implement the policy of higher treatment standards has been estimated to be a further $2,600 million [Metocean Consultancy Ltd: *Newsletter*, Spring 1991].

A recent study by TNO, in the Netherlands, for the World Bank and European Investment Bank, estimated that it would cost $16 billion to clean up the Mediterranean Sea as a result of pollution [TNO *Newsletter*, February/March 1991].

With regard to instrumentation for monitoring of water quality, in the U.K. two authorities have been set up with statutory duties and responsibilities relating to the environmental quality of controlled waters. In England and Wales, this body is the National Rivers Authority (NRA) and in Scotland, the equivalent bodies are the River Purification Boards. Controlled waters cover all shallow waters including rivers, reservoirs, underground waters, estuaries and the sea to a distance of three miles from the shore. This responsibility also includes the maintenance and improvement of fisheries.

Disposal of effluents from industrial firms and sewage treatment works in liquid form to water courses is permitted only if consent has been obtained from the NRA. Apart from the water and sewage treatment companies, industry is not presently required to carry out self-monitoring and, therefore, the NRA carries out its own monitoring programs. This is expected to change as a result of the *Environmental Protection Act*. However, the general view is that the reliability of automatic on-line monitoring instruments in the U.K., or elsewhere in the European Community (E.C.), is still below that necessary for continuous monitoring.

It is estimated that the market turnover for instrumentation, control and automation technology in the water industry is in the order of $28 million to $35 million, with an annual growth rate of four percent to seven percent [Report by City University for Chemical Sensors Club, Lab of the Government Chemist, U.K.] The European market is estimated to be $150 million.

Problems experienced with on-line monitors include:

- fouling of probes
- inaccurate and unreliable information
- existing probes perceived as incapable of accurate measurement of ammonia, undermining the practicality of the monitor
- scepticism regarding self-calibration

Clearly, NRA is moving toward standardization of monitoring equipment. Developments include:

- Hand-held multiparameter monitor — The monitor will be used for effluent control and pollution incident prevention and, for fresh water applications, measures six basic parameters — pH, ammonia, dissolved oxygen, conductivity, turbidity and temperature. For tidal waters, only four parameters will be measured — dissolved oxygen, conductivity, solids and temperature. The approximate price of such a system would be $4,000, and around 700 systems will be deployed by NRA alone.
- Transportable remote continuous monitor with logging capability — It is intended that such a monitor would be left unattended for one month. The price would be approximately $9,000.
- Fixed station remote continuous monitor using mains power — The price range would be $35,000 to $50,000.

In the longer term, it is proposed that a substitute for the laboratory-based biochemical oxygen demand (BOD) test for deployment in automated monitors be developed. It is believed that total organic carbon (TOC) monitoring might be such a substitute.

As a consequence of EEC Directives and implementation of the polluter-pays principle, every coastal outfall in the Member States could require on-line monitoring instrumentation. It is estimated that there are approximately 100,000 such outfalls (there are approximately 250 in the Forth Estuary in Scotland alone). Assuming that the price of instrumentation is reduced to $20,000, this suggests a potential market of $2,000 million for monitoring instrumentation alone.