14 January 1977, Volume 195, Number 4274 SCIENCE

Oil Spills

The grounding and gradual subsequent destruction of the ship *Argo Merchant* off Nantucket Island released most of a cargo of 28,000 metric tons of number 6 fuel oil. The circumstances furnished ingredients for a series of exciting news stories. On the air and in print there was liberal use of the terms disaster, ecological catastrophe, and destruction of fisheries.

Journalists might have provided a better perspective on the event. A considerable body of information about oil spills now exists. During the past decade ten incidents have occurred, each involving greater tonnages than that off Nantucket. An excellent source of information on the fate of spills is the comprehensive report *Petroleum in the Maritime Environment* issued by the National Academy of Sciences.*

When an oil spill occurs a series of dissipative mechanisms begin to operate. These are not effective in a confined or anaerobic environment. However, on the open seas with high winds, events move rapidly. First the spill spreads, and the 20,000-km^2 area mentioned in recent news accounts is in line with those seen in other spills after 2 weeks. The spreading is not uniform—part of the area has a thickness of a few millimeters, most has a thickness of about 10^{-4} cm. In any event, the circumstances favor evaporation of hydrocarbons. Substances with a molecular weight of 300 or less are volatilized quickly. Simultaneously the remaining material is subject to oxidative processes, especially in sunlight. The thin film of petroleum absorbs ultraviolet light and activated molecules react readily with oxygen to form more soluble, more surfactant products. In stormy seas yet another dissipative process is effective—removal via sea spray. Tiny drops containing hydrocarbons may be carried by winds as far as 100 km.

A wide variety of animals and microorganisms metabolize or detoxify hydrocarbons; the straight-chain molecules are particularly easily handled and can be the sole carbon source for some microorganisms. Hydrocarbons containing naphthenic or aromatic rings are slowly attacked. In contrast to some other lipid-soluble substances such as chlorinated hydrocarbons, petroleum compounds are not concentrated in food chains.

With removal of some of the constituents, the remaining hydrocarbons of the thicker patches of the present spill came to have the consistency of a thick pudding. With continued wave action the patches will break up, forming tar balls. These balls will have a density close to 1.0 g/cm^3 and when denser particulate matter is added may slowly sink. One mechanism for increasing the density involves copepods. These small sea grazers ingest particulate matter including small tar balls and later excrete the tar unchanged as part of a dense feces. Part of the tar balls will remain at the surface. At the various levels, currents with different velocities will dissipate the spill further. In the aerobic environment oxidation continues slowly. The probable lifetime of a tar ball is about 1 year.

The Academy report provides estimates of the major sources of hydrocarbons in the marine environment. In much of the sea and sea bottom biogenic processes are the principal sources of the hydrocarbons present. Estimates of annual biosynthetic production range from 3 to 10 million tons. A comparable amount, 6.1 million tons, was contributed by petroleum sources in 1971. Of the total, 2.1 million tons was lost during transportation. A nearly equal amount was derived from river and urban runoff.

Obviously, when 28,000 tons of heavy oil are released to the environment damage must result. Already there has been loss of some sea birds. Later, part of the tar balls may reach land, where they will be a nuisance. Incidents of this kind should be avoided and the perpetrators should be forced to pay for any demonstrable damage. But talk of an ecological catastrophe thus far is only talk. It has no factual basis.—PHILIP H. ABELSON

*Ocean Affairs Board, *Petroleum in the Maritime Environment* (National Academy of Sciences, Washington, D.C., 1975).