by John Noble and Harry Rothmans

In September last year the corpses of over 8,000 sea birds were washed up on our coasts from Northern Ireland, Ayrshire, Cumberland, Lancashire to North Wales. We may never fully understand how this disaster came about for only eight of the dead birds were properly examined for toxic chemicals etc. However, they all contained larger than usual amounts of one particular compound, polychlorinated biphenyl or PCB. To most naturalists the name PCB meant nothing. For this reason we feel that it is worthwhile summarising the current state of knowledge of environmental pollution by PCB.

PCB is not a single compound but a general name for a whole family of compounds with a common basic structure. Mixtures of PCB compounds have interesting properties enabling them to be used in diverse technical areas. Our awareness of the ecological implications of PCB is comparatively recent and so it comes as a surprise to many people that commercial manufacture of PCB was begun as far back as 1929 by the Monsanto Chemical Company of America.

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Since then PCB production has spread to most major industrial countries, including Britain. Monsanto are still the major manufacturer here and market PCB mixtures under the trade name Arochlor.

PCB is made by adding chlorine to biphenyls, terphenyls and other more complex poly-phenyls. Chlorination is done in special cylindrical steel towers three feet in diameter and eighteen feet high using special catalysts and heat.

The technical uses of PCB depend on their great chemical stability and special physical properties, which may be varied to suit specific applications. PCB has a number of uses in the electrical industry, in paints and varnishes where they have a similar role to oil except that they do not oxidise and lose their flexibility with age. Resinous products of PCB are an integral part of synthetic adhesives. Lubricants for use under extreme conditions often contain PCB.

The national and international production figures for PCB have never been published but we can see from the list of its applications that PCB is used on a large scale.

For such a widely used compound, toxicological data were pretty sparse, yet it was noticed recently that the effects of exposure to PCB are not limited only to the immediate location of its use.

Affects skin and liver

In the standard text on industrial toxicology, *Dangerous properties of industrial chemicals* by Sax, PCB is reported to have two distinct actions on the body, namely a skin effect and a toxic action on the liver. The lesion produced in the liver is an acute yellow atrophy... The higher the chlorine content of the diphenyl (=biphenyl) compound, the more toxic it is liable to be... The skin lesion is known as chlorache, and consists of small pimples and dark pigmentation of the exposed areas initially. Later comedones and pustules develop. In persons who have suffered from systemic intoxication the usual signs and symptoms are nausea, vomiting and loss of weight, jaundice, edema and abdominal pain. Where the liver damage is severe the patient may pass into a coma and die. PCB is also recognised as a disaster hazard, for highly toxic fumes are given off when it is heated to decomposition. Of course these are acute effects resulting from exposure to very high concentrations. Such a danger could only arise in the event of an industrial accident."

A very disturbing finding about the biological effects of PCB is that they can have an insidious effect on the hormonal system of birds. Hormones are vital in co-ordinating the complex biochemical reactions of living organisms. Any interference with the normal body-regulating effects of hormones could have a profound effect on an organism, for they control rates of growth, ultimate body size and shape, masculinity or femininity, mental and physical alertness.

Effect on birds

The way in which PCB interferes with the hormonal systems of birds, is complex and not yet fully understood. Only a small quantity of PCB can speed up the production of certain enzymes produced by small bodies in the liver, a process called enzyme induction. As a result, the calcium metabolism so vital in egg production, is disturbed.

This information becomes crucial when it is realised that PCB has been found throughout much of the global environment, even in measurable amounts (0.06 parts per million) in mother's milk samples in California. Environmental scientists are becoming increasingly concerned about any chemicals which can persist in the environment and be accumulated along food chains. How do they get into the environment and what long term toxic hazard do they present?

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leagues have reported that the highest levels of PCB are found in wild life from industrialised areas. In the few land birds and fresh water species examined by American scientists PCB was found, and it is quite likely that the compound is now distributed in the continental ecosystems of the United States.

Exactly how PCB gets into wild life is not yet known, for unlike organochlorine insecticides, PCB is not deliberately sprayed into ecosystems. There are however several possibilities. The fact that PCB residues are generally highest in creatures living near to industrial areas, leads us to suspect that PCB might escape from the factories manufacturing or using it. It could be released in effluent or PCB-containing hydraulic oils into the rivers, eventually reaching the sea. Another potential PCB source is air pollution. It has been suggested that transport by air currents explains the presence of PCB in remote regions like Alaska. As far as we know no one has recorded and measured the presence of PCB in the air. It might escape into the atmosphere during its manufacture at a point when high temperatures are reached. Alternatively, the burning of waste containing PCB may lead to atmospheric pollution. The Ministry of Housing and Local Government has started a research project to examine the sources of PCB pollution which will no doubt throw more light on this problem.

Long term effects?

PCB possesses great chemical stability and is therefore highly persistent once it escapes into the environment. It is likely that a steady build-up is occurring. Small amounts of PCB have been shown experimentally to have sub-lethal physiological effects on birds, and small amounts are now found in people. Will they have any long term toxic effect? Nobody knows, but do we have to wait? The best move might be to suspend further use of PCB in industrial processes until one has established its effects on ecosystems and human health. Such firm action would also act as a spur to industry to work more seriously in the future on the ecological implications of their action.

The almost accidental manner in which PCB pollution was discovered does not give us great confidence in the practical environmental monitoring efforts. Wild life populations are a sensitive one, said "our miner's canary", but only very rarely is there the necessary information about population dynamics to say with any accuracy whether a particular population is behaving in a peculiar fashion. It is necessary to finance, on a world scale, studies of a carefully selected range of species so that we can biologically monitor environmental changes. Any change in the numbers, behaviour or chemical composition of an indicator population would be noted and its cause searched for. It is a priority task, and the scale of activity in such monitoring ought at least to be tied to the increasing rate of industrial activity. The cost of such a "doomwatch" activity may be high, but if it helps mankind to avoid large scale ecological disasters, it is a price that has to be paid.

Harry Rothman, aged 32, is a graduate in Zoology, and has a deep interest in ecology and its political implications. He lectures in the Department of Liberal Studies in Science, Manchester University on the social relations of science and technology. In 1971 his book on Industrial Society and Pollution will be published by Hart-Davis in UK and Bobbs-Merill in USA.

John Noble, aged 22, graduated from the Liberal Studies in Science Department last year (1970). There he read "Science Greats" an honours course designed to develop "scientific generalists"

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