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The Caribbean Academy of Sciences

NEWSLETTER

UPDATES:

⇒ Trinidad and Tobago elects new CAS Chapter Executive Committee

⇒ CAS Guadeloupe Chapter shares a focus on Geoscience

⇒ CAS participates in Caribbean Science and Innovation Meeting

⇒ CAS Guyana Chapter shares a series of webinars through its Facebook page—https://www.facebook.com/CASGyChapter/

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Special points of interest

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- Discover Guyana's Iwokrama Rainforest
- Rare Earth Elements, a potential resource for the Caribbean
- A look at Energy, Culture and COVID-19
- Rural Initiatives in Science Education (Pueblo Science)

Dr. Anna Perreira
Lecturer II, Department of Architecture, FET, University of Guyana
CAS Guyana Chapter Vice President, FET ABET Committee Member, Head of Faculty Research Committee and Coordinator of the GREEN Institute

Engineering Accreditation for a Sustainable Economy (EASE):

ABET Accreditation for University of Guyana's Engineering Programmes

The University of Guyana's Faculty of Engineering & Technology

Established in 1969, the faculty offered regular academic programmes such as the General Technical Diploma (GTD) and the Higher Technical Diploma (HTD) in Architecture and Building Technology, in Civil, Electrical and Mechanical Engineering until 1977 (University of Guyana, 2019). In 1978, the Faculty discontinued the GTD and HTD programmes and introduced the Diploma in Technology and Bachelors of Engineering and Science (Architecture) programmes. Majors in the Diploma in Technology were subsequently expanded to include Agricultural Engineering, Mining and Surveying. A diploma in Technology programme in Aeronautical Engineering was introduced in 2005 in collaboration with the Art Williams/Harry Wendt Aeronautical School. All Academic Programmes follow a semesterized format. The name was changed to Faculty of Engineering and Technology (FET) as of July 09, 2018. Presently, there are five departments (***Architecture, Civil, Electrical, Mechanical and Petroleum & geological Engineering***), serviced by 39 staff members; and 100 academic faculty members and with over 900 students (University of Guyana, 2019). Four-year undergraduate BSc. Programmes are also offered which satisfy the academic requirements of the Guyana Association of Professional Engineers (GAPE). All students also undertake a mandatory 10-month industrial training stint to expose them to the world of work.

Rationale for Accreditation

Guyana's new found oil has positioned it as a major oil producer in the Western Hemisphere and this new oil and gas (O&G) industry will quickly be an integral part of national development for decades. While the effects will be transformative, the requisite skills in the country need further development to facilitate competitiveness on the global market and to ensure sustainable national development. The University of Guyana (UG) and the Faculty of Engineering and Technology (FET) will play a pivotal role in building the necessary human capital – knowledge, skills, and innovation needed to navigate this new frontier. While international operators will supply some of the specialized engineering skills needed, operations will create demand and opportunity for Guyanese with an engineering background.

JULY 2020

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ABET Accreditation

ABET is the recognized global accreditor of college and university programs in applied science, computing, engineering, and technology. Some regional programmes already have ABET accreditation, but this will be a first for Guyana. Accreditation is a peer-review process that certifies the quality of the postsecondary education and provides assurance that programs meet top-tier global quality standards for engineering (ABET, 2020). Educational institutions or programs with ABET certification also undergo periodic reviews to ensure that established criteria are being met. The ABET Board is comprised of four commissions: The Applied Science Accreditation Commission (ASAC); Computing Accreditation Commission (CAC); Engineering Accreditation Commission (EAC); and the Technology Accreditation Commission (TAC). The FET will pursue accreditation under the EAC.

Engineering Accreditation for a Sustainable Economy (EASE)

Since September 2019, Prof. Norman Munroe (a Fulbright Scholar) has been leading a faculty committee to prepare for the assessments, documentation and all other ABET accreditation requirements. The committee is joined by Dr. Anna Perreira, Mrs. Elena Trim Mr. Anil James and representatives from each academic department who will be working closely with the faculty in preparation for ABET accreditation. The committee also comprises representatives from each academic department who will be working closing with faculty in preparation for ABET accreditation. On June 3rd, 2020 the US Embassy in Guyana hosted a special webinar with prospective constituents in order to both publicize and gain support for the ABET process. The panellists included the US Ambassador to Guyana the Honourable Ms. Sarah-Ann Lynch, UoG's chancellor Prof. Edward Greene, newly elected Vice Chancellor, Prof. Paloma Mohamed-Martin, the FET ABET committee, Mr. Rod Henson (Exxon representative and former country manager), Mr. Stuart Hughes (President of GAPE), Dr. Vincent Adams (Executive Director of the EPA), Mr. Joshua Trotman (Faculty Student Rep), and Ms. Verlyn Klass (Dean of FET). To date, numerous individuals (academics and practitioners) and associations have indicated their support and commitment towards achieving ABET accreditation of the FET engineering programmes. A proposal is being developed which identifies the necessary human, financial, technical and physical resources required to accomplish ABET accreditation for FET's engineering programmes. A proposal was also recently submitted to the US Government seeking funding for the expansion of the laboratory and classroom facilities.

Conclusion

Graduates of an ABET-accredited program have an excellent educational foundation. These include enhanced employment opportunities with multinational corporations; entry to the technical profession through licensure; registration and certification in professions; and more flexibility in the transfer of credits to institutions. They are also equipped to respond to local issues related to sustainable development and emerging Green Economies. The University of Guyana's FET ABET committee continues to work assiduously to ensure programmes are accredited and to safeguard the sustainable development of the nation through the delivery of competent and ethical graduates.

References:

ABET. (2020, July 9th). *ABET*. Retrieved from What is Accreditation : https://www.abet.org/accreditation/what-is-accreditation/

University of Guyana. (2019, July 9th). *About Us* . Retrieved from Faculty of Enigneering and Technology: https://fot.uog.edu.gy/faculty-engineering-technology

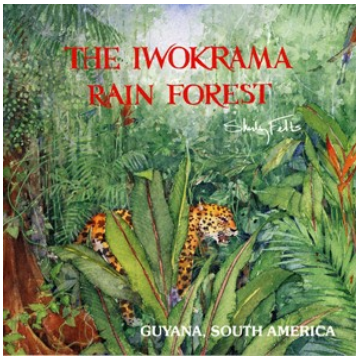
Note: The University of the West Indies, Mona, Jamaica has one ABET accredited engineering program in Electrical and Electronics Engineering (10/01/2015) and Barbados is currently pursuing ABET accreditation of a Mechanical Engineering program for a new engineering school in what can be viewed as education touri

IWOKRAMA: A RAINFOREST LABORATORY FOR SCIENTIFIC RESEARCH

Dr Raquel Thomas-Caesar
Director, Resource Management and Training
Iwokrama International Centre for Rain Forest Conservation and Development

Iwokrama Science Committee

The University of Guyana's Forestry students visit Iwokrama



Iwokrama is one of five protected areas in Guyana, founded in 1989 by the Late President Desmond Hoyte and established as a Operational Centre in 1996 though the passing of the Iwokrama Act by Late President Cheddie Jagan, which cemented the international partnership between the Government of Guyana and the Commonwealth.

Iwokrama's mission is: ***"To promote the conservation and the sustainable and equitable use of tropical rain forests in a manner that will lead to lasting ecological, economic and social benefits to the people of Guyana and to the world in general, by undertaking research, training and the development and dissemination of technologies."***

Scientific research has been conducted at Iwokrama of well over two decades focused on the three pillars of natural resources management: ecological, social and financial.

Phase 1

The initial phase was focused on baseline data collection which was needed for informing important management processes including the zonation of the Iwokrama Forest and also for the development of plans for forestry, tourism management, monitoring as well community interests.

The Iwokrama Forest covers 371,681 ha in Central Guyana. This forest has been zoned into a Wilderness Preserve (WP) with 187,174 ha and a Sustainable Utilisation Area (SUA) with 184,506 ha.

Phase 2

In 2009, Iwokrama established the Iwokrama Science Committee (ISC) inclusive of the University of Guyana and other international universities, to assist the Centre to launch and oversee a new phase of integrated on-site research , which was focused on the following:

- Measurement and valuation of Iwokrama's ecosystem services and the benefits they deliver to human well-being and the resilience of the forest;
- Practical ways to improve community benefits;
- Interactions between climate change and the Iwokrama forest and the influence of the Iwokrama forest on the global climate; and
- Development, testing and installation of new models of sustainability, crossing traditional disciplinary boundaries.

Phase 3

In November 2017, commenced the re-establishment the ISC and to prepare a new 5-year science programme with following thematic areas:

- Water and climate
- Biodiversity, sustainable use and conservation management
- Natural capital, resilience and livelihoods
- Policy institutions and society
- Community relations
- The cross-cutting theme: Traditional knowledge and education.

Some Research (2000-2020)

New species in Iwokrama

From research done over the years, seven (7) new species that are new to science have been found in the Iwokrama Forest inclusive of a new species of Crabwood, Carapa akuri, bat, frog, lizard and more. Further research is needed to determine if any are endemic only to Iwokrama, Guyana or the Guiana Shield.

Invisible Carbon Study

In 2019, Iwokrama in collaboration with the Lyell Centre, Heriot Watt University commenced a study to look at invisible carbon in the water ways within the Iwokrama Forest. This research is focused on river carbon exchange building on the ground-breaking research at Iwokrama that identified a previously unrecognised component of the carbon pool, known as invisible dissolved organic matter (iDOM). This iDOM cannot be measured using remote sensing (e.g. satellite) or in-situ technologies (e.g. water quality probes).

Biodiversity study on Forestry Impact

Another study in 2019 saw Iwokrama in collaborating with the University of Guyana and the University of Kent (UK) with the selection of University of Guyana student, Arianne Harris, as the PhD candidate to assess the long-term impacts of Iwokrama's sustainable harvesting operation on faunal diversity, mainly birds and bats, in the Iwokrama Forest.

Fungal studies

Iwokrama commenced a collaboration with Purdue University in 2019 for an assessment of fungal diversity in the Iwokama Forest. While some previous work has been done on endophytic fungi, this study will add to Iwokrama's biodiversity records as the macrofungi of Iwokrama has not been yet officially documented. A preliminary list of marcofungi has been provided along with photographs.

Additionally, Dillon Husbands, Guyanese PhD student also collected data for her study on fungal infestation of Greenheart seeds by a new fungal species, *Xylaria karyophthora* which means 'seed destroyer'. Her work is looking at the transmission biology of this fungus.

Global Comparative Study

Iwokrama joined 12 other countries in collaboration with International Centre for Forestry (CIFOR) to review the progress of REDD+ within country. This study on Guyana was completed in July 2020 for Guyana.

Long term Scientific Collaborations

Jaguar Study – Drs Anand Roopsind and H Sambhu

This camera trapping study funded by WWF was done to assess the presence of Jaguars in the logging site. This data has been integrated with Project Fauna's work lead by Dr Jose Fragosa and the collaborative paper was published.

Camera trapping Study

*I*wokrama collaborated with Dr Matt Hallett on a camera trapping study to monitoring fauna in the Iwokrama forest including the Forestry areas. This body of work showed the first ever recorded sightings of bush dogs in the Iwokrama Forest, and these were seen in the logged area.

Operational Wallacea

Since 2011, Iwokrama has partnered with Operation Wallacea and Surama to implement faunal surveys that follow our Forest Impact monitoring methodology, within the Iwokrama Forest and Surama Village. Following the concept of targeting key indicator species the scientists that join this expedition focusses on birds, bats, dung beetles, herps and there have been some surveys looking at parasites in fish. Volunteers from Universities primarily from the UK, Canada, the USA and University of Guyana join the scientists to learn about methods in research relating to faunal surveys.

This exercise ensures that long term monitoring data is collected for Iwokrama and Surama which can be used to observe if any changes are happening within these areas. Several peer reviewed publications have been produced so far from this programme and many more are expected over the next few years.

For information regarding conducting research in Iwokrama please contact Dr Raquel Thomas, Email: rthomas@iwokrama.org or training@iwokrama.org Website: www.iwokrama.org

By

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July 2020

RARE EARTH ELEMENTS: A POTENTIAL RESOURCE OF THE CARIBBEAN REGION

Professor Ramsey McDonald Saunders
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Modern society has within a short time span become increasingly dependent on the ubiquitous mobile devices. These devices as well as a wide range of modern products, equipment and machines are dependent on the properties of a group of chemical elements called the Rare Earth Elements (REEs). The REEs consist of seventeen chemical elements that are so similar chemically that they are difficult to isolate. Although these elements are relatively abundant in the earth's crust (150 to 220 ppm) compared with other elements e.g. Zinc (70 ppm) they "rarely" exist in concentrations that are mineable.

The REEs are generally divided into two groups, the light (LREEs) which include the elements Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Samarium (Sm), Europium (Eu) and Gadolinium (Gd) and the heavy (HREEs) which include Yttrium (Y), Promethium (Pm), Terbium (Tb), Dysprosium (Dy), Erbium (Er), Thulium (Tm), Ytterbium (Yb) and Lutetium (Lu) and Hafnium (Hf). The LREEs are generally cheaper to produce and are produced in greater quantities than the HREEs.

To emphasize how diverse the applications are and the contribution that Caribbean countries can make, some applications are now highlighted. The glass industry is the largest user of the REEs where they are used in the precision polishing of glass and flat screen devices. They are also used as glass colorants and decolorants as well as in imparting special optical properties to glass such as increasing the refractive index which is related to the bending of light as it travels between two different layers. This is important in optical glass fibers to which REE dopants may be added enabling them to function as lasers. This is important in communication systems. Some are used in camera lenses as well as special colorants which provide light filtering and glare reduction. The ions of Neodymium (Nd^{3+}) and Europium (Eu^{3+}) are important in liquid laser systems. The REEs are important catalysts in the petroleum industry for breaking down large hydrocarbon molecules to smaller molecules which vastly increases the productivity of the petroleum industry. They also find use as catalytic converters in automobiles reducing carbon monoxide production. The manufacture of permanent magnets made from alloys of REEs is now of significant and growing importance. These magnets are among the strongest magnets and find applications in hard discs, cell phones, electric motors for automobiles as well as wind turbines and jet engines. REE alloys enable the engineering of magnets to function under a range of diverse conditions e.g. high temperature while remaining as permanent magnets and not losing magnetic strength as ordinary magnets do. REEs are in addition used in rechargeable batteries in hybrid vehicles Another application is as "mishmetal" or mixed metal to remove impurities in the steel making process. REEs also find applications in the manufacture of phosphors for cathode ray tubes, flat screens for displays and in light emitting diodes (LEDs). Gadolinium (Gd) phosphors are used in X-ray as well as MRI imaging. One interesting and new application is in the production of synthetic gems for lasers, microwave equipment, superconductors, nanofilters, memory devices, power converters, optical clocks and fusion energy.

Because of their wide and diverse applications in modern technologies, the REEs are of international strategic importance. As such their supply and availability to industry is important. China produces about 90% of the world's supply and is the main exporter of REEs. The ore concentration in China is low ranging from about 0.05% to 0.5%. In 2016 using Electron Microscopy and X-Ray Elemental Analysis (Figs 1 and 2), I observed that soil and rock samples in three areas Grenada had concentrations of REEs as high as 17%. Because Grenada is but one of the islands of the islands of the eastern Caribbean chain of volcanic islands it is possible that Grenada as well as other islands may have substantial supplies of high concentration and mineable REEs.

There is however the need for extensive research by regional scientists on the extent of REEs in the region. Since the REEs are a key to modern industry, it is important that the REEs be an integral part of the curriculum for students at all levels. Additionally governments at the highest levels perhaps via the CARICOM Secretariat should be fully seized of the potential and economic possibilities of the REEs of the region. Young Scientists should be encouraged to conduct research on the REEs. Areas should include Materials Science. Volcanology, Geology, Extractive Chemistry, Engineering, Marine Sciences, Seabed Mining, Environmental Sciences, Medical Sciences, Economics and Social Sciences.

It should however be noted that the extraction and purification of REEs may be very damaging to fragile island ecosystems and great caution must be taken if there is to be any exploitation of regional REE resources. A detailed study and environmental assessment of the quantities available and the type of mining permissible to minimize environmental degradation must be carried out. A necessary consideration must therefore be whether REE ore -mining is compatible with traditional island style living.

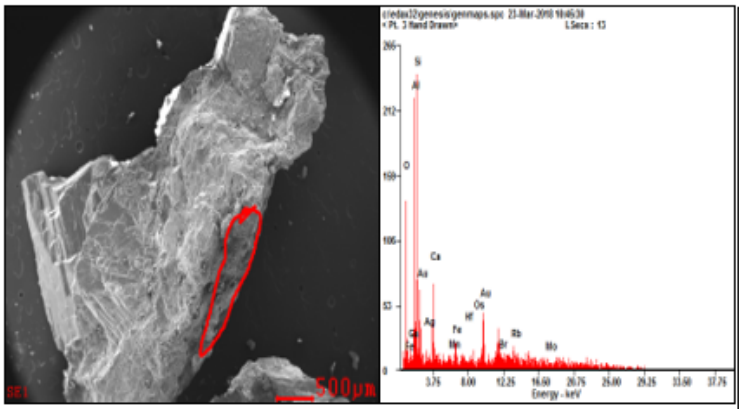
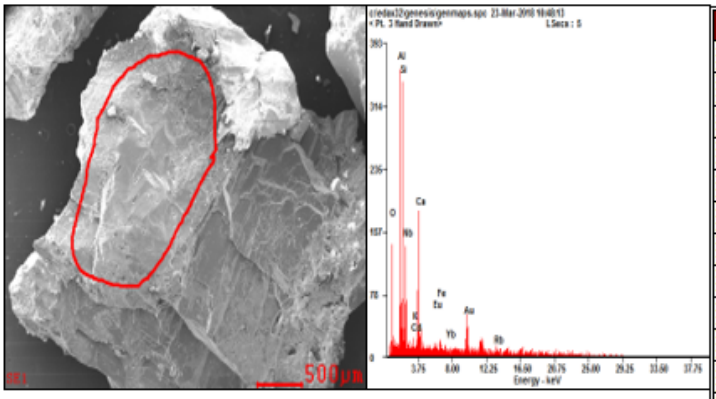


Figure 1. For this sample the Rare Earth element Hf (1.01%) is observed.

Element	Wt%	At%
OK	31.09	59.94
GaL	00.87	00.39
AlK	11.25	12.86
SiK	11.75	12.90
AgL	00.64	00.18
CaK	04.61	03.55
MnK	00.35	00.20
FeK	01.17	00.65
HfL	01.01	00.18
OsL	00.95	00.15
AuL	18.28	02.86
BrK	02.54	00.98
RbK	04.71	01.70
MoK	10.76	03.46
Matrix	Correction	ZAF



Element	Wt%	At%
OK	27.77	53.42
AlK	14.03	16.00
SiK	14.15	15.50
NbL	12.40	04.11
CdL	01.05	00.29
KK	00.15	00.12
CaK	07.89	06.06
EuL	01.08	00.22
FeK	00.91	00.50
YbL	01.38	00.25
AuL	16.51	02.58
RbK	02.68	00.96
Matrix	Correction	ZAF

Figure 2. This also indicates a solid structure which has a high concentration of the Rare Earths Yb (1.38%) and Eu (1.08%).

It should be noted that gold, Au, in both samples originate from the gold coating of samples required in Electron Microscopic analysis.

CAS Guadeloupe Chapter Update:

A focus on Geoscience

Dr. Yves Mazabraud, Assistant Professor, Université des Antilles.

We take the opportunity to share with you some of the accomplishments of the Guadeloupe DFA Chapter for the 2018-2019 period. These are unprecedented times which forces geologists to stay in confinement and cannot go out into the fields.

A group of 45 engineering students from the of Université Quisqueya, Haïti visited Guadeloupe in June 2018. They came to visit the Université des Antilles in Guadeloupe, for an end-of-study field-trip, in the fifth year of their degree programme. The trip was organized by Pr Saint-Fleur (UNIQ) and Y. Mazabraud (CAS, UA) under patronage of the CAS-DFA Chapter. They had the opportunity to visit the laboratories of our members, some infrastructures, such as the Geothermal power plant and the Volcanological Observatory, and to enrich their Caribbean cultural background. One of the highlights was the visit of the analytical platform C3MAG. They also went in the field, to study the geological formations of Guadeloupe, from rocks to soils to water resources. It was the opportunity for these young civil engineers to explore the link between the nature of the ground and its mechanical properties.

Students from UNIQ, Haiti, invited by the CAS, at the Université des Antilles, Guadeloupe

The first French National Day of Geology was held on May 14, 2019 , under the patronage of the National Geological Society. Hundreds of participants attended over sixty local events. In Guadeloupe, the manifestation was organized locally by the CAS chapter. CAS member Yves Mazabraud along with two geological engineering students, Yaëll Conchis and Laure Bouriat who were in a trainee period, led a one-day field trip in North-Eastern Guadeloupe. It was the occasion to discover or re-discover the iconic cliffs of the Grande-Terre landscapes and to learn more about the formation and the evolution of limestones under the Caribbean weather.

In November 2019, Yves Mazabraud (DFA, Guadeloupe Chapter) was renewed as a member of the Scientific Council of the Guadeloupe National Park and of the UNESCO Man and Biosphere Reserve of Guadeloupe, of which he is a member since 2013. He was also renewed as a member of the Guadeloupe Regional Natural Heritage Scientific Council (Conseil Scientifique Régional du Patrimoine Naturel), from which he was elected Vice-President in May 2019.

Participants enjoy the wonders of Caribbean Geology during National Day Geology.

CAS REPRESENTATION AT THE CARIBBEAN SCIENCE AND INNOVATION MEETING

PROFESSOR EMERITUS WINSTON MELLOWES AND DR. JEFFERY SMITH

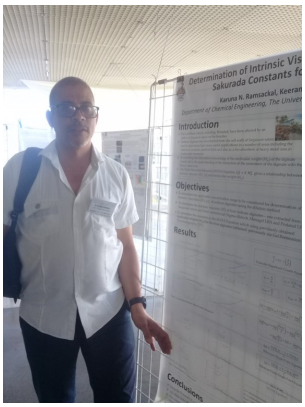
The Caribbean Academy of Sciences (CAS) President Professor Emeritus Winton Mellowes and CAS Member Dr. Jeffrey Smith represented the Academy at the *Caribbean Science and Innovation Meeting* held in Le Gosier (Guadeloupe) in October 2019. This meeting was a side event to the *International Meeting of Sargassum*, which was also held in Le Gosier from October 23 to 26, and which brought together specialists and stakeholders involved in the study and management of "the transit of Sargassum in the Caribbean and their massive stranding on the shores of the islands", and which is a problem that affects the health and economy of most Caribbean countries.

The *Caribbean Science and Innovation Meeting* was dedicated to the identification of scientific and technological priorities, common to Caribbean countries, for which cooperation can represent a key for development and innovation. The hope was that there could be a broadening of cooperation for Caribbean research and industry, starting from the positive experience gained during the periodic meetings organized by Caribbean scientific associations (Caribbean Academy of Sciences, CARISCIENCE, Caribbean Science Foundation). In addition, the sharing of the results already achieved and the strengthening of exchanges between researchers and entrepreneurs in the Caribbean could lead to the implementation of future collaborations and the identification of new cutting-edge activities in industry and research.

The opening ceremony included the official welcome, and speeches on behalf of CAS (delivered by Prof. Mellowes), CARISCIENCE, and Le Conseil Régional de Guadeloupe (delivered by Council Vice President, Dr. Sylvie Gustave-Dit-Duflo - herself a member of the Organizing Committee) . This was followed by the presentation of the CARICOM Science Award which was presented to Dr. Shirin Haque from the Physics Departments of The UWI, St. Augustine. Dr. Haque gave a presentation on *Exploring black holes and life in the Universe – a Caribbean perspective*. The keynote lecture *Research, Training and Innovation in Earth Science: a Caribbean perspective?* was delivered by Prof. Eric Calais, Department of Geosciences at the prestigious École Normale Supérieure in in Paris.

Participants at the meeting were drawn from the English, French, Spanish and Dutch Caribbean as well as from North America and Europe. There were some 66 oral presentations and 78 poster presentations over the course of two days. Conference themes included *Biodiversity & Health*, *Biodiversity-Chemistry*, *Natural Risks*, *Chemistry*, and *Biodiversity & Agronomy*.

Prof. Mellowes gave an oral presentation *Stimulating Regional Economic Development – A Case for Informal Science Education*, which had been prepared by Dr. Ruel Ellis from the Department of Mechanical and Manufacturing Engineering, The UWI, St. Augustine (CAS News, Vol. 2, Issue 4, December 2019, pp 1-2)



Dr. Jeffery Smith

Dr. Smith presented a poster *Determination of Intrinsic Viscosities and Mark -Houwink-Sakurada Constants for Sodium Alginates* on behalf of co-authors Ramsackal KN and Ward K. In this work the fact was noted that many of the islands of the Caribbean have been affected by an influx of Sargassum natans seaweed on their beaches, with the resultant adverse effect on their fishery and their tourism industries. Sodium Alginate may be extracted from the cell walls of Sargassum natans, and its derivatives have many useful applications in a number of areas including the chemical, cosmetic and medical fields and also as a bio-absorbent of heavy metal ions in wastewater treatment. In modelling this absorption, a knowledge of the molecular weight of the alginate would aid in the understanding of the interaction between the monomers of the alginate and the heavy metal ions. The work involved the determination of the intrinsic viscosity of various alginates via dilute solution viscometry methods and the determination of their molecular weights via these intrinsic viscosities in conjunction with the Mark-Houwink-Sakurada equation. The significance of the work is being able to determine the molecular weights of the alginates via dilute solution viscometry rather than more detailed and expensive methods such as Gel Permeation Chromatography.

The Scientific programme for the meeting ended with workshop/discussion sessions on *Tools and means for the development of collaborative research in the Caribbean: case study of INTERREG programme* and on *Design and establishment of a "university research school" in the Greater Caribbean including Central and South American countries of the Caribbean coast (EUReKA project)*. The aim was to work towards the establishment of a new research and education consortium bringing together Caribbean, Central and South American universities, research organizations and industries to address current and relevant topics for the Caribbean future. The CAS representatives at the meeting were able to contribute to these discussions.

On the following day, which saw an overlap between the the *Caribbean Science and Innovation Meeting* and the *International Meeting of Sargassum*, the Organizing Committee was kind enough to schedule a visit to the very impressive Mémorial ACTe (museum focusing on the history of slavery from Ancient times to the modern day).

The CAS representatives to the *Caribbean Science and Innovation Meeting* express appreciation and gratitude for the invitation extended and the hospitality shown by the Organizing Committee, whose members included CAS Fellow Prof Jean-Louis Mansot (Délégation Régionale à la Recherche et à la Technologie), Dr Thomas Forissier (President CAS Guadeloupe) and Prof. Olivier Gros (Secretary CAS Guadeloupe).

Workshop Discussion Session

Prof. Emeritus W. Mellowes and Dr. J. Smith

ENERGY, CULTURE & COVID-19

Dr. Kiron C. Neale
Energy Transitions & Mainstreaming Solar Energy Expert

To begin thinking about the implications of the COVID-19 pandemic for household energy cultures and energy transitions, it is worth firstly understanding that an energy system essentially represents all the social and technical elements connecting the supply of energy to its consumption. Therefore, an energy transition is a fundamental realignment of this system's policies, science, technologies, markets, cultures, and industries which usually unfolds over decades or centuries (see Geels (2018)).

So, what do modern energy transitions look like?

For instance, in Barbados in the Caribbean, there is one electricity utility company providing electricity to homes and homes pay the company for their electricity consumption. However, solar water heaters (SWHs) have been widely adopted by households i.e. they have been mainstreamed (Neale, 2020). Barbados' residential energy system consequently underwent a fundamental realignment (and one which has been going on since the 1970s):

- **Policy**: Various active-inactive cycles of tax credit policy support for SWHs.
- **Science**: Increasing efficiency of SWH technologies.
- **Technology**: Large-scale, centralized, utility-owned power generation units are now accompanied by the smaller, decentralized SWHs on houses.
- **Market**: The electricity consumption-bill payment model is now accompanied by a market for SWH services e.g. retailing and servicing
- **Industry**: Centralized institutional electricity services are now accompanied by local SWH manufacturing.

But what about 'culture'?

Stephenson et al. (2015) presented the concept of 'energy cultures' as the interactions between norms (thoughts), practices (actions), material culture (objects), and their external influences. For example, with lighting, the practice would be flipping the switch; a norm would be expecting that you can see more clearly due to the illumination; the lightbulb and switch are material culture; and an external influence will be the darkness of nightfall.

So, thinking about these dynamics with all the various appliances (material culture) that are in your home begins to show just how structured in-house activities are and these are further aggregated with other households using similar appliances hence the complex nature of household energy cultures.

In the case of Barbados, the mainstreaming of SWHs meant that consuming solar energy in the home is an example of a new norm; purchasing a SWH is an example of a new practice; SWHs became material culture; and sunlight, cloud cover and temperature are external influences since they affect the use of SWHs. In addition, all these developments are integrated into the previous energy culture linked to the pre-SWH residential energy system (see Neale (2020)).

So, how do these cultural dynamics relate to energy transitions?

Firstly, 'culture' has five key proactive and reactive roles during an energy transition (Neale, 2020). For example, in the case of Barbados:

Adaptive capacity: Though SWHs were assimilated culturally electricity is still very much the dominant structural element of the energy culture.

Reactions to changes: The creation of new norms, practices, and material culture due to the adoption of SWHs.

Resistance to changes: Varying degrees of available policy support for SWHs affected the perceptions and adoption of them.

Technological selectivity: There are norms that will make some SWH brands more culturally palatable.

Niche-creation: The prevalence of SWHs means that other solar technologies like photovoltaics (PV) are more culturally acceptable.

Secondly, norms, material culture, practices and external influences are not equally salient, and all have varying cultural saliences over time. Their saliences are very much linked to their roles in our lifestyles and routines as an energy transition unfolds. In the case of material culture for instance, one might find that appliances like televisions or washing machines are quite salient because they are used frequently every day/week versus others like an outdoor grill which are not frequently a part of daily/weekly household life.

So, where does 'COVID-19' come in?

Defining the scope of an energy transition is subjective and dependent on the scale of analysis. But in the broadest sense, it is likely that 'an energy transition' will not be the direct and immediate result of the COVID-19 pandemic. Rather, its developments represent aggregated forces that will, over a prolonged period of time, affect the opportunities that can shape a global energy transition that has actually already been underway i.e. the transition from fossil fuels to renewables – which many have referred to as the next transition in humanity's energy history.

Further, what is interesting is that the policy responses to COVID-19 e.g. testing, social distancing and working from home (see Roser et al., 2020) are all examples of non-energy policies that are having an 'energy' impact. The virus itself is an external influence on our household energy cultures but it is going through a series of translations through policies (which are themselves also external influences) that make the virus a 'change' force on/in the residential energy system.

All these policies created the 'lockdown' effect which essentially meant that the movement of energy users was modified and changed the 'where', 'why' and 'when' of energy activity in homes. For example, where persons previously went to work from 9am to 5pm for instance and used their desktop or laptops in the office during those times, they are now being used at home during times when they usually would not have been. It also means that the amount and costs of using this specific energy for 'work' is no longer consumed in the workplace or paid for by employers but rather in and by households.

For the full article please visit: link: https://lnkd.in/dUfJz5W.

The Pueblo Rural Initiative for Science Education (RISE) Programme: Guyana's Implementation

Dr. Mayrose Salvador and Ms. Petal Punalall Jetoo

Dr. Mayrose Salvador, Executive Director, Pueblo Science

Pueblo Science is a registered Canadian charity founded in 2010 by scientists working to advance science education across the world. We do this with a combination of local and international programs designed to engage children and spark their interest in science through active, hands-on learning experiences, discovery, experimentation and problem-solving opportunities.

Pueblo Science founders, Dr. Mayrose Salvador and Prof. Cynthia Goh, having both grown up in rural towns in the Philippines, have realized that improving the quality and accessibility of science education is one of the most effective and sustainable methods of advancing health and achieving economic success in developing countries. Their goal of overcoming limited resources and designing and providing effective teacher training aims at improving science education in low-resource communities. It empowers teachers to make science engaging and maximize their students' learning.

The implementation of the Pueblo RISE programme in Guyana resulted from a collaboration with the St. Stanislaus College Board of Directors, its Toronto Alumni Association and the Science Unit of the Ministry of Education.

During the period 2015-2019 four Pueblo Science workshops were implemented. A total of 324 teachers and 73 students benefited from these workshops. Three of the four workshops were held at the St. Stanislaus College, Brickdam, Georgetown.

In 2019, the fourth workshop was held in Region 6 and a summarized one-day version was held in Region 10.

Dr. Mayrose Salvador and Ms. Petal Punalall Jetoo worked in close collaboration to identify relevant content and activities that were aligned with the Caribbean Secondary Education Certification (CSEC) STEM subjects' curricula. The Pueblo RISE Guyana manual developed as a result of this collaboration, was provided to each teacher . Schools that participated received materials to support their immediate implementation of the RISE programme.

Students were engaged in robotics and chemistry in separate student sessions. A team of students that participated in the 2017 Pueblo workshop, volunteered to assist in supporting the implementation of the 2018 workshop. The students were paired with Pueblo facilitators. In some sessions students and teachers worked together in a shared learning space. These students immediately established STEM clubs for their schools using the Pueblo RISE manual and materials. The STEM clubs established at the Marian Academy, St. Stanislaus College, Queens College and the Bishops' High School resulted from students engagement in Pueblo Science workshops among other initiatives implemented through the Ministry of Education's Science Unit.

2018 Workshop Group Picture

Pueblo facilitators engage teachers and students

Mayrose and a group of teachers discussing intermolecular forces of attraction and performing less than one-minute activities to experiment on the concepts

Dr. Martin Labreque and Mr. Fuhad Rahman engage students in robotics

"I just want to say thanks a lot. In Guyana so far all I have learnt is to read the book and regurgitate what I learnt, but because of your program and series of intense application of my knowledge, it changed my view. Once again, I just like to say thanks for everything and if you all come back in the next two years, I should be able to volunteer, so I will stop by"

Student participant, 2017 (from an email to Dr. Mayrose Salvador)

Save the Date

March 2021 is the suggested date Guyana's hosting of the CAS 22nd Biennial Conference and General Meeting. Further details will be provided .

Guidelines for the submission of articles

I. Articles should not exceed 1000 words (1 1/2 pages)

II. Images should be submitted as separate files

Articles should be submitted to:

1. pjetoo@gmail.com
2. secretariat@caswi.org

Note: Editors reserve the right to edit the length.