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**“Promoting the professional and scientific interests of members to safeguard the public interest in the application of chemical sciences in water-related industries.”**

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## Message from the WSF Chair

Dear WSF Members

2020 has been a challenging year for everyone and the RSC along with its associated Divisions and Interest Groups is no exception. The Water Science Forum Committee last met face to face in January. Our planned May meeting was cancelled, but we held a remote meeting via MS Teams early in October.

There have been a few changes in our membership. We welcome Professor Fiona Regan and Dr Ana Castro-Castellon on to the Committee, filling the vacancies created earlier this year by the departure of Clive Thompson and Martin Padley, who had finished their second terms of membership, though Clive remains on the Science Program Group as a co-opted member. Two new vacancies have been created by the resignations of Zain Khan and Alexandra Borisova. The Committee thanks them for their contribution. Given the current pandemic, the Committee decided to delay recruiting further members until 2021. We will review the situation at our (online) January meeting.

There is one further departure of note. Our illustrious and hard-working Treasurer, Jonathan Mace has reached the end of his term. The Committee thanks him for his dedication and diligence in preparing our annual budget, monitoring income, and expenditure and generally keeping us on the straight and narrow. He will be a hard act to follow, and that unenviable task falls to Margaret McGuinness who has kindly volunteered to take over in the role.

All of our planned events for 2020 have been cancelled. It is likely that there will be no face to face meetings or conferences held by RSC Divisions and Interest Groups until the second half of 2021. However, the Science Program Group did meet in October and we are planning what we hope will be an interesting program of seminars as soon as normal service is resumed. In the meantime, we hope to host one or two webinars in the first half of 2021. Further details in the New Year.

On behalf of the WSF Committee, I wish all of our Members and their families a safe, happy Christmas and a prosperous, and hopefully Covid-free New Year!

Simon Gillespie

**Water Factoid**— The Antarctic Ice Sheet contains 30 million cubic kilometers of ice!



# Pharmaceutical Study on Breich Water—Bursary Report

Jamie Harrower from the Glasgow Caledonian University is extremely grateful to the Water Science Forum for receiving the Alan Tetlow Bursary. Jamie conducted a field work project on the Breich Water (West Lothian, Fauldhouse), with an aim to determine the concentrations of pharmaceuticals (including antibiotics) in river and waste water. During the fieldwork Jamie employed spot sampling together with passive sampling - Polar Organic Chemical Integrative Sampler (POCIS). The concept behind passive sampling is that the device can concentrate the pollutant/ lower Limit of Detections (LODs) on the disc (**Figure 1**). The discs are then placed in a metal support cage (**Figure 2**) and deployed in the river for the duration for the study (4 weeks). The discs are then removed from the field site and extracted using a suitable solvent, such as methanol or ethyl acetate. Limits of detection were in the range of  $0.01 - 0.1 \text{ ng mL}^{-1}$  using a High-Resolution Mass Spectrometry – Orbitrap.



Figure 1: POCIS



Figure 2: POCIS Disc in cage

Passive samplers allow Time Weighted Average (TWA) concentrations to be measured rather than a 'snapshot' which would be obtained from spot sampling. During the field study five sites (**Figure 3**) were selected, based on the position of the Waste Water Treatment Plant (WWTP) and accessibility.

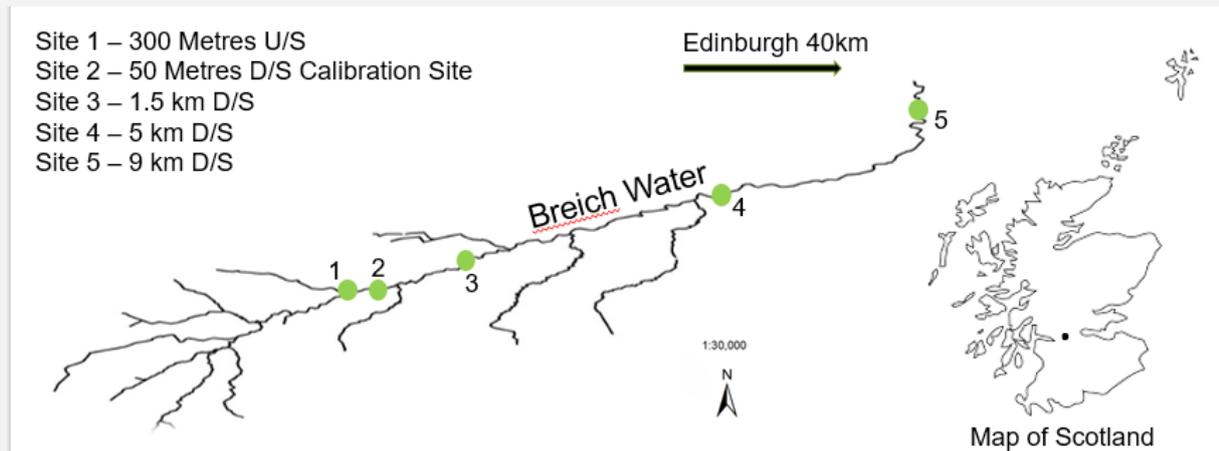


Figure 3: Map of field site and sampling positions

During the study carbamazepine and clarithromycin were present at every site, including the upstream (U/S) location. However, concentrations of these two drugs were present in much higher concentrations in the effluent and downstream (D/S) sites in comparison to the upstream locations. Prior to deploying the POCIS devices into the field they were calibrated in-situ at site 2 to measure the sampling rates ( $R_s$ ) of each individual compound. In-situ calibration of POCIS devices is much more favourable than calibration in the laboratory. This is because hydrological conditions, such as pH, salinity, temperature, flow rate and total organic content, can affect  $R_s$  of each individual compound. The results of this study have proven that POCIS can be calibrated within a small river catchment and be used to estimate TWA concentrations. However, future studies must be conducted in a different season to observe the differences in the sampling rates under different hydrological conditions.

WSF Events—Keep up to date with our future events on the [RSC event website](#)

If you would like to propose or help organise an event please contact [rscwsf@gmail.com](mailto:rscwsf@gmail.com)

# Antibiotics in the Water Environment Event— Occurrence, Detection, Fate

While the current world focus is very much on the COVID-19 virus pandemic, there already exists a serious and widely recognised threat to human health arising from the increase in antibiotic resistance to bacterial diseases. This led to a warning in November 2018 from the Chief Medical Officer for England, Prof Dame Sally Davies (now UK Special Envoy on Antimicrobial Resistance) that if no action is taken, antibiotic resistance is “at risk of putting medicine back in the dark ages”.

Antibiotics occur as widespread and persistent contaminants in water. They occur in urban water cycles and are found in surface waters, groundwater, drinking water and wastewaters. Typically, between 30-90% of the active pharmaceutical compound is excreted. Also, globally, two-thirds of the antibiotics produced are used in animal rearing, notably associated with intensive agriculture and aquaculture. Due to the increased worldwide usage of antibiotics, there is growing risk of new drug-resistant organisms evolving when they interact with bacteria present in aquatic environments. This can contribute to formation of so-called ‘superbugs’ which are of serious health concern. Antibiotics and their metabolites are also under scrutiny over their wider potential ecological impact and interaction with water treatment systems. A one-day meeting was held last year at RSC Burlington House to review the latest scientific knowledge relating to the impact and fate of antibiotics in aquatic systems.

Adrian Clark, WSF Committee, opened with a brief introduction to the issue of rising antibiotic resistance, describing the various awareness campaigns, and international action plans directed at combating antibiotic resistance and in reducing the occurrence and spread of antibiotics in the environment. The European Commission has now included antibiotics on their updated Watch List of substances to be carefully monitored in EU surface waters by member states. Dr John Wilkinson, University of York described a seminal project to monitor pharmaceutical contamination of rivers on a global scale and presented findings from the latest phase of research. This project has involved a consortium of over 100 collaborators, in the largest study of its kind worldwide. Dr Andrew Singer, CEH Wallingford, presented “AMR in the Environment: An Agricultural Case Study”. This project, again citizen science based, set out to measure the prevalence of azole fungicide resistance in *Aspergillus fumigatus* across the UK and in particular whether widespread fungicide application might lead to resistance. Professor William Gaze, University of Exeter Medical School addressed the environmental dimension of AMR. Antibiotic resistance is an ancient phenomenon in the natural world and has evolved over evolutionary time. While current focus is on the role of pharmaceuticals driving the emergence of AMR, relatively little account is taken of resistance genes originating in environment bacteria before being transmitted to human pathogens. The next speaker, Dr Jan-Ulrich Kreft, University of Birmingham, described the value of using a mathematical approach to predict the fate of antimicrobial resistance gene-carrying plasmids in activated sludge, which made use of an industry- standard Activated Sludge Model. Dr Barbara Kasprzyk-Hordern, University of Bath completed the morning session with a talk which focused on occurrence of enantiomerism in antibiotics and its impact on environmental fate.



Presentations in the afternoon session focussed on wastewaters. Mark Craig, Severn Trent Water Ltd discussed the prevalence and removal of selected antibiotics in wastewater treatment processes. He outlined the water industry Chemical Investigations Programme. The CIP is a collaborative project coordinated by UKWIR on behalf of UK sewerage providers, environmental regulators and DEFRA. It is aimed at improving our understanding of the prevalence of priority substances in wastewater and their removal. Mark presented results from Phase 2 (2015-2020). Results showed that in many cases there is only partial removal of antibiotics and being able to achieve the predicted no-effect concentration depends upon subsequent river dilution. A wide range of novel treatment technologies have been trialled as part of the CIP2 programme, so far with variable results. The next phase (CIP3) includes a more substantive investigation into AMR and antibiotic removal. Mark Sinton, Environment Agency, set out the Agency's interest in risk-based monitoring and management of chemicals in order to inform UK Government policy and priorities. He described the EA Monitoring Network which tracks 1,500 chemicals using GC-MS and LCMS and highlighted the distribution of WFD Watch List Monitoring Points across England. The final presentation was given by Professor David Graham, Newcastle University. The question was posed ‘are wastewater treatment plants a problem or a solution?’ David argued that effective operation of wastewater treatment plants is the most important way of reducing the spread of AMR, and that in many cases WWTP operations are not adequately controlled or optimised. This requires a better understanding of AMR ecology, genetics and engineering within WWTP systems. This final presentation sparked a lively debate which rounded off a very successful meeting.

PDF copies of the author-approved presentations will appear on the WSF Website under Past Events. Copies of poster abstracts are available on request from [adrian.clark@btinternet.com](mailto:adrian.clark@btinternet.com).



## In the News

**Coronavirus: Sewage tests detect local COVID-19 hotspots— *Sky News***

<https://news.sky.com/story/coronavirus-sewage-tests-detect-local-covid-19-hotspots-12111784>

**Researchers Uncover 2,000-Year-Old Maya Water Filtration System — *Smithsonian Magazine***

<https://www.smithsonianmag.com/smart-news/researchers-uncover-2000-year-old-mayan-water-filtration-system-180976186/>

**Plastic pollution to weigh 1.3 billion tonnes by 2040— *BBC News***

<https://www.bbc.co.uk/news/science-environment-53521001>

**Water quality could change in buildings closed down during COVID-19 pandemic, engineers say—*Phys Org***

<https://phys.org/news/2020-04-quality-covid-pandemic.html>

## Papers of Interest (RSC Journals)

- [Use of Chemcatcher® passive sampler with high-resolution mass spectrometry and multi-variate analysis for targeted screening of emerging pesticides in water](#)
- [Deep-bed filters as post-treatment for ozonation in tertiary municipal wastewater treatment: impact of design and operation on treatment goals](#)
- [Growth of Legionella during COVID-19 lockdown stagnation](#)

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## Water Science Forum bursaries

Water Science Forum bursaries have helped support research across a number of subjects. If you are interested in applying for our Water Science Forum Bursaries, up to £2000 is available per applicant for both the Alan Tetlow and Water Science Bursary. They are open to all WSF members from any country and the money available can be used for a wide range of activities including conferences, research, lab visits and research projects across a range of topics including water quality.

Contact: Hon Sec, RSC Water Science Forum, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK

See our website for more information: <http://www.rsc.org/Membership/Networking/InterestGroups/WaterScience/bursaries.asp>

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The views expressed in the newsletter are those of the authors and do not necessarily represent the views of the RSC, the Water Science Forum



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Water Science Forum are now on Twitter and Linked In. Please join us and become a group member by following the links provided below. We welcome your involvement with posts and conversations on all water related topics.



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