Pb in Seawater 1879

Lead Concentrations in Beirut Waters

Forty-eight samples were collected from the northern seashore area of Beirut and analysed for lead by atomic absorption spectrophotometry.

Lead concentrations of 5-10 ppm were found at distances over a kilometre from the shoreline, while concentrations of 10-30 ppm were found closer (about 100-200 m) to the shore especially around the port area.

Lead is one of the natural elements that easily accumulates in the environment and has become of increasing concern to human health. Chisolm (1971) reported that lead poisoning is a major source of brain damage, mental deficiency and serious behavioural problems, and can also inhibit the biosynthesis of haem, a constituent of haemoglobin.

There have been many tests of the amount of lead a person can take up without damage. It has been found that the body can excrete up to about 0.3 mg of lead daily. Respiratory intake of lead ranges from 5 to 50 μg daily for people who live in large cities. This does not cause noticeable damage but long-term exposure can cause measurable amounts of lead to accumulate in the bones. If the intake of lead exceeds 1.0 mg/day, clinical disorders will occur (Chisolm, 1971).

Environmental lead pollution has several sources. With the use of lead in exterior paints, petroleum fuels, linings of sewage pipes and solder of pipes, there is now a greater danger of a higher level of lead getting into the human system.

The main sources of lead pollution come from leaded gasoline, lead arsenate pesticides and industrial wastes. Marine organisms are able to concentrate lead in their tissues. Of importance are those that are directly utilized as food by man. Craig (1967) found lead concentrations ranging from 1.09 to 2.57 ppm in the bivalves, *Venus mercanaria* and *Spisula* sp. in waters containing from 0.4-42.0 ppm. Dorfman and Whitworth (1969) found a reduced rate of growth in brook trout in water with a concentration of 25 ppm lead. Brown and Ahsunallah (1971) found a marked decrease in the growth of larvae of two marine animals, *Ophryotrocha* and *Artemia*, which showed a decrease in their life span within a given period. Their life span decreased by half with the addition of 5 ppm lead.

Natural lead found in the sea is at a standard concentration of 0.0003 ppm (Dorfman & Whitworth, 1969). The maximum solubility of lead salts in the sea is 0.9 ppm and this is not thought to be toxic to marine organisms. Lead had been found in organisms in a concentration 1400 times greater than the surroundings (Gafford, 1970). The large concentrations of lead building up in the sea are now thought to be the result of exhaust from automobiles which is being washed into the sea (Portmann, 1970).

Lead at its natural concentration of 0.0003 ppm is determined by either the co-precipitation or solvent extraction method. Co-precipitation can be used to recover lead concentrations of 20 ng/l., while the use of atomic absorption spectrophotometry allows determination of concentrations of as low as 0.28 ppm (Dorfman & Whitworth, 1969).

Collection of Water Samples

A survey was conducted to investigate the lead content in a major fishing area of Beirut. Preliminary sampling was conducted over the area extending from the American University of Beirut to the Jounieh power plant. Water was sampled from the fifteen locations along the shore shown in Figure 1. Sampling was done on 2 October, 1971, 19 November, 1971 and 12 March, 1972. One litre samples were collected in glass bottles from the top 30 cm level at a distance of approximately 200 m from the shore. The samples were allowed to settle for at least 30 days. Samples which had a large

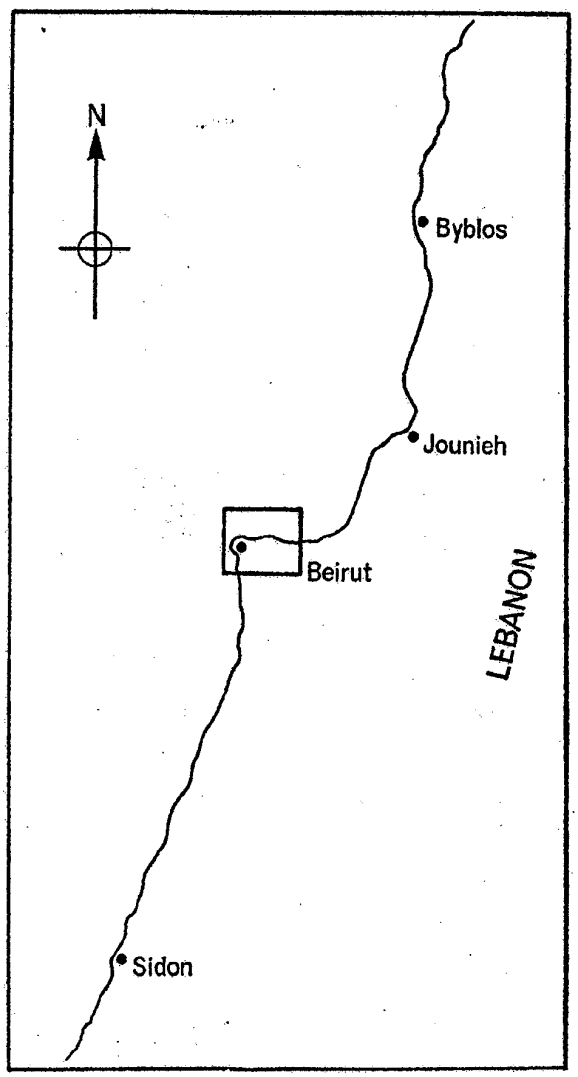

Fig. 1A Lebanese coastline showing location of surveyed area boxed in. Samples 1-8 and 13-15 are included inside box. Samples 9-12 are from the area between Beirut and Journieh.

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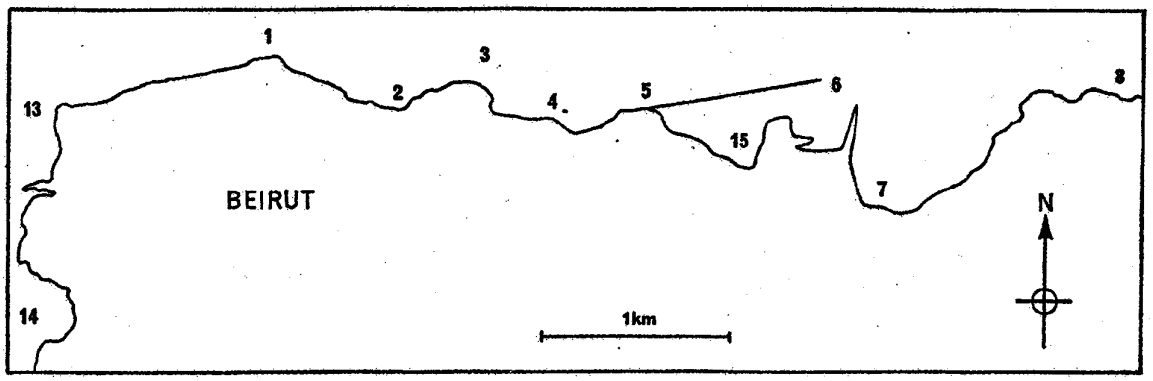

Fig. 1B All numbers correspond to those under locality in Table 1A. They represent only general location. There is no exact correlation between the different samplings. (Samples 9-12 were taken north of Beirut.)

quantity of suspended particles were filtered through Number 2 Whatman paper.

Analysis for Lead

The analysis was done on a Varian Atomic Absorption Spectrophotometer at the College of Petroleum and Minerals, Dhahran, Saudi Arabia.

Calibration curves were constructed employing the standard addition method. A volume of distilled water of 5 ml containing 5, 10, and 15 ppm of lead were added to 20 ml of seawater samples. Using distilled water as a blank, the absorption percentage was determined for each sample at a wavelength of 217 nm following instructions given in the manual for the Varian Techtron Model AA-5. A sample calibration curve is shown in Figure 2.

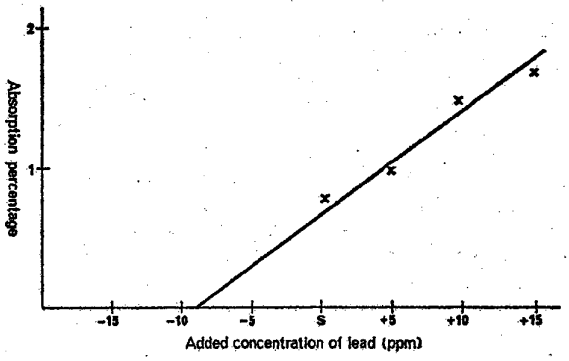

Fig. 2 Sample calibration curve. Negative intercept represents the concentration of lead in ppm of the original sample. Positive numbers represent the added concentrations of lead in ppm.

Results and Discussion

The results of analyses of water samples from various locations along the shore in the vicinity of Beirut are given in Table 1.

The range of lead concentration in the area of Beirut that was sampled ranged from less than 2 to 30 ppm. The great fluctuation in the same general area could be due to different amounts of runoff rain water, sewage and other wastes, and also due to changes in wave action and water currents.

The lower concentrations probably do not affect the fish in the area, but the higher levels could very easily affect marine life drastically.

Dorfman and Whitworth (1969) and the report by Brown and Ahsunallah (1971) indicate that the concentration of lead is high enough to affect the growth of some fish. Craig (1967) points out that lead is a cumulative poison, hence the concentration of lead in the Beirut waters may be built up in animal life. Gafford (1970) and Portmann (1970) report that the concentration is far above the standard set for naturally-occurring lead, and it is greater than the maximum solubility, which implies that it is being held in suspension. In addition, concentration of lead by fish and other organisms could constitute a hazard to the population using such animals for food. There are a number of possibilities that could account for the high concentrations of lead. It could build up from the burning of wastes at the sea shore dumps. Exhaust from automobiles (using leaded gasoline) that is being washed into the sea could also be an important factor in the buildup of lead. It is concluded by Chow (1971) that such exhaust fallout is the major source of lead in sea water.

TABLE 1
Lead concentration of samples collected from the sea north of Beirut.

Locality	Sample	I	II	IIIA	IIIB	IIIC
American University of Beirut (1)			<2	15	8	20
Ain Mreisseh (2)				19	12	19
St. Georges (3)			7	12	13	19
Ajram (4)				10	17	10
Breakwater beginning (5)				10	5	9
Dock mouth (6)		25	18	10	9	16
Dump I (7)			15	11	9	11
Dump II (8)				16	15	9
Shell dock (9)				20	15	8
Distant offshore (10) (1-5 km)		5	5	10	8	12
Dog River mouth (11)		10				
Jounieh power plant (12)		23				
Military Beach (13)				30	13	12
Pigeon Rocks (14)						8
Inside Dock (15)		16				

Samples I, II, and IIIA, B and C were taken on 2 October, 1971, 19 November, 1971, and 12 March, 1972 respectively.
All lead concentrations are in ppm. The numbers given to the various localities are used to indicate sampling positions on map shown in Figure 1.

The problem of lead poisoning in Lebanon has not received the attention that it had in many other countries of the world. It may seem that the problem is even worse than it would appear because the largest amount of fishing is at the points of highest lead concentration. The point of highest lead concentration is the west end of Ras Beirut, point 13 in Figure 1, which is heavily fished. The dock area which is a centre of net fishing in Beirut, also has a high concentration of lead.

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JOHN G. SHIBER*
BRYAN RAMSAY†

American Community School, Beirut, Lebanon.

* Present address: Purdue University, Lafayette, Indiana, USA.
† Present address: University of Notre Dame, Notre Dame, Indiana, USA.

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Polychlorinated Biphenyls in North Atlantic Seabirds

Polychlorinated biphenyls are usually thought to be discharged in industrial effluents and therefore to be commonest in inshore waters close to centres of industry. It now appears that high concentrations are found in pelagic-feeding seabirds from the North Atlantic, far from possible industrial sources of these compounds.

Organochlorines have been known to be present in British seabird eggs for a decade (Moore & Tatton, 1965), and substantial amounts in a pelagic seabird frequenting one of the remotest North Atlantic breeding sites, the Bermuda petrel *Pterodroma cahow*, and traces in Antarctic species, for half that time (Wurster & Wingate, 1968; Sladen *et al.*, 1966). At first these were identified as pesticides and their metabolites, but more recently polychlorinated biphenyls (PCBs) used in industry have been detected as well, at first as a source of interference in other estimations and then as additional contaminants (Jensen, 1966; 1972) in a number of highly polluted areas in Europe and North America such as the Baltic (Jensen *et al.*, 1969), Dutch Waddenzee (Koeman *et al.*, 1969) and coast of California (Risebrough *et al.*, 1968).

Their presence was noticed in British seabirds such as the guillemot and kittiwake in the first report of their occurrence in British wildlife (Holmes *et al.*, 1967) but, while a few quantitative estimations are given in one review of their occurrence in British birds (Prestt *et al.*, 1970), and considerable concentrations were found in the livers of some of the large auks washed up starving around the Irish Sea in the autumn of 1969 (Holdgate, 1971), there is still comparatively little published information available on their occurrence in the more pelagic species in the North Atlantic. We are therefore placing on record the results of a preliminary examination of a number of birds collected in the course of other work in areas between Britain and the Arctic.

Methods

The specimens examined were selected to include a representative range of the more marine species and types of body available for analysis. All tissue samples were subjected to Soxhlet extraction overnight with hexane: acetone. After evaporation of the solvent, the residue was made up with hexane. Muscle and liver samples were cleaned up on florisil columns directly, while fat and oil samples were subjected to dimethylformamide liquid-liquid partition, (De Faubert Maunder *et al.*, 1964) before florisil. PCBs along with DDT compounds were separated from DDD and pp'DDT on silica columns (Holden & Marsden, 1969) or more commonly by saponification with alcoholic KOH. PCBs were identified by the peak pattern obtained on three gas chromatography columns, SE-30, GEXE-60 or SE30-QF1 compared with a peak pattern obtained using a standard mixture Aroclor 1254 (Monsanto). The identity of the peaks was confirmed by mass spectrometry. PCBs were quantified using a method similar to that of Risebrough *et al.* (1968). This method gave excellent results using Aroclor 1254, but the relative peak heights in the seabird samples are different from those with Aroclor 1254, introducing some inaccuracies. However, the relative peak heights in all the seabirds were similar and direct comparisons between them can be made with greater accuracy. While DDE, which was the commonest of the other organochlorines present, cannot be separated satisfactorily from a PCB with a similar retention time, in the majority of the samples where the PCB/DDE ratio is low the interference by PCBs in the determination of DDE is fairly small. Where the ratio is larger than ten, the interference is substantial. In the results given in Table 1 the DDE value is calculated from the total height of the peak with a retention time equal to that of DDE. Thus where the PCB/DDE ratio is large, it should probably be even greater than that recorded.

Results

The results are interesting in a number of respects. In the first place, the relation found between PCBs and