Pharmaceuticals in the Environment by **Dr Leon Barron** on 19 October 2018

Dr Barron began by saying that must of his work involves drugs, some detectable in fingerprints. Pharmaceuticals can get into waste water and the atmosphere, polluting it. New ones enter the environment all the time, at a rate that has been increasing since 2000. Sewage epidemiology assesses population health in areas with contaminated water. The sources of contaminants are sought, their degradability, one's exposure to them, and their effects. This applies not just to people, but to livestock and manure on farms, and to pets; and in the home or in hospitals. There is little legislation, the EU Water Framework does not regulate pharmaceutical waste, and there are no restrictions on treated sewage. Nevertheless, sewage epidemiology is being studied for population health assessment. The OSPAR (Oslo-Paris) convention of Atlantic European nations, aims to protect marine life by controlling pollution.

The liver is there to clear toxin from the body; polar compounds it can break down to harmless, or useful, chemicals. Non-polar compounds such as medicines and drugs it excretes, some being first combined with a metabolite to facilitate the excretion - most of these are from pills, only 4% from illicit drugs.

Sources include food (animals highly dosed with antibiotics to keep them healthy, or growth promoters), lifestyle (cosmetics, cleaning agents, atmospheric pollution), manufacturing chemicals, etc. These go into the sewer and the treatment works (typically serving a population of 3.5m). The main outputs of a treatment works are water and sludge, which will contain micropollutants and have bacterial resistance – with ecological effects. The sex ratio of fish can be wildly changed. Some drugs, tamed by the liver, can be stripped back to their potent state during treatment – making the effluent worse than the incoming raw sewage.

Drugs monitoring has been set up at sewage treatment works at 70 cities across Europe. Having collected a sample, usually daily, it is analysed for target materials, and the concentration normalised to the:

Amount in Doses per Day per 1000 Inhabitants.

This usually shows steady results on weekdays but higher at weekends. The collection and analysis across Europe can be patchy – not everyone has a good forensic laboratory. Cannabis is the most common drug, but for more kicks London has cocaine, particularly at weekends. A compound of cocaine & ethylene is much worse.

In the Czech lands, where they make them, and countries east, amphetamines are the drug of choice. What people prefer can vary from one place to another, even when quite close.

Other common drugs are from pesticides, the "pill", nicotine, sports doping, steroids in animal feed, etc.

Alcohol comes in at a greater usage than recommended (even without allowing for non-drinkers). There are a lot of antibacterial chemicals (hand soap) too – the most toxic antibacterial chemical is banned. However, organisms in the soil do produce their own; fungi are happy to eat and thrive on such chemicals.

Coastal pollution directly affects fish and other organisms, and then what feeds on them; for instance, mussels are filter feeders and can be badly affected, with some measured to have 50 nanograms of pollutant per gram body weight, when a more normal level in other fauna is around 1 ng/g.

Analysis of results is done by computer programmes, including artificial intelligence which 'learns' from initial input data what to look for and extracts results that would be difficult to spot by other means (though they still need to be scrutinised).

One important point was the question of the effect of a cocktail of drugs – the (range of) effects of individual drugs can be found. However, it is known, for instance, that aspirin & alcohol can cause stomach ulcers, and in other instances the potency of one drug can be increased tenfold by adding another. No one knows what a random mixture of drugs might do, even in low concentrations.

Dr Barron closed by saying that the levels of pollution were generally low, and not too hazardous. Micro-particles in the atmosphere could gather smaller particles on their surface, and be washed out by rain. Plastic was fairly benign chemically, but could rip cells apart if consumed – as has been seen in fish.