BACK BOX

Petrichor: rain's piquant perfume

Remember that delightful fragrance when rain breaks the summer drought? Its cause has always intrigued people. Now we know the answer. The smell comes from a yellowish oil trapped in the rocks and soil.

Its discoverer, the late Mr Richard Grenfell Thomas, called it petrichor—derived from the Greek words *petros*, a stone, and *ikhor*, the ethereal fluid that flowed like blood in the veins of the gods. Mr Thomas obtained this oil by steam-distilling rocks that had been exposed to warm dry conditions in the open.

In fact, he wasn't the first person to extract the oil thus. He later discovered a small Indian perfumery had been using it for years to produce a scent called *matti ka attar* or 'earth perfume'.

Miss Joy Bear joined Mr Thomas in 1957 to help him analyse what petrichor was, and she continued the investigations after his retirement in 1961.

The scientists' studies at the CSIRO Division of Mineral Chemistry revealed that the oil could be broken down into three fractions—a small basic one with a smell like pyridine, an acid one, and a large neutral one with a smell reminiscent of petrichor. No single fraction had the typical smell; so, as in many perfumes, the redolence must be the product of a whole range of them.

The largest fraction, the neutral one, contains aliphatic hydrocarbons, aldehydes, ketones, esters, lactones, and probably alcohols. The acid one contains nitrophenolic compounds as well as fatty acids.

Where does petrichor come from? Its smell seemed the same regardless of whether it was formed in the country, in suburbs, or in the air of central Melbourne.

The researchers became convinced that the traditional explanation—that it came from bacteria or fungal spores in the rocks and soils—wasn't right. They still got petrichor after exposing rocks treated with fungicidal mercuric chloride, or from ores too radioactive to permit bacteria and fungi to survive. Besides, dry conditions don't encourage bacterial and fungal growth. Instead, the scientists deduced, it comes from blue haze—that feature of hot summer days.

Blue haze probably consists mainly of terpenes—chemicals (that are found in turpentine) derived from plants. Apparently some 450 million tonnes of these volatile compounds get released into the atmosphere each year—mainly, at any one time, from those regions experiencing summer.

But the organic chemicals in the air are not quite the same as those in petrichor. By sucking a lot of air through special liquid air traps, the researchers showed that they could indeed obtain an oil chemically similar to petrichor, but with an unpleasant smell quite unlike the fragrance they were looking for.

They concluded that the volatile substances emanating from plants are first partly degraded and undergo oxidation and nitration in the atmosphere before being adsorbed and catalytically transformed on rocks and soil. Increasing humidity before the rain starts to fall fills the pores of the rocks with water, which washes the oil out of the stones, and thus releases its smell.

These findings have an intriguing implication—oil may be formed this way. The scientists' analyses of petrichor's fatty acids revealed that they were very similar in size and chemical structure to the paraffins found in some petroleum oils. Unfortunately the researchers could find no information about the fatty acids in recent sediments, so they couldn't compare these and clinch the argument.

Oddly, petrichor suppresses plant growth. You might expect otherwise—deserts, potentially the best petrichor-collecting regions, are famed for their sudden flush of growth after rain. But no; seeds of mustard, cress, and various grasses grown in contact with petrichor took longer to germinate and grew more slowly than normal. The longer the soil had been exposed, the greater was the effect.

Genesis of petrichor. I. J. Bear and R. G. Thomas. *Geochimica et Cosmochemica Acta*, 1966, **30**, 869–80.