Oil Eaters in Nature

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After being lashed around for six hours by a force 12 gale, the oil tanker *Braer* went aground on Shetland, northeast of the Scottish mainland, on January 5 this year. Some of the ship's tanks ruptured immediately, and oil began to spew on to beaches at the southern end of the island. Over the next few days, the entire cargo of 85,000 tons of light crude, plus 500 tons of bunker fuel, escaped into the sea.

Reflected in massive media coverage of blackened beaches, dead sea-birds and the astonishing quantity of oil sprayed onto the land by 110 mph winds, the incident was soon being described as one of the greatest maritime disasters the world had ever known.

Barely three weeks later, much of the oil had vanished from the heavily contaminated eastern and southern shores of Shetland, and the Braer incident had disappeared equally dramatically from newspaper headlines and television screens. Three months after the spill—and while birds, humans, fish, and shellfish have undoubtedly suffered some harmful effects—it's clear that the impact of the oil has been considerably less serious than was originally imagined.

Shetland, January 1993, can be logged as a lucky escape. But it was not human intervention that averted catastrophe. The incident should therefore sharpen our determination to understand much more fully those biodegrading processes in the biosphere that we could consciously control in handling major oil spills in the future. There is, of course, a running debate over the preferred strategy for bioremediation. Should we genetically engineer highly efficient strains and release them for defined purposes? If so, major regulatory and political difficulties lie ahead. Or should we seek instead to stimulate the indigenous flora by measures such as aeration and the provision of nutrients? Here we face metabolic uncertainties and the possibility of unknowingly converting nontoxics to toxics.

In either case, surely, the *sine qua non* is a thorough knowledge of the pathways through which xenobiotics are disassembled in nature.

Consider the evidence now beginning to emerge concerning organisms in the Persian Gulf. In addition to dealing with 160,000 tons of oil discharged every year (both legally and illegally), the microbial flora of the Gulf was confronted on January 19, 1990 with the single largest oil pollution incident ever known, when Iraqi forces released 500,000 tons of crude from the Mina Al-Ahmadi terminal. Overwhelming repercussions might have been expected— the obliteration of all forms of life.

Not so. Writing toward the end of last year in *Nature* (**359**:109, 1992), Thomas Hopner of the University of Oldenburg in Germany, with colleagues at the University of Kuwait, described the widespread appearance, since that devilish discharge, of blue-green mats of microorganisms embedded in mucilage, over oiled intertidal areas of the Gulf. The sole living things in these heavily polluted zones, the microbial mats were the first signs of self-cleansing.

As Hopner and his colleagues pointed out, there was no information whatever in the literature about mats of this sort before the Mina Al-Ahmadi incident. Yet every gram of fresh mat contained, embedded within mucilage produced by an associated cyanobacterium, up to a million cells of organotrophic bacteria capable of using crude oil and individual n-alkanes as sole sources of carbon and energy. It's still unclear whether the photosynthetic cyanobacteria can degrade oil. However, two obvious merits of the association are that the photosynthesizers provide the organotrophs with both oxygen and the mucilage that prevents them from being washed away into the open sea.

Here is an example of a hitherto unknown microbial consortium coming into existence in response to an exceptional challenge. Elsewhere, other contributors to oil disposal are being recognized for the first time too. O.O. Amund and T.S. Akangbou, for example, working at the University of Lagos, have just described (*Letters in Applied Microbiology*, **16**: 118, 1993) a hydrocarbon-degrading *Aspergillus niger* in the Lagos Lagoon that has been intensively studied in the past. Repeated spillages of both light and medium crude oil occur in this area, and previous sampling showed that species of *Micrococcus*, *Pseudomonas*, and other bacteria helped to clean up the waters. Now studies with oil-impregnated membrane filters have established that the fungus also plays an important role.

Equally significant, however, is Amund and Akangbou's discovery that the composition of the population alters as it attacks first the light and then the heavier fractions of the oil. Whether in the Gulf of Arabia or Mexico, the North Sea or Prince William Sound, it is not particular strains but consortia of organisms that purify our environment. They could do so even more efficiently with the informed support of biotechnologists in the future. This, surely, is the type of research which the oil companies should be supporting far more vigorously than they are at present.