impurity species and will be more difficult to extract. These challenges require modifications to the processing practices currently used in our bauxite plants.

My research goal is to identify the chromium and zinc species present in our bauxite, to predict their behaviour during processing and to help develop strategies to control or remove these impurities. I am excited about my work. It is challenging and requires painstaking analyses but for me, it is a habit that I thoroughly enjoy.

The research is jointly funded by The University of the West Indies, Alcoa World Alumina, and Jamalco.

April Johnson  
Programme: MPhil in Natural Products Chemistry  
Supervisor: Prof. Helen Jacobs

In my programme I am investigating three species of Jamaican Peperomia plants, namely, *Peperomia* sp. nov., *Peperomia amplexicaulis* and *Peperomia hernandifolia*, from which I have isolated several secondary metabolites. It is anticipated that these isolated compounds may have significant biological activity and could enhance the quality of life for mankind.
Megil McNeil  
Programme: MPhil in Chemistry  
Supervisor: Dr. R. B. Porter

The foci of my research include the following:

- Extraction and characterization of constituents of essential oils from local medicinal and odoriferous species of *Cleome* genus (*C. viscosa*, *C. rutidosperma*, etc.) and *Hyptis* genus (*H. suaveolens*).

- Investigation of biological activities inclusive of anti-oxidant, insecticidal and antimicrobial properties of various essential oil extracts of *Cleome* and *Hyptis* species.

- Phytochemical investigation of *Cleome rutidosperma* including anti-mycobacterial activities of essential oils and other solvent extracts from the plant.

Shannen Lorraine  
Programme: MPhil in Chemistry  
Supervisors: Dr. Paul Maragh and Professor Tara Dasgupta

As first year student in the MPhil programme, I have valiantly taken the step outside the box to do the uncommon. Already, two persons before me have been engaged in the field of Catalysis. It is my ambition to be successful and as such, open the doors for further catalytic works that could be groundbreaking for the University of the West Indies.

The project covers the reactivity, selectivity and effectiveness of inorganic GARPHOS catalyst. GARPHOS catalysts are phosphine-type catalysts which have palladium, ruthenium or rhodium metal centres. These catalysts are novel and have had recent applications in chiral hydrogenation.

The GARPHOS catalysts will be applied to the typical catalytic reactions such as Suzuki coupling, Heck Coupling and possibly other coupling reactions. The focus presently, is their application in Suzuki cross-coupling reactions. This is one of the most common catalytic reactions which involve the synthesis of asymmetric biaryl compounds. These compounds have possible applications in pharmaceuticals and medicine.
CHEMISTRY

Dipali Nair
Programme: MPhil in Chemistry
Supervisor: Dr. Camille Bowen-Forbes

My research project is entitled “Health-Beneficial Properties of Extracts and Phytochemicals from Jamaican Black Raspberries”. It is aimed at discovering the positive biological properties of *Rubus racemosus*. This tasty, purple-black raspberry is quite uncommon, and as such, its culinary and health-beneficial potential have been unexploited. My investigation into its antioxidant, anticancer, antidiabetic, and anti-inflammatory properties is expected to unveil the extremely positive attributes of this fruit.

Stacy-Ann J. Parker
Programme: MPhil in Chemistry
Supervisor: Prof. Helen Jacobs

I am a past student of the Mount Alvernia High School for Girls. I completed my BSc. in 2007 with a double major in Chemistry and Biotechnology. I am currently a Master of Philosophy student in the Department of Chemistry, whose interest lies in drug discovery.

My project is entitled “Phytochemical Investigation of members of the Clusiaceae Family”. The driving force for phytochemical studies is the discovery of natural products that lead to new drugs. Natural products are molecules shaped by evolution, and many natural products have a profound impact on human health. Thus, two of the aims of my project are to: characterize the secondary metabolites from members of the Clusiaceae family, and to obtain their biological activity.

The Clusiaceae family (“Mammee Apple Family”) contains a wide range of species with interesting phytochemical properties. A large number of plants belonging to the family are reported to be used in folklore medicine. The family is notably known for St. John’s wort, an over the counter antidepressant and (+)-calanalide A, a nonnucleoside HIV-1 specific reverse transcriptase inhibitor under development as an AIDS chemotherapeutic. (+)-Calanalide A as a chemotherapeutic drug for HIV is currently in clinical trials.
Alexa Redway
Programme: MPhil in Chemistry
Supervisors: Professor Yvette Jackson and Dr. Nadale Downer-Riley

I am from the resort capital of Montego Bay, Jamaica. I obtained a BSc degree with a double major in Chemistry and Biochemistry from the University of the West Indies, Mona in 2009, and was the recipient of the Wilfred Chan award for excellence in Organic Chemistry in 2008. My research explores methodologies towards the synthesis of the natural product violatinctamine isolated from a Kenyan marine tunicate in 2004. Compounds of this general type usually possess biological activity. I will explore structure activity relation studies on the natural product and some key intermediates.

Ruth Williams
Programme: MPhil in Chemistry
Supervisor: Dr. Camille Bowen-Forbes

My research project is entitled “Nutraceutical Properties of Exotic Jamaican Flora”. It is primarily focused on the antioxidant, antidiabetic, anticancer, and other health-beneficial properties of the Jamaican blackberry (Rubus jamaicensis). Based on previously published literature, blackberries are known to exhibit impressive biological and chemical properties. Diets rich in berries, wines, vegetables and cocoa have been shown to result in reduced risks of chronic illnesses due to the presence of compounds such as flavanoids, phenolic acids, tannins and anthocyanins. My goal is to isolate and purify phytochemicals from this plant, and investigate the positive biological properties of these compounds as well as other plant extracts.
Nijole Young
Programme: MPhil in Chemistry
Supervisors: Dr. Anthony Greenaway and Dr. Michael Coley

Title of Research: Spectroscopic studies of phosphorus mineralogy; solubility and control in sodium aluminate liquors from Jamaican bauxites.