PD-ABE-190
77357

TRIP REPORT ON ENVIRONMENT & HEALTH IN THE BALTIC COUNTRIES

January 11 - February 12, 1992

Prepared by:

Clyde Hertzman MD, MSc, FRCPC

WORLD ENVIRONMENT CENTER
419 Park Avenue South, Suite 1800
New York, NY 10016

May 1992

DISCLAIMER

The opinions expressed herein are the professional opinions of the author and do not represent the official position of the Government of the United States or the World Environment Center.

Environment and Health in the Baltic Countries

by

Clyde Hertzman MD, MSc, FRCPC

My investigations into environmental health conditions in Latvia, Lithuania, and Estonia were the first I conducted in republics of the former Soviet Union. In comparison to Poland, Hungary, Czechoslovakia, and Bulgaria (herein, the non-Soviet republics or Central Europe) which I previously investigated, they were notable for a general lack of useful data on the human health impact of environmental pollution. This difference could not be attributed to an absence of public health agencies similar to those found in the non-Soviet republics since, in a superficial sense, the institutional structures are quite similar all across Central and Eastern Europe. However, the Baltic republics seemed to have additional obstacles to the effective evaluation of environmental health problems not encountered in Poland, Hungary, Czechoslovakia, and Bulgaria.

In the Baltics, the agencies responsible for environmental measurement and public health investigation tended to have stronger reporting relationships with Moscow than with each other. This lead to a low degree of inter-agency co-operation and made the agencies susceptible to manipulation according to interests which conflicted with their (theoretical) mandate to protect the public's health. This point cannot be overstated. Unlike the non-Soviet republics, the capitals of the Baltic countries, until independence, were little more than regional administration centres, with the main lines of communication running from each governmental and quasi-governmental agency to a central authority in Moscow. With independence, these countries are now trying to turn the local administrative "branches" they inherited into policy/regulatory agencies. This means learning such basic habits as sharing information between agencies; planning monitoring protocols which are appropriate for local circumstances; making decisions based on locally collected information; critically appraising past practises; and not accepting the advise of others as though it were edict.

The level of technical sophistication brought to environmental health investigations was also lower in the Baltics than in the non-Soviet republics. In particular, there was virtually no local capability for measuring metals in human blood or for making spirometric measurements of lung function as part of field studies. Over-exposures to lead and respiratory diseases among children were the two principal findings in hot spot areas in the non-Soviet republics and might have been expected to top the list of environmental health problems in the Baltics, too. Therefore, the most important environmental health outcomes were virtually all underinvestigated. Many of the investigations which were conducted involved naive methods, making it difficult to make a valid interpretation of the data. This, too, is evidence of technical unsophistication.

Finally, it would appear that the conceptual models used to explain health and disease in the former Soviet Union are much less influenced by Western traditions than they are in the non-Soviet republics. Health is seen in more "holistic" terms, and "preventive medicine" tends to mean visits to a health spa rather than protection against specific diseases or exposures. It is not the purpose of this presentation to compare the relative merits of Eastern holism with the more mechanical organ-system approach of Western medicine. Unfortunately, however, when it comes to evaluating the influences of environmental chemical exposures on human health, it is necessary to adopt a "problem-oriented" approach which focuses on the specific biological effects of the exposures in question and

not on health status as a whole. Thus, the holistic approach is often unhelpful when it is applied to toxic substances in the environment.

Despite these limitations it is possible to identify and evaluate a considerable number of important human health concerns related to environmental pollution in the Baltic countries. These are presented country-by-country later in this document. The section immediately following this one presents national health status information on the three countries as a group, since these patterns show marked similarities with one another.

Population Health Trends

Like other countries in Central and Eastern Europe, life expectancy among both men and women in the Baltic countries currently lags behind "the West" by several years. Table 1 shows that Baltic life expectancies are similar to those of the non-Soviet republics, but with notably large male-female differences. Latvia, in particular, with a 9.9 year male-female difference in life expectancy, is the largest among countries for which data are available. Because the Baltic countries were part of the Soviet Union, it is useful to consider, also, how life expectancy evolved in comparison to the Union as a whole. Table 2 places the historical evolution of Baltic life expectancy in the context of Soviet, Czech, and Western/Northern European changes from the 1950s to the 1980s. From this table it can be seen that the relative decline in life expectancy in the Baltics was not as great as for the Soviet Union as a whole. In 1955-60, overall Soviet life expectancy overlapped with the Baltic countries, but, by the 1980s, had fallen behind. At the same time, Table 2 shows the way in which the life expectancies of all the Central and Eastern European regions had fallen behind the West. The pattern of relative decline in the Baltics most closely resembles the Czech Republic, which typifies the patterns of change found among the non-Soviet Republics.

It is not clear why the evolution of life expectancy in the Baltics should more closely resemble the non-Soviet Republics than the Soviet Union itself. Three possible reasons deserve consideration. First, the Baltics were among the wealthiest part of the former Soviet Union, and increased socioeconomic status (among both individuals and countries) is known to be a powerful determinant of better health status. Second, the Baltics were among the most Westernized parts of the former Union, and may have come to adopt (unspecified) "healthy" cultural characteristics from the West, to a greater degree than the rest of the Union. Finally, the Baltic countries are notably absent of any areas of large-scale environmental devastation of an intensity that could have a major impact on life expectancy, such as are found in many places in the rest of the former Soviet Union.

Notwithstanding this unresolved question, historical comparisons of the evolution of life expectancy between the Baltic countries and Finland provide important new evidence about the nature of the East-West life expectancy gap. The Finnish experience is vital because it was part of the Czarist empire until 1917, like the Baltics, and, like them, enjoyed a period of independence between the Wars. However, during World War II Finland was not reincorporated into the Soviet Union like the Baltic countries were. This makes the historical comparison of the evolution of life expectancy a kind of quasi-experiment, with all variables held constant except the nature of the post-war political/economic system.

Table 3 shows the Finland-Latvia comparison (which typifies all the others). These two countries emerged from more than a century of Czarist domination with virtually identical life expectancies. This similarity remained unchanged throughout the inter-war period *and afterward until the late 1960s!* During the 1970s and early 1980s a life expectancy gap emerged: 6 years for males and 4 years for females. This is the best evidence we have so

Table 1: Current Life Expectancy in International Perspective

Country	Year	Life Expectancy	
		Males	Females
Japan	1988	75.8	81.9
Sweden	1987	74.2	80.4
Switzerland	1988	74.0	81.1
Netherlands	1987	73.6	80.3
Canada	1987	73.3	80.2
Australia	1987	73.2	79.8
Norway	1987	72.8	79.8
France	1987	72.6	81.1
W. Germany	1988	72.3	79.1
United Kingdom	1988	72.5	78.2
United States	1987	71.6	78.6
Finland	1987	70.7	78.9
E. Germany	1988	69.7	76.0
Yugoslavia	1987	68.5	74.3
Bulgaria	1990	68.1	74.8
Czechoslovakia	1988	67.7	75.3
Lithuania	*1989*	*67.7*	*76.6*
Poland	1988	67.1	75.7
Estonia	*1988*	*66.6*	*75.2*
Hungary	1988	66.1	74.2
Latvia	*1989*	*65.3*	*75.2*

Table 2: Historical Changes in Life Expectancy, Baltic Republics, USSR and Other Places in Europe

Region	1955-1960		1980-1985	
	Males	Females	Males	Females
Estonia	64.3	71.6	64.6	74.4
Latvia	65.2	72.4	64.4	74.2
Lithuania	64.9	71.4	65.5	75.4
USSR	*64.4*	*71.7*	*63.0*	*73.0*
Czech Republic	*68.2*	*73.7*	*66.9*	*74.1*
Northern Europe	68.1	73.3	71.3	77.3
Western Europe	67.1	72.5	70.9	78.2

Table 3: Historical Evolution of Life Expectancy in Finland and Latvia

Years	Males		Females	
	Finland	Latvia	Finland	Latvia
1921-30	50.7	50.7	55.1	56.9
1931-40	54.5	55.4	59.6	60.9
1956-60	64.9	65.2	71.6	72.4
1961-65	65.4	66.5	72.6	74.0
1971-75	66.7	65.2	75.2	74.7
1981-85	70.1	64.1	78.4	74.4
1988	70.7	66.3	78.7	75.1

far that the life expectancy gap cannot be put down to an historical lag of East behind West, or to changes which were evident immediately following the establishment of the Soviet Union, but that its explanation is firmly rooted in East-West differences in the conditions of life during the 1960s, 1970s, and 1980s.

Similar patterns of mortality account for the life expectancy gap between Latvia and Finland as they do for East-West differences generally. Table 4 shows that Baltic infant mortality rates are higher than those of most Western countries, but not enough to account for a large fraction of the overall life expectancy gap. In all three countries the period of the emerging life expectancy gap is dominated by increases in age-specific mortality rates for ages 40-64, whoch run concurrent with mortality declines in this age range in the West. By 1988, cardiovascular disease mortality rates in Latvia were 30-100% higher than in Finland for males and females aged 35-64 and 65-74. This was by far the largest component of the life expectancy gap.

The observation of greatest interest from the environmental health perspective is the fact that mortality rates for respiratory diseases in early childhood (age 0-14) were 4.2 and 7.4 times higher in Latvia for females and males, respectively, than in Finland. This represents a small fraction of the life expectancy gap but is of interest because it is consistent with the observation that neonatal respiratory mortality rates were 7-8 times higher in the most heavily air polluted parts of the Czech Republic compared to the unpolluted areas.

Table 4: Current Infant Mortality in International Perspective

Country	Year	IMR/1000	
Japan	1988	4.8	
Sweden	1987	6.1	
Finland	1987	6.1	
Switzerland	1988	6.8	
Canada	1987	7.3	
W. Germany	1988	7.5	
Netherlands	1987	7.6	
France	1987	7.8	
Austria	1988	8.1	
Norway	1987	8.4	
Australia	1987	8.7	
United Kingdom	1988	8.9	
Belgium	1986	9.7	
United States	1987	10.1	
Latvia	*1988*	*11.1*	*(1990--13.5)*
Lithuania	*1988*	*11.9*	*(1990--10.2)*
Czechoslovakia	1988	11.9	
Portugal	1988	13.1	
Estonia	*1988*	*14.3*	*(1990--12.4)*
Bulgaria	1990	14.8	
Hungary	1988	15.8	
Poland	1988	16.2	
Yugoslavia	1987	25.1	

Estonia

At present, the main priorities for Estonia do not have to do with environmental protection. They include assuring the food supply, returning land to private ownership, and creating a convertible currency and modern banking system. Nonetheless, environmental protection is recognized to be an important priority to address after the current crisis is over. Some initiatives are being taken even now.

Evaluation of the public health impact of environmental pollution in Estonia is carried out by several agencies operating in a relatively uncoordinated fashion. These include the Sanitary Epidemiology Stations, the Institute of Preventive Medicine, the Institute of Experimental and Clinical Medicine, the Estonian Cancer Registry, the Institute of Hydrometeorology, the Ministry of Environment, and the local environmental committees. The role of each is discussed below.

Ministry of Environment/Local Environmental Committees--The Ministry of Environment is the lead agency in environmental protection in Estonia. Its current priorities are to improve the value of the forests; to find less polluting ways to burn oil shale so that Estonia can maintain energy self-sufficiency; to decrease emissions from the chemical industries which use oil shale; to upgrade the Eesti Tsement plant, which is a major source of dust pollution; to upgrade wastewater treatment throughout the country to comply with the Baltic Sea convention; and to decrease SO_2 emissions by 30% and NOx emissions by 70% in compliance with international conventions. A special problem, with international political overtones, is the recent discovery of two small nuclear reactors at the Soviet submarine training base at Paldiskips on the Baltic coast. Soviet military facilities have been closed to Estonian environmental officials, so nothing is known about the environmental impact of these reactors, or whether or not there are other environmental problems at the other military bases around the country.

There is a debate currently going on within the Ministry as to whether or not they should continue to use Soviet environmental standards or switch to those of the Nordic countries or the European Community. As in other locations where this debate rages, the case for Soviet standards is based on the fact that they tend to be more stringent than their Western counterparts and that it is valuable to maintain comparable standards throughout the region. The argument for Western standards is that they represent enforceable, rather than ideal, conditions and that harmonizing regulations with the West is becoming increasingly important for economic progress. Nonetheless, Ministry officials estimate that it will take 10-20 years to bring the country into compliance with even the less stringent Western standards.

At present, the Ministry is in a relatively weak position to fulfill its leading role in the environmental field. Aside from being strapped for cash, the Ministry does not have its own air and water measurement capabilities (found in the Institute of Hydrometeorology) and has had no control of the environmental monitoring program in the past. It has not been highly sensitive to human health priorities and has no staff with expertise in evaluating the public health impact of environmental pollution. The most positive development to date has been the decentralization of environmental regulation. Local environmental committees have been established in 19 regions which are financed by a share of the fines and fees levied on local polluters. The local environmental committees are responsible for collecting these charges and they seem to have considerable latitude in determining local environmental protection priorities.

Sanitary Epidemiology Stations--Like in all Central and Eastern European countries there is a regional network of Sanitary Epidemiology Stations which have primary responsibility for traditional public health concerns. However, in the regions where there are significant environmental health problems, such as Narva and Kohtla-Jarve in the Northeast, the San-epi stations have been active in the field. For instance, in Narva the San-epi station has participated in large-scale health studies of pollution and health, collected some air and drinking water quality data, and kept track of occupational health problems. The head of the San-epi station works closely with the head of the local environmental committee; the San-epi laboratory does work for the environmental committee and the two agencies carry out joint inspections of industrial facilities. Nonetheless, the relative weakness of the San-epi station in environmental health is demonstrated by the fact that they have only 1 full-time staff member devoted to the field.

The specific regulatory powers enjoyed by the San-epi stations were not easy to comprehend and seemed to vary from location to location. The most intriguing description given to me came from Kohtla-Jarve, where one large chemical industry, PO Slantsekhim, is the principal source of concern regarding environmental pollution. Under the old system the San-epi station was the principal agency doing environmental protection in the plant. The plant worked with the San-epi station in planning environmental controls and in introducing new technology; both of which required San-epi approval before introduction. The San-epi stations had some powers to fine the plant for violations of environmental regulations found on inspection, although the amounts were small. When occupational diseases from the plant were detected at the local polyclinics and confirmed in Tallinn, a certificate would be forwarded to the San-epi station. This would often precipitate a joint investigation by the head of San-epi and the plant safety manager. Similar investigations would also occur after major accidents or acute poisonings. The San-epi station would refer some incidents to the procurator (prosecutor) for consideration, and, also, would take some issues directly to the city committee and the Communist Party committee. I was left with the impression that this latter had been an effective, although informal, avenue of response in the past.

At this time the Kohtla-Jarve San-epi station has lost its right to impose fines but seems to have retained its right of inspection and evaluation of new products/technologies. Nonetheless, I had the strong impression that political factors, rather than formal regulatory powers, actually determined what would and would not be done by the San-epi station in the near future. Furthermore, the modus operandi described in Kohtla-Jarve seemed to be unique. In contrast, there are other regions with significant environmental concerns where the San-epi station has taken no regulatory initiatives at all with respect to the principal polluting industry and one, Sillamae, where the Soviets established a special San-epi station which was outside Estonian control. This was done because the major local "chemical" industry was a source of ionizing radiation pollution and, also, of strategic importance to the Soviet Union.

Institute of Preventive Medicine--The Institute of Preventive Medicine operates under the auspices of the Ministry of Health, and serves, in part, as a service research center for environmental health problems throughout the country. It has a department of hygiene with four subunits: the laboratory of children's health protection, laboratory of atmospheric air toxicology, laboratory of food toxicology, and chemical sanitary laboratory, each of which carries out some investigations in "human ecology". Most of the usable environmental health information in the country has emerged from this Institute, although, conversely, only a small fraction of what they produce under the rubric of "human ecology" is helpful for the purposes of evaluating the impact of the chemical

environment on human disease. The principal reasons for this have already been outlined in the introductory section of this report.

In addition to the problems of lack of computerization and up-to-date analytical equipment similar to those in Central Europe, the Institute of Preventive Medicine has faced two other important obstacles to its work; one of which is in the process of being solved while the other is likely getting worse. The first problem is the long tradition of secrecy associated with birth and death statistics, and attendant concerns about poor quality control and outright falsification of these data. Until last year, they were controlled by a central statistical agency in Moscow which was resistant to the Institute's special needs for vital statistics. In 1991 the data were taken over by Estonia, and there is confidence that the problems with secrecy and quality control can now be solved.

The second problem, a much more intractable one, is that the Institute of Preventive Medicine and the San-epi stations are seen as remnants of the old order by Estonian nationalists working in environmental health. The main reason for this is that, until recently, there was no public health training in Estonian medical schools. All the public health specialists were trained in Russian in Leningrad, and tended therefore to be ethnic Russians. This has led to an atmosphere in which Estonian-dominated agencies, such as the Ministry of Environment, are reluctant to accept the professional credentials of public health staff, trust their work, or recognize a legitimate role for them in environmental health regulation.

It is true that Russian training in non-infectious disease epidemiology is completely inadequate and, also, that the research protocols used by the Institute of Preventive Medicine have tended to come, pre-packaged, from Moscow and then been implemented uncritically in Kohtla-Jarve and other polluted areas. But these are shortcomings which need to be corrected through professional unpgrading and are not an appropriate basis for ostracizing public health agencies from the environmental health field. At present there is a disturbing tendency to distort the work done by Russian trained personnel and to dismiss all initiatives taken by them. This poisoned atmosphere has already hampered the environmental health effort in Estonia. It will not be easily combatted because the most outspoken "Russophobes" are proud of their ethnocentricity and are not deterred by calls to put professionalism before nationalism, especially when voiced by outsiders such as me.

Institute of Experimental and Clinical Medicine--This experimental medical research institute has started an epidemiology and biostatistics department along Western lines and devotes a large share of its resources to environmental health issues. Nine projects were described to me, including experimental carcinogenesis studies on oil shale products; development of an asthma and bronchitis registry; studies of the environmental determinants of gastrointestinal diseases in rural areas; hygiene studies of polycyclic aromatic hydrocarbons in water bodies and fish; and four separate studies of populations exposed to occupational or environmental agents. Unfortunately, all of these investigations were at an early stage and I was not able to obtain any usable results in the short time available to me.

The Institute does not see itself as a service research agency, and is not interested in doing studies which cannot be defended on rigourous scientific grounds, even if they might be important for public health decision-making. Its main financial support has come from scientific foundations and it does not feel under pressure from the Ministry of Health to engage in service research. However the Institute has done contract research, which it sees as a source of added revenue, when it can be done to international scientific standards. Despite its tendency to take a strictly academic approach to its work, all nine of the Institute's current environmental health projects are relevant to regulation and policy-

making. The Institute's leaders complained to me that this work was being ignored by the regulatory agencies since they (especially the Ministry of Environment) did not have specialists who understood it. This complaint proved to be well-founded, and, in fact, I was the first individual to explain some of the Institute's work to the Ministry of Environment and help create contacts between them.

Estonian Cancer Registry--Estonia has a cancer incidence registry of international calibre that is reliable back to 1968 and is estimated to have an ascertainment rate of 95-98% of incident cancers. The data is registered by 17 local areas, creating the potential to do regional variation studies. This potential was exploited in the late 1960s, but then cancer data were classified as secret, and remained so until two years ago. Now, new cancer incidence and mortality maps are being generated and the cancer incidence data for the last 5 years has been computerized.

At present there are no plans to use the registry for linkage to occupationally or environmentally exposed populations. This unfortunate state of affairs seems to be due to uncertainties at the Registry (and in the Institute of Experimental and Clinical Medicine where it is housed) as to whether or not environmental cancer studies can been carried out in a valid way. Ironically, in a part of the world where environmental health data of low quality is often accepted uncritically, the culture around the Registry and its parent Institute is more unforgiving of the natural limitations of environmental health investigations than would be found almost anywhere in the West.

Institute of Hydrometeorology--In Estonia the vast majority of air and water quality monitoring is done by the Institute of Hydrometeorology, which has operated according to a sampling strategy laid down by Moscow authorities 15-20 years ago and not changed substantially thereafter. This has meant that there has been little input from the Ministry of Environment, local environmental committees or Ministry of Health regarding what, when, and where to monitor. The Institute has 2 stations for monitoring transboundary air pollution, 6 air monitoring stations in Tallinn, 4 in Kohtla-Jarve, and 2 in Narva. Their measurement capabilities include dust, CO, SO_2, sulfate, phenols, NOx, NH_3, formaldehyde, and hydrogen fluoride. They have no capability to measure airborne lead. The choice of what to monitor at each station is based on the nature of the local emission sources. All stations measure dust and SO_2 but only one station, in Tallinn, measures all compounds.

The air monitoring system is based on grab samples taken during 3 one hour periods each day. Only one continuous, on-line monitoring apparatus exists in the country, at Kohtla-Jarve. There have been quality control problems with the system, the most serious of which concerns the measurement of SO_2. In 1991, the method of measurement was changed to one which would involve less cross-contamination with other sulphur-based compounds. As a result, measured SO_2 levels appeared to decline approximately 10-fold. In addition, there has not been any routine air monitoring capability in several other important locations, such as Kunda (site of a heavily polluting cement plant), Sillamae (site of a chemical facility of strategic importance under the old Soviet regime), and Kehra (site of a pulp mill with significant airborne effluents). Because the Institute has tended to operate autonomously from the Ministries responsible for regulating environmental pollution there have been few special collaborative efforts involving air monitoring. The only example I could document took place in the town of Saka, near Kohtla-Jarve, in collaboration with the Institute of Preventive Medicine.

Water samples are collected from 26 rivers at 58 points, as well as in 21 points in Lake Peipsi and 52 points in the Baltic Sea. The priorities used for selecting monitoring

locations include protection of fish stocks, control of known point sources of water pollution, and protection of drinking water sources. However, they do not monitor the water supplies themselves. This is done by the owners of the "pipes". In addition to traditional water quality parameters, they measure phosphates, ammonia, phenols, oil products, six forms of organochloride pesticide, and detergents.

Until now the Institute's main inter-agency responsibility was to report monitoring data, by day, month, and year, to the Ministries of Environment and Health, city councils, and targeted scientific organizations. Now a new monitoring committee has been set up, involving representation from the Ministries of Environment, Health, and Agriculture; the Institute of Hydrometeorology; Tallinn Polytechnical School; and some local environmental committees and other scientific Institutes. Its mandate is to review the whole environmental monitoring program, identify future monitoring priorities, and determine the equipment and expertise needed to achieve these priorities.

Environmental Conditions of Concern to Public Health

Air Quality--In general, air quality in Estonia is not as unfavourable to human health as it is in the most heavily industrialized and urbanized areas of Central Europe, such as Silesia or Northern Bohemia. This seems to be due to three factors. The country is not heavily industrialized and nowhere are large numbers of highly polluting industries clustered close together. Tallinn is the largest city and there are concerns about traffic emissions there; but it is nonetheless too small to generate the degree of traffic pollution found in a place like Budapest. Finally, strong winds which often blow across northern Estonia favour long-distance transport of pollutants, especially to Finland, rather than local deposition. Table 5 compares sulfur dioxide and dust levels from the areas of greatest concern in Estonia with data from Latvia, Lithuania, Bulgaria, Hungary, Poland, and Czechoslovakia. The sulfur dioxide levels recorded in Estonia are several-fold lower than the highest levels in Central Europe, despite the fact that the Estonian sulfur dioxide data is known to be overestimated until 1991, when their analytic method changed. The dust levels, which are likely more accurate, show that only Narva comes close to the levels in Central European hot spots.

Table 6 helps explain why Narva's dust levels approach Central European levels. It identifies the principal non-transportation sources of air pollution in Northeastern Estonia. The two leading sources are the Baltic and Estonia Power Plants which produce prodigious quantities of sulfur dioxide and dust. These two plants are located on the Narva River within a few kilometres of one another and on the outskirts of the city of Narva. They are the only power plants in the world using oil shale as a fuel. It is inefficient and dirty, but it is mined locally in Northeastern Estonia in an extensive network of open pit and underground operations. Also in the local area is the city of Kohtla-Jarve, where the chemical industry Slantsechim is located. As table 6 indicates, it is an airborne polluter of a large variety of toxic substances, some of which are emitted in significant quantities. It also relies on oil shale as one of its principal resource inputs. Nearby is the town of Sillamae, which houses chemical and metallurgical industries that use radioactive input materials such as tantalum oxide, niobium oxide, and thorium. There is also thought to be a uranium dump site there, but these facilities are still cloaked in secrecy. It is not surprising that the Narva-Sillamae-Kohtla-Jarve area is considered to be the main environmental pollution hot spot in the country.

Table 7 summarizes the worst case air quality conditions in Estonia. Worst case short-term conditions are represented by the 95th percentile concentrations of the one-hour air samples for the three routinely monitored cities while the worst case long-term conditions are

Table 5: International Comparison of Air Quality

a. Sulfur Dioxide

Country (date of samples)	Range of Ambient Levels (ug/m^3)
Czech Republic (1981-1988)	0.4-184
Hungary (heating season 1987-88)	36-112
Poland (1988)	3-636
Bulgarian Hot Spots (1989-90)	28-485
Estonian Sites:	
Kohtla-Jarve (1990)	40
Narva (1990)	50
Tallinn (1990)	90
Saka (1990)	82
Latvian Sites:	
Ventspils (1989)	20
Daugavpils (1989)	<10
Liepaja (1989)	<10
Riga (1989)	10
Lithuanian Sites:	
Vilnius (1988-90)	10-25
Kaunas (1990)	70-160
Canada (1985)	0.2-45

b. Dust

Czech Republic (1981-1988)	18.3-222.8 ug/m^3
Silesia (1987)	174-318
Estonia Sites:	
Kohtla-Jarve (1990)	100
Narva (1990)	200
Tallinn (1990)	100
Saka (1990)	36
Latvian Sites:	
Ventspils (1989)	100
Daugavpils (1989)	100
Liepaja (1989)	100
Riga (1989)	100
Lithuanian Sites:	
Vilnius (1988-90)	60-166
Kaunas (1990)	160-370
Canada (1985)	17-100

Table 6: Air Pollution Emissions in Northeastern Estonia

Point Source	Substance	Tonnes/year
Baltic Power Plant	sulphur dioxide	126,000
	dust	125,000
Estonian Power Plant	sulphur dioxide	126,500
	dust	53,600
Kohtla-Jarve PP	sulphur dioxide	3,500
	dust	2,300
Kohtla-Jarve Slantsechim	sulphur dioxide	5,559
	dust	941
	carbon monoxide	700
	aliphatic hydrocarbons	3,109
	aromatic hydrocarbons	3,575
	ammonia	373
	hydrogen sulphide	19
	sulphuric acid	120
Combined Point Sources	lead	57
	mercury	38

Table 7: Worst Case Air Quality Conditions in Estonia, 1990

a. short-term

Substance	95th Percentile (ug/m3) Narva	Kohtla-Jarve	Tallinn	30 Minute Standard
Dust	384	61	99	500
Sulphur dioxide	166	154	193	500
Sulphate	28	32	26	----
Carbon monoxide	2576	2720	2280	5000
Nitrogen dioxide	74	55	45	85
Nitric oxide	52	71	15	400
Hydrogen sulfide	4	6	3	8
Phenol	---	4	4	10
Ammonia	---	182	74	200
Formaldehyde	21	18	21	35
Hydrofluoric acid	---	---	13	20

b. long term--exceedances of daily MAC by annual average concentrations

Substance	Narva	Kohtla-Jarve	Tallinn	Daily MAC
Dust	200	---	---	150
Sulphur dioxide	50	---	90	50
Ammonium	---	50	---	40
Formaldehyde	9	5	8	3
Phenol	---	5*	---	3

*OPSIS measure

represented by average annual concentrations which exceeded the Soviet daily MAC's. *It can be seen from the table that none of the worst case short-term conditions exceeded even the stringent Soviet standards.* Although there were some exceedances among measurements at the 99th percentile, these would not likely represent sufficient exposure time to human populations to be of health significance. On the other hand, average annual concentrations exceeded the daily MAC's for 2-3 of 5 monitored substances in each monitored city. Even if the sulfur dioxide data is discounted, dust and formaldehyde levels are elevated in Narva; ammonium, formaldehyde, and phenol are elevated in Kohtla-Jarve; and formaldehyde is elevated in Tallinn. The sources of phenol and formaldehyde in Kohtla-Jarve include the waste dump of the chemical plant, which towers over the town, and also the plant itself.

Another air pollution parameter of special interest is benzo(a)pyrene, a carcinogenic polycyclic aromatic hydrocarbon which is emitted from motor vehicles and is also a byproduct of oil shale processing. In 1990 the average measured benzo(a)pyrene concentration in Tallinn, with the largest population and highest traffic flows, was 1.0 ng/m^3 (maximum=2.7) and in Kohtla-Jarve, where the chemical plant is a point source, was 1.12 (maximum=3.8). In contrast, Narva, which has a population of less than 100,000 and no major point source of benzo(a)pyrene, had an average concentration of 0.35 (maximum=0.9), approximately three times lower.

The other principal air emission source *of regional significance* is the Eesti Tsement plant in Kunda, in the region of Laane-Viru east of Tallinn. A photograph of the town of Kunda was featured in a National Geographic article on the Baltic countries showing houses in the vicinity covered with a thick layer of cement dust, creating the impression of permanent snow cover. This impression is borne out on visiting the town. Also unmistakable is the enormous quantity of dust emerging from the plant's several stacks, which is quantified in table 8. The composition of the 75,000 tons of dust per year is of interest because 13.5% is silica (which has toxic effects on the respiratory system beyond simple dust deposition) and there are greater than trace amounts of a wide variety of toxic metals present as well (6 of which are reported in table 8). *In light of these realities it is remarkable that no routine or special air quality data exists for Kunda up to the present and that the regional San-epi station has taken no interest in human health issues associated with dust emissions there.*

Water Quality--At present, problems with water quality in Estonia have lead to restrictions in its recreational use and to replacement of certain polluted local drinking water supplies with more expensive, distant sources. In Estonia there are 24 public beach areas, of which 10 have been closed to swimming during the last 3 years due to microbiological pollution. Closures have occurred mostly in the Tallinn, Parnu, Haapsalu, and Kohtla-Jarve areas on the coast, in two locations on the island of Saaremaa, and on a lake in the Viljandi district. In each case the problem is attributed to untreated or inadequately treated sewage, which is an almost universal problem in Estonia. Since swimming tends to be forbidden at the beginning of the season, only one person is believed to have contracted a disease from swimming in the past three years. Public health authorities are particularly concerned about beach closures because they believe that swimming is important for optimum development of the respiratory organs in children. Thus, they tend to view beach closures as a threat to health protection, much like that which might be posed by an interruption in the supply of vaccines against childhood diseases.

Because of groundwater pollution, mainly with oil products, it has been necessary to transport drinking water to the inhabitants of some districts of Rakvere, Tapa and Kuressaare, and also to Tamsalu and some small settlements near Tartu. The water supply in Kohtla-Jarve is piped in from the Narva River because of groundwater contamination in

Table 8: Characteristics of Dust Emissions from Eesti Tsement

Total dust	**75,000 tonnes/year**
Selected major components of dust:	
Al_2O_3	3.6%
MgO	2.7
SiO_2	13.5
CaO	42.5
Major toxic metals in dust:	
Arsenic	36.1 grams/tonne
Cadmium	0.9
Mercury	0.1
Lead	60.0
Thorium	4.8
Uranium	6.0

Table 9: Summary of Lead Exposures in Estonia

Location	Children's Hair Lead (1.0=Tartu)	Ave.Children's Blood Lead	Ave. Adult's Blood Lead
Tartu	1.0	---	---
Kohtla-Jarve	2.5	---	17.1 ug/dl
Saka	2.3	10.5 ug/dl	---
Narva	2.1	---	---
Sillamae	2.0	---	---
Tallinn	---	---	8.3 ug/dl

the area. In Kivioli, which is another industrial settlement near Kohtla-Jarve, the soil has been contaminated with hydrocarbons, which, in turn, has contaminated the groundwater.

The most severe industrial water pollution problem in Estonia involves the waste pile at Slantsechim in Kohtla-Jarve. This enormous pile is watered regularly to reduce dust emissions, since it is close to human settlements. The resulting bright red runoff enters the Purtse River, raising the phenol levels to 300-1500 times the standard of 0.001 mg/l. This discharge has killed all the fish in the river and also in the Kohtla River it feeds into, as far as the Gulf of Finland. We were told that the pile itself is relatively impermeable to water, since it is mostly composed of semi-coke, and therefore has not yet affected groundwater or wells within 200 metres of the waste pile. This assertion does not jibe with the reality that water for Kohtla-Jarve is being piped in from the Narva River.

Another important industrial water pollution problem concerns discharges from the Baltic and Estonian Power Plants. In both locations cooling water is discharged into the Narva River, which is 6-9 ^{o}C warmer than the receiving waters, increasing its temperature 2-3°C at each discharge point. Also, there is in excess of 1.5 million tons per year of runoff into the Narva River from each of the limestone "ash fields" which serve as slag heaps for each of the power plants. (These are 8 km^2 and 11 km^2 in area at the Estonian and Baltic plants, respectively.) Their runoff is highly basic, with a pH of 12-13.

The Maardu chemical plant on the outskirts of Tallinn discharges high concentrations of phosphite and sulfate into the Baltic Sea, the latter being as high as 2000mg/l in the receiving waters. It is suspected that the chemical and metallurgical works in Sillamae are a source of radioactive discharges into the Baltic. There is also concern in Estonia about water pollution due to agricultural drainage from fertilizers (nitrate pollution) and enormous numbers of farm animals concentrated in large farming operations (microbiological pollution).

Hazardous Waste--Industry in Narva and Kohtla-Jarve, as well as the oil shale mines in the vicinity each generate more than 1,000,000 tonnes of waste per year(all of which seems to be labelled "hazardous"), while Tallinn and Sillamae each generate between 100,000 and 1,000,000 tonnes annually. There are four "ash hills" for oil shale waste: one adjacent to each of the Baltic and Estonian Power Plants, one adjacent to the Slantsechim chemical plant in Kohtla-Jarve, and a fourth nearby in Kivioli. Although each of these is classed as an "ash hill" the processing wastes in Kohtla-Jarve and Kivioli have much greater toxicity than the power plant wastes. Other specialized landfills for industrial wastes are found in Kunda, Maardu, Elva, Voru, and Haapsalu.

Human Health Problems Associated with Environmental Pollution

Lead Exposures--In each of the other Central and Eastern European countries so far evaluated, blood lead levels among children have been a useful environmental health indicator. This is because lead is both a common emission from industries and vehicle transport (where unleaded fuel is still uncommon), and, also, has neurobehavioural effects among children with no evidence of a lower "safe level of exposure". Estonia does not seem to have the capability to do routine blood lead measurement. This is unfortunate because it is a well documented and easily interpretable form of exposure assessment. Therefore the lead exposure situation in Estonia must be pieced together from hair lead data, which is difficult to interpret, and occasional blood lead sample studies. Table 9 gives *relative* hair lead levels among children in various locations in Estonia. It shows that the average level in the four cities of the industrial Northeast are 2-2.5 times as high as in

Tartu. The only blood lead survey among children in the Northeast, in Saka, shows an average blood lead level of 10.5ug/dl. This is not especially high by the standards of Central and Eastern European hot spots, where average blood lead levels often range from 20-35ug/dl. But in places where leaded gasoline had been eliminated, average blood lead levels of greater than 10ug/dl among children would signify an area of concern. In Canada, average children's blood lead levels in the three best documented hot spots range from 10-13ug/dl. In Vancouver, where there are no major point sources of lead, the average blood lead among 2-3 year olds in a recent survey was only 5.2ug/dl.

Adult blood lead levels are harder to interpret when they fall below the level of acute toxicity (above 40ug/dl). Nonetheless, table 9 shows an average value for Kohtla-Jarve in the Northeast which is approximately twice that found in Tallinn. This would suggest that traffic conditions in Tallinn are not comparable to those in Budapest, where traffic emissions alone are a public health problem. However, the lack of lead exposure measurements among children in Tallinn is notably unfortunate because the routes of lead exposure to children are somewhat different than for adults. In particular, children ingest much more dirt and dust each day, as a percent of total body mass, and are therefore more sensitive to exposures from dusty roadsides, roadside parks, etc.

Northeastern Estonia--There have been several large sample studies in the industrial areas of Northeastern Estonia which have produced findings consistent with concerns about industrial emissions there. These include:

*a 2.3-fold increase in the prevalence of chronic bronchitis and asthma among adults in the oil shale area compared to unpolluted areas.

*a 2.5-fold increase in allergic sensitization to common allergens among adults in the oil shale area compared to unpolluted areas.

*an increased prevalence of allergic sensitization and allergic dermatitis among children in Narva/Kohtla-Jarve/Sillamae compared to Tartu. Because of the awkward way in which the data are reported it is not possible to estimate the precise magnitude of these increased prevalences.

*in one study of 2317 children aged 3-14 in Tartu versus Narva/Kohtla-Jarve/Sillamae, the following hematologic outcomes were found:

Variable	Tartu	Kohtla-Jarve	Narva	Sillamae
Erythrocytes <3.5 million	0.3%	1.8%	10.3%	4.3%
Hemoglobin <11.5g/dl	0.0	7.0	26.7	5.0
Eosinophils >400	2.6	18.2	18.2	20.7
Monocytes >700	0.8	6.9	10.9	13.1

These data indicate marked elevations in the prevalence of anemia among children in the Northeast, as well as in the prevalence of those whose immune systems have been overstimulated. These findings are quite non-specific, and may be attributable to various combinations of chemical and microbiological exposures, and nutritional factors. The most characteristic finding consistent with a role for the chemical environment is the 7-8 fold increase in the prevalence of "eosinophilia" among the children from Northeast Estonia.

*a strong correlation between changes in the frequency of medical visits for respiratory disease and fluctuations in air pollution levels in Narva and Kohtla-Jarve.

*an increased prevalence of respiratory morbidity and immune system dysfunction in a "clean" versus a "dirty" part of Kohtla-Jarve.

*for the last several years, 2-8% of children in Sillamae have had problems with baldness which, in some cases, went away when children left the area. In Narva the prevalence ranged from 2.3-4% and in Kohtla-Jarve, from 0.6%-4.7%. In Tartu, the comparison community, the prevalence was found to be 0.8%. Therefore, this has been variously described as a problem of Sillamae or as a problem of the whole area. Because the Sillamae area has been under direct Moscow control for at least a decade, local public health officials are not certain about the patterns of environmental exposure there and are not prepared to commit themselves to an environmental etiology for this phenomenon. This would appear to be a prudent conclusion to take under the circumstances.

*in the village of Saka, 2-4 km from Kohtla-Jarve, "proportional mortality" from 1979-1988 was compared with the rest of Estonia for 1980. The following table presents a "corrected" version of that data, taking into account the overall difference in the mortality rate between Saka and Estonia as a whole:

Cause of Death	Observed	Expected	O/E Ratio
Cardiovascular	45	37	1.22
Cancer	7	9	0.78
Injuries,poisonings, violence	8	7	1.14
Respiratory	12	2	6.00**
Other Causes	1	5	0.20

**statistically significant difference

The six-fold increase in respiratory mortality cannot be explained away by differences between the age structure of the local population and Estonia as a whole. Yet the local air quality is not severe enough to explain it, so if the effect is an environmental one then it is likely related to the working conditions of those who happen to live in Saka.

*concerns about increased rates of stomach cancer in the oil shale area in the 1970s have not been re-evaluated, and need to be. In addition, I was given second-hand information that a study of respiratory cancer in the oil shale area did not reveal any occupational or environmental etiology. However, I have not been able to get a first-hand look at these data since the study was "classified" and the investigator has moved to Israel.

*it was difficult to obtain a precise accounting of occupational disease at the Slantsechim chemical plant. I was told that bronchitis, asthma, and liver diseases were common problems there, but only 6 cases of occupational disease had been compensated in the last year, including vibration related conditions, allergies, and skin diseases. Low rates of ascertainment of occupational disease is thought to be a problem here. In-plant airborne exposures include more than 20 known toxic substances (e.g. benzene, styrene, toluene, phenols, formaldehyde, epichlorhydrin, manganese dioxide, various sulfur compounds, and ammonia) but ambient air quality data for the plant seem to be lacking. Inspection of the plant suggested that hygienic conditions were relatively poor so it is anticipated that exposures to some of these substances may be considerable.

Other Locations--Some human health data is available from Kunda (site of the cement plant), Kehra (site of a Pulp and paper mill), Maardu (site of a phosphite chemical fertilizer plant) and Tallinn.

*Formal study of human health problems in Kunda is just now beginning and it is long overdue because the airborne emissions there are easily the most extreme in the country. Although no data is yet available from the study, the Chief of the local polyclinic had some

observations which should be recorded here as interim findings. This polyclinic is the only medical facility in town making its clinic records a population-based information source. The Chief Physician, who has been at the polyclinic for 22 years, believes that environmental emissions from the plant have increased markedly over the last 10 years, and so she has been interested in increases in the incidence of specific conditions over that time. She reports that in the last 5 years there has been a marked increase in diagnoses of bronchitis and asthma in children and a more modest increase among adults. Also, she believes that there are high rates of skin allergies and conjunctivitis due to eye irritation among both adults and children. She has seen 21 cases of kidney stones among adults this year, a very large number for a community of 5000. Although this is not often associated with non-dietary exposures, airborne exposure to calcium oxide, which makes up 42.5% of the cement dust, could be a risk factor. Finally, because occupational disease cases are referred directly to the Institute of Pulmonology in Tallinn, she is not sure about the respiratory disease status of workers at the plant.

*In Kehra, air quality within 200 metres of the pulp and paper plant is poor, with sulfur dioxide, phenols, formaldehyde, and hydrogen sulfide exceeding the Soviet daily MAC by 5-9 fold. A health study was done on children in the whole town, both inside and outside the 200 metre perimeter. The most useful finding relates to the development of the respiratory system. Vital (lung) capacity was measured among 5 and 6 year old girls and boys. The proportions of children who were below their expected level for age and sex were: 76.9% and 29.3% for 5 and 6 year old boys, respectively, and 75.0% and 69.0% for 5 and 6 year old girls, respectively.

*In Tallinn, there are weak, non-statistically significant correlations between average monthly carbon monoxide and nitrogen dioxide levels taken between 1986 and 1989, and the monthly incidence of medical visits for respiratory problems.

Lithuania

Like Estonia, the political and economic problems of societal transformation are currently the top priority in Lithuania, with creation of a convertible currency and re-privatization of land high on the agenda. In Lithuania, it was painfully apparent that meaningful self-government had only begun with the failure of the coup in August, since the agencies I dealt with seemed as though they were only just beginning to adapt themselves to work styles appropriate to the needs of a sovereign state. In practise, this meant that there was a considerable degree of awkwardness and confusion in the field of environmental health regulation, as well as something of a vacuum at the level of overall coordination. However, food and fuel are not nearly as scarce there as they are in Estonia and concerns about the ethnic composition of the population are not as intense. This might leave room for the problems of environmental health regulation to be addressed sooner than in other, more troubled post-Soviet Republics.

Environmental Health Regulation in Lithuania

In Lithuania, the Ministry of Health is more dominant in the field of environmental health than in Estonia but has managed to create an organizational structure that tends to separate the process of identifying and evaluating human health issues related to environmental pollution from the day-to-day activities of public health regulation. Starting at the level of the Minister of Health two separate branches of authority diverge: one for regulation and another for investigation.

Regulatory Authority in the Ministry of Health--The regulatory authority begins with a four-person Department of Hygiene, to which four agencies report: the Republican Hygiene Centre, the Specialized Hygiene Centre, the Immuno-preventive Centre, and the Nutrition Centre. The former two Centres are the ones relevant to environmental health. In this regard, the lesser of the two is the Specialized Hygiene Centre. Its role is to inspect military, police, and customs facilities. It formerly belonged to the Ministry of Internal Affairs and has recently been transferred to the Ministry of Health. It has yet to contribute anything to the understanding of environmental health issues associated with military facilities, which is an important issue.

Most important is the Republican Hygiene Centre, which is the central referral agency for the Municipal Hygiene Centres. (These latter are like the San-epi stations in the other countries in the region. There are 52 in all: 8 in the largest cities and 44 in regional districts, one of which was a military camp station recently taken over from the Soviets.) The role of the Republican Hygiene Centre is highly restricted to the planning and approval of residential, industrial and transportation facilities. *They receive air quality data from the Ministry of Environment and occupational health information from the Municipal Centres almost exclusively for the reactive purpose of providing approval for new facilities, but not for identifying issues of human health concern for proactive regulatory intervention.* As a result of this narrow definition of its responsibilities, the Republican Hygiene Centre had only been involved with one human health study in relation to environmental pollution in the last decade and was not in close touch with others who had done such work.

Similar to the Republican Centre, the main activities of the Municipal Hygiene Centres are traditional sanitary inspection and approval of industrial establishments, facilities dealing with food, institutions for children, and swimming and recreational areas. They have further responsibilities in approving waste management facilities, agreeing to zoning plans,

certifying drinking water safety, and surveying residential air quality. Because of this latter responsibility, they do generate some air quality data in residential areas which is separate from that of the Ministry of Environment. However, all the air quality measurements seem to go to the Ministry of Environment and get recycled as "data" from there. In no case was I able to get a precise description of who had collected which air samples underlying any of the data which I was shown!

Investigative Authority of the Ministry of Health--The investigative branch of the Ministry of Health begins with a committee composed of the Minister, Deputy Minister, and a board of medical specialists who decide on the priorities for environmental and other public health investigation. *It is important to note that there is no representation from the Department of Hygiene or the Republican Hygiene Centre on this committee.* The agency which receives instruction from the committee is the Institute of Hygiene, which carries out most of the environmental health investigations in the country. Their general mandate is in the area of ecology and health, with special concerns for air, water, food, and soil. Their investigative priority is the health of people in the residential areas of polluted places. They have access to polyclinic records and the right to do environmental sampling including, once again, air quality monitoring. Until one year ago they kept their monitoring data separate, but now are sending it to the Environmental Protection Department for collation with all the rest. From time to time they involve the Municipal Hygiene Centres in their work, but they do not ask the Municipal or Republican Centres for input into what to investigate or how to investigate it. As a result, the Institute of Hygiene has only initiated one study at the request of local authorities. In effect, this system splits the regulatory and investigative roles which in most other Central and Eastern European countries are found in a single agency.

Environmental Protection Department--In Lithuania, as in Latvia, there is no ministry of environment as such, but a fully staffed quasi-ministry which functions as a committee of parliament and reports directly to it. In Lithuania this agency is called the Environmental Protection Department, and its Head enjoys ex-officio status in cabinet. The quasi-ministerial structure seems to reflect the politically charged nature of environmental concerns on the one hand, and, on the other, the fact that a distinct environmental agency, as opposed to one simply concerned with nature conservation or forestry, is a new feature of political life.

Central collection and collation of environmental data in the Environmental Protection Department seems to be the principal act of coordination between the Ministry of Health and Environmental Protection. At the local level there did not seem to be a high level of interaction between the two agencies and their representatives tended to view local problems quite differently. The principal exception to this is in Kaunas, where the municipal council has taken the lead in coordinating environmental protection management. The system, which was developed as an initiative of WHO Europe's "Healthy Cities" program, has regional environment and municipal hygiene officials reporting to an Ecological Board of the City Council and an Environmental Protection Division of the municipal administration, which, in turn, report to a coordinating body of the healthy cities program. Under this structure, Kaunas has been able to organize its information and set priorities better than elsewhere in the country and create an environmental improvement plan for 1991-1995.

Finally, other health agencies such as the Lithuanian Cancer Centre and the Academy of Medicine in Kaunas have gotten involved in activities relevant to environmental health. This often occurs because of special requests to them or because of the interests of key individuals within an agency. Like in Slovakia and Estonia, cancer registration in Lithuania is of international quality. The Lithuanian Cancer Centre has a deputy director who is an

oncologist-epidemiologist. He managed to receive training at the International Agency for Research on Cancer in Lyon, and, as for his Slovakian counterpart who also trained there, gained the skills necessary to adequately exploit the cancer registry for epidemiologic purposes.

Environmental Conditions of Concern to Public Health

Air Quality--Like Estonia, there are no large areas in Lithuania which compare with Northern Bohemia or Silesia in the scale of environmental degradation or the intensity of airborne exposures. In this respect the international comparison data in table 5 are misleading, since they purport to show sulfur dioxide levels in Kaunas and dust levels in Vilnius and Kaunas which compete with those of the Central European hot spots. The problem here is that the Polish and Czech data apply to large areas while the Lithuanian data in table 5 apply, at the high end of the stated range, to very localized areas: in Kaunas, a small but heavily industrialized valley and in Vilnius, a small industrial area with heavy traffic flows. Nonetheless, these data do foreshadow legitimate concerns about adverse air quality conditions in certain local areas which are of interest from a public health standpoint.

Table 10 presents the 7 leading point sources of industrial emission in Lithuania. These data are not as useful a guide to the communities of health concern as similar data were in Estonia because the two key locations represented in the table (Akmene and Mazeikiai) have not been investigated from that perspective. Both locations are relatively sparsely populated, and the prevailing winds tend to blow the emissions northward into nearby Latvia. (In fact, I heard more expressions of health concern about these facilities in Latvia than I did in Lithuania, although the Latvians, too, had not actually done any further investigations.) On the other hand, the Lithuanian Power Plant in Elektrenai and the Azotas Fertilizer Plant in Jonava are both associated with public health concerns, as will be discussed later.

Table 11 summarizes the air pollution conditions in the main cities and industrial centres of Lithuania, expressed in milligrams per cubic metre, rather than in micrograms as in table 5. It identifies Kaunas, Siauliai, and Kedainiai as the dustiest locations in the country. In Kaunas this is related to the fact that approximately 25% of Lithuanian industry is concentrated there. There are approximately 150 significant industrial emission sources in Kaunas, most of which are not adequately monitored for emissions. Estimated emissions based on factory data from a minority of plants were 19,960 tonnes in 1990, 75% of which comes from chemical, construction and electric power industries. Motor vehicle emissions make up 50-65,000 tonnes per year. A mapping exercise done by the Kaunas Municipal Council suggests that 98,000 people live in areas where average dust levels exceed the daily MAC by 1-4 fold and a further 28,600 live in areas where it is exceeded by more than 4 fold.

In Siauliai the main concern is the large Soviet air base nearby, where planes take off less than 2.5 kilometres from a main residential area. In Kedainiai there is a large "biochemical" plant which produces phosphorite fertilizers and emits SO_2, H_2SO_3, NH_4, and HF.

The data in table 11 regarding sulfur dioxide show that Lithuania, like Estonia, have had some trouble producing reliable results. These data, from the Ministry of Environment, give the same low mean concentration for all locations. While this may represent a valid lower detection limit, the data for Kaunas differ from that in table 5 by an order of magnitude. These latter data came from local health and environment officials who,

Table 10: Major Air Pollution Emission Sources in Lithuania,1990

Facility	Total Emissions	Comment
Akmene Cement	62,200 tonnes	nearly 100% dust
Mazeikiai Refinery	50,900	
Lithuanian Power Plant	41,100	
Vilnius Power Plant #3	15,300	
Mazeikiai Power Plant	11,700	
Azotas Fertilizer (Jonava)	11,100	(COx,NOx,sulphur anhydride)
Kaunas Synthetic Fibre Pl	4,900	

Table 11: Air Pollution in the Main Cities and Industrial Centres of Lithuania, 1990 (mg/m^3)

Place	Dust		SO_2		NO_2		B(a)P*	
	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.
Vilnius	0.1	1.4	0.01	0.07	0.03	0.27	1.3	4.5
Kaunas	0.3	1.2	0.01	0.04	0.06	0.20	1.9	9.2
Klaipeda	0.1	0.8	0.01	0.12	0.03	0.20	0.8	3.6
Siauliai	0.3	1.5	0.01	0.04	0.07	0.22	3.2	8.6
Kedainiai	0.2	1.2	0.01	0.07	0.02	0.14	0.4	1.8
Jonava	0.1	1.0	0.01	0.12	0.02	0.11	0.9	2.0

*ng/m^3

Table 12: Less Commonly Measured Air Pollution Parameters (% of samples above the short-term MAC, 1990)

Place	Formaldehyde	Phenol	Carbon Monox	Lead
MAC	*0.035*	*0.01*	*3.0*	*???*
Vilnius	7.9%	5.3%	49.2%	12.5%
Kaunas	22.1	----	3.8	55.3
Siauliai	60.0*	----	25.0	26.7

*1989 percentage

theoretically, report to the Ministry of Environment. Therefore, some resolution of the contradictions should have occurred but did not. Thus, like in Estonia, routinely collected data regarding ambient sulfur dioxide exposures must be regarded as invalid. In contrast, the data on nitrogen dioxide in table 11 is in the range expected for relatively small places which do not have massive traffic flows.

The data in table 11 regarding benzo(a)pyrene is interesting in that it identifies Siauliai as a place with high exposures to this known carcinogen, despite the fact that traffic flows would be much lighter than in Vilnius or Kaunas. These data support the contention that overflights from the Soviet air base are a significant source of exposure in Siauliai. This impression is reinforced by table 12, wherein short-term elevations of airborne formaldehyde, carbon monoxide and lead are common in Siauliai.

Table 13 presents more detailed data on local areas in Kaunas, Vilnius and Jonava. The worst case condition in Vilnius, Savanoriu District, has heavy traffic flows and several industrial plants. In 1990, these plants emitted 58 tonnes of toluene, 29 tonnes of xylene, 54 tonnes of carbon monoxide, 15 tonnes of nitrogen dioxide, 19 tonnes of acetone, and 8 tonnes of hydrogen chloride.

The main industrial area identified in Kaunas is in a narrow stretch of valley, where approximately 12,000 people live amongst small industrial facilities. One of the most important is a boiler-making factory which emits metal dust. The municipality ordered it closed, but this order was ignored because it is the only facility in Lithuania which makes boilers. Other facilities in the valley include a paper factory, a plant which makes steel racks, another which makes pre-fabricated houses, and others which produce building materials such as bricks and asphalt. The air quality in downtown Kaunas would appear to be comparable to the industrial area, largely because of the combination of traffic and industry downtown, including the synthetic fibre plant listed in table 10.

The middle section of table 13 shows the influence of the fertilizer factory on air quality in Jonava. Of particular interest is the high level of exposure to hydrogen fluoride which is characteristic of communities adjacent to fertilizer plants in Central and Eastern Europe. In Dimitrovgrad, Bulgaria, similar exposures were associated with increasing reductions in respiratory capacity among children age 10-14 when compared to unexposed children.

Table 14 presents air pollution index scores for major centres, generated by the Lithuanian Ministry of Environment. These are a useful summary, since they supplement the list of emission sources in table 10 in identifying principal areas of public health concern due to air pollution. Each of the locations identified on table 14 has already been mentioned except Klaipeda. In Klaipeda, a port city on the Baltic, approximately 50% of air pollution emissions come from motor vehicle traffic. The next largest source is the oil-fired power plant. Other air pollution sources include a pulp and paper plant, dry cell battery plant, oil terminal, and shipyard. Until 1985 the effect of the pulp mill could be detected up to 1000 metres from the plant in terms of elevations of oxides of nitrogen, sulfur dioxide and carbon monoxide. More will be said about these locations in the section on human health effects later in this report.

Water Quality--Tables 15a and 15b summarize the microbiological and chemical state of drinking and recreational water in Lithuania, showing that the principal problems in the country relate to drinking water from wells and recreational water in general.

The chemical contaminant of concern in well water is nitrate, like it is elsewhere in Central and Eastern Europe. The primary sources of contamination are thought to be fertilizers and industry, but, unlike in Bulgaria, this belief has not been subjected to critical investigation.

Table 13: Air Quality in Selected Hot Spot Areas

a. Savanoriu Street, Vilnius

Contaminant	Annual MAC (mg/m^3)	1988	1989	1990
Dust	0.15	0.110	0.166	0.147
NO_2	0.04	0.041	0.050	0.033
CO	3.0	2.4	2.8	2.48
SO_2	0.05	0.022	0.015	0.025
Phenol	0.003	0.0024	0.0037	0.0037
Formaldehyde	0.003	0.0070	0.0124	0.0079

b. Within 1.5-5.0 km of Azotas plant in Jonava

Contaminant	Short-term MAC (mg/m^3)	1986		1987	
		min	max	min	max
Ammonia	0.2	0.05	0.89	0.15	0.44
Formaldehyde	0.035	0.031	1.4	0.14	0.16
SO_2	0.5	0.23	0.52	0.03	0.67
NO_x	0.085	0.05	0.41	0.15	0.3
Hydrogen Fluoride	0.02	0.02	0.067	0.05	0.09

c. Kaunas Hot Spots 1990: range of short-term measurements (mg/m^3)

	CO	NO_2	Dust	SO_2	Lead*
Downtown	1.0-3.3	47-70	160-370	100-160	0.0-5.0
Industrial Area	1.0-3.2	60-80	220-300	70-120	1.5-4.5

*ug/m^3

Table 14: Air Pollution Indexes for Major Cities and Industrial Centres

Place	API Score	Substances on which score is based
Siauliai	11.01	B(a)P,Dust,NO_2,SO_2
Kaunas	7.50	B(a)P,Dust,NO_2,CO,Formal
Klaipeda	5.40	B(a)P,Dust,NO_2,NH_3,Formal
Vilnius	4.40	B(a)P,Dust,NO_2,CO,Formal
Jonava	2.25	B(a)P,Dust,NO_2,NO,HF
Kedainiai	2.04	B(a)P,Dust,NO_2,SO_2,HF

Table 15: Water and Food Pollution in Lithuania

a. Water Supplies Not Meeting Microbiological Standards (%)

Source of Water	1989	1990
Centralized drinking water	7.4%	6.7%
Well drinking water	40.9	30.1
Rivers/lakes recreational	39.7	40.8
Sea recreational	27.1	24.6

b. Water Supplies Not Meeting Chemical Standards

Source of Water	1989	1990
Well drinking water	41.5%	39.0%
Rivers/lakes recreational	24.5	17.1
Sea recreational	45.8	62.7

c. Food Quality

Food Item	Problem (% of samples)
fish (1988)	1.3% with pesticide levels above standard
vegetables (1990)	10.2% with nitrate levels above standard
vegetables (1988)	3-4% with pesticide levels above standard
milk (1988)	3-9% with pesticides, cadmium or lead above standard
all food tested (1990)	1.6% with pesticide levels above standard
all food tested (1990)	0.5% with lead levels above standard
all food tested (1990)	1.2% with cadmium levels above standard

d. Beach Water Not Meeting Recreational Standards, Klaipeda Area, Summer 1991

Location of Beach	% of Substandard Samples
Smiltyne--on Curonian Peninsula	4%
Beach closest to Curonian outfall on Baltic Sea	54.3
Next furthest beach from Curonian outfall	51.4
Furthest beach from Curonian outfall	42.9

Table 16: Summary of Workplace Monitoring in Lithuania, 1986-1990

Variable Tested	% of Tests Exceeding Standard
gases and vapours	9.6-21.0
dust	24.2-29.9
vibration	24.2-26.6
noise	29.6-43.9
number of workers in "unhealthy" shops	*175,514 (1989)*

Elevated nitrate levels are widely distributed throughout the country and are moderate in degree, rarely exceeding 200 micrograms per litre. There have been sporadic cases of methemoglobinemia diagnosed among newborns each year. Methemoglobinemia is a potentially fatal form of chemical asphyxiation which can be caused by nitrates entering the bloodstream and irreversibly bonding to hemoglobin, thus blocking oxygen transport. It was suggested to me that 1-3 cases were being found each year, that the situation had been "worse in the past", and that the condition was likely underdiagnosed. However, each of these assertions was based on hearsay and there did not seem to be any systematic reporting of methemoglobinemia in Lithuania the way there is in Slovakia. To combat the problem, approximately one-third of Lithuania is covered by a program of water replacement for pregnant women. This operates through the polyclinics, in conjunction with the local hygiene centre, which test the well water being used by newly pregnant patients and provide replacement during pregnancy. This program is quite unlike the one in Hungary which provides water to newborns and children, rather than pregnant women. The difference in emphasis likely reflects a difference in the understanding of the etiology of methemoglobinemia, but does not seem to have been the subject of any discussion or consensus building among public health officials in Central and Eastern Europe.

The public health significance of microbiological pollution in well water in Lithuania is unclear. There has been no evidence of large-scale waterborne outbreaks of infectious disease, but there is some concern that water may be contributing directly or indirectly (through contamination of food) to the 1-2000 cases of salmonella, shigella, and hepatitis A in Lithuania each year, as well as to Giardia, leptospirosis, and viral infections. One guesstimate put the proportion of shigella cases attributable to waterborne exposures at 18%, but this was entirely hearsay and I could find no evidence that a systematic study of this issue had ever been done. Several milk plants around the country have been closed due to unhygienic conditions, but I was unable to get any descriptions of infectious disease outbreaks due to contaminated water in milk plants. This is in contrast to Latvia, where such epidemics have been documented.

The problems with recreational water in Lithuania primarily concern sewage and industrial effluent contamination of the Neris-Nemunas River system, the Curonian Lagoon it feeds into, and the Baltic Sea coastline to the immediate north of the outflow of the Lagoon. The Nemunas River has its origins in Belarus, where it begins to pick up untreated sewage. The river is dammed just upstream of Kaunas, and the biologic sediment in the lake which is created has blooms of blue-green algae and disturbs the flavour and smell of the water. It then flows past the industrial valley, picking up all the industries' discharges of "deca-tonnes of dyes, detergents, chrome compounds and other chemical substances". Next, the Nemunas is joined by the Neris River downstream of where the Neris receives all the residential sewage (untreated) from Kaunas. This combination of insults has lead to the permanent closure of beaches in Kaunas along the river system. Downstream of Kaunas the Nemunas River receives enormous amounts of industrial waste from two large, late nineteenth century pulp mills in the Kaliningrad Oblast which discharge directly into it. The river then flows into the Curonian Lagoon, where raw sewage from Klaipeda is dumped, along with 24 million cubic metres of effluent per year from a local pulp and paper mill and smaller amounts from a battery plant. Wastes from this latter include manganese and mercury, but not lead.

Despite this history, fish are caught and eaten from the Curonian Lagoon and at present there are no restrictions on fishing in it. Two fish samples in the past three years have exceeded safety limits for arsenic but no other significant metal concentrations have been detected. Ministry of Environment officials tell anecdotes about fish being caught with tumours, but Municipal Hygiene Centre officials, who are responsible for inspecting fish, say that they have not detected diseases in fish. The biggest problem they perceive is

massive fish kills in the summer due to blue-green algal blooms, brought on by microbiologic pollution in the lagoon.

The most direct effect of contamination of the Neris-Nemunas-Curonian water system so far has been beach closures in the path of its outflow into the Baltic Sea. Table 15d shows that the fraction of substandard microbiological samples at the beach along the Curonian Peninsula, *which is not in the path of the outflow* , is an order of magnitude lower than at the beaches which are along the outflow. The three beaches closest to the outflow were all closed for the full season last year, early enough to prevent outbreaks of waterborne infectious diseases. There was also one beach closure at Palanga, an economically significant resort area several kilometres further north along the Baltic.

At present the prospects for remediating this situation are mixed. Kaunas is yet to work out funding for its proposed sewage treatment plant and there are no plans to improve effluent controls at the Kaliningrad pulp mills. In fact, before the dissolution of the Soviet Union, environment authorities in Klaipeda and Kaliningrad used to work together inspecting the pulp mills and levying fines on them. Now this cooperation has ceased. Moreover, a new Lithuanian law on water management inadvertently omitted the power to fine industries which inadequately treat their sewage, thus weakening the hand of local Health and Environment authorities.

Construction on the Klaipeda sewage treatment plant was halted when the Polish firm doing the project demanded, but did not receive, hard currency payments for their work. It is 30-50% complete, but none of the electrical or mechanical equipment has been purchased yet. On a brighter note, the pulp mill in Klaipeda is currently constructing its own sewage treatment plant.

There is disagreement between Ministry of Environment and Municipal Hygiene Centre officials about whether or not the necessity for beach closures will be eliminated by finishing the Klaipeda sewage treatment facility. Ministry of Environment officials were optimistic that it would but Hygiene Centre officials believe that upstream pollution will be sufficient to force beach closures under the right wind and temperature conditions, even in the absence of an increased bacterial load from Klaipeda. This important disagreement had not been a topic of discussion between the agencies and only emerged as a result of our visit. It was typical of the lack of communication found between these agencies throughout Lithuania.

Food--Table 15c provides a summary of available information on contamination of food with industrial substances, showing exceedances of standards for pesticides, metals, and nitrates in 0.5-10.2% of sampled items. This information is insufficient to make inferences about human risk, but is a useful indicator of the degree of food contamination for comparisons over time. Public health officials do not think that pesticide contamination in food and water is currently a major problem, but are concerned about whether or not pesticide use will get out of control when agriculture is privatized. Already there is soil contamination with simazine in many locations, and there are 45 other "trade marks" of more than 650 tonnes each being used in Lithuania each year. At present, the country does not have a compulsory declaration system for pesticides. Despite these concerns, the main problem at present is microbiological contamination of food in processing plants. For example, epidemiological investigations revealed that 36% of reported acute dysentery in 1990 was transmitted by milk. Bacterial contamination of milk was found in 5.7% of routinely-collected samples in 1986 and 8.9% in 1990. The Head of the Hygiene Department in the Ministry of Health estimates that approximately 37% of shigella infections are from food, although what proportion is due to food industry hygiene conditions, as opposed to food-handler carelessness, is not clear.

Hazardous Waste--Lithuania's problems with toxic waste are mitigated by the fact that it is not a major industrial region. Nonetheless, it has been estimated that the country produces more than 200,000 tonnes of industrial toxic wastes per year, only 7% of which is currently being reused. However, all toxic waste producers in Lithuania have a problem because there are few adequate storage or treatment facilities. There is one site specially designed for pesticide storage and, in theory, all toxic pesticide residues go there. There are no specially designed facilities for treating non-pesticide toxic waste, much of which is stored on waste generators' sites. Some ends up in municipal waste facilities. It would appear that the situation is out of control like it is in many other places in the industrialized world.

Because 25% of the country's industry is in Kaunas it has made a claim to be the site of a national toxic waste facility. Already much of the toxic waste from Klaipeda and other places is sent there for storage, in addition to that which is being generated in the Kaunas area. It would appear that most of this ends up in the municipal dump. Currently, runoff from the municipal dump is beginning to contaminate drinking water sources upstream of Kaunas along the Neris River. Here and elsewhere, bore wells are dug 40-70 metres into the river bank to obtain bank filtered water. The contaminants include iron, copper, zinc, chrome, nickel, cobalt, manganese, and oil, but have not yet reached levels requiring restrictions on the use of the water. At present, discussions are going on between Vilnius, Kaunas, and Denmark regarding the planning and financing of a toxic waste treatment facility in the Kaunas-Vilnius area. It is not clear how much support this initiative has at the level of the national government.

Occupational Health--There are 4 laboratories in cities around the country and one at the Republican Hygiene Centre which analyze samples from the occupational environment. They are able to measure 80 different chemical substances as well as noise and vibration. Data on the hygienic conditions of Lithuanian workplaces is collected at the Republican Hygiene Centre in Vilnius, but is organized in a manner which is not conducive to pinpointing remediable problems or problems with human health implications. Table 16 summarizes these summaries; showing the proportion of all workplace hygiene tests which exceeded the standards. Since the tests are likely concentrated in industries of special concern and include repeat tests in problem locations, they cannot be interpreted as an estimate of the proportion of workplace environments in the country which are of concern. The most useful statistic I found in that regard is at the bottom of table 16, which estimates that 175,514 workers are working in shops where there is a concern among Hygiene Centre officials about exposure to chemical or physical hazards. The most hazardous industries are considered to be textiles, machinery and building materials.

In 1990, 373 cases of occupational disease were registered in Lithuania, up from 240 in 1989. Most of these, 67%, involved vibration (primarily vibration-related back injury from tractors), 10% involved noise (primarily hearing loss in the textile, furniture, and lumber industries), and 7% involved the respiratory system. As a result of vibration problems with poorly maintained tractors, half of all reported occupational diseases occur in agriculture. Other recognized problems include skin allergies among health care workers using inadequately sterilized syringes; asthma among painters, workers producing building materials, and workers at the cement plant in Akmene; and silicosis among moulders in steel foundries.

Officials at the Republican Hygiene Centre have reason to believe that occupational disease is underreported in the country. For instance, no occupational diseases are reported from pulp and paper mills or fertilizer plants; no record is kept of Hepatitis B cases among medical staff; and no lead surveillance is carried out in electrotechnical industries where

soldering is done. There is little specialized diagnostic equipment in the country for occupational health purposes, especially as regards early diagnosis of insidious conditions. Variability due to medical diagnostic factors is best illustrated by the fact that, when a new specialist who was interested in vibration-related disease began work three years ago, the number of compensated cases of vibration-related disease across the country doubled! As another example, only 1-2 acute pesticide poisonings are recorded each year, but these tend to be acute emergencies. No-one knows how many less acute cases occur. Finally, there is no organized insurance fund for workers' compensation. The legislated benefits are quite generous, but they must be paid directly by the employer. Therefore workers are pressured to not report occupational health problems. The Republican Hygiene Centre considers establishing a compensation fund to be a priority.

Human Health Problems Associated with Environmental Pollution

National Issues--After Chernobyl, all of the (then) Soviet Republics had to send clean-up crews to the Ukraine in numbers proportional to the Republics' populations. As a result, 8000 Lithuanians were exposed to the zone of heavy contamination for a period of several months. Follow-up of this group is the top environmental cancer priority for the Institute of Oncology at present. A proposal for follow-up has been written and funding is being sought through the National Institutes of Health in the US.

One other national study has recently been completed which is of significance to environmental health. This was a case-control study of lung cancer which focussed on smoking habits and living in polluted communities. After adjusting for age and smoking habit, the risk associated with residential exposure to pollution was 1.5 (95% confidence interval=1.04-2.3), which suggests that those living in polluted communities had a 50% greater risk of developing lung cancer than those living in environments considered "clean". Although this study did not go into detail about environmental exposures, the result is useful for deciding whether or not environmental cancer is a relevant topic of inquiry in Lithuania, which, it would seem, it is.

Kedainiai--Kedainiai has received a lot of attention over the years because, during the 1970s, sulfur dioxide emissions from the fertilizer plant there were uncontrolled and the local forests were destroyed by acid rain. The incidence of lung cancer in Kedainiai became the highest in the country during the period 1970-79. The ratio of males to females, about 8 to 1 in the rest of the country, is much lower there, suggesting the influence of a common risk factor such as the airborne environment. As of 1988-90, the lung cancer incidence rate in 7 contiguous districts around Kedainiai is still the highest in the country. The Institute of Oncology is planning a case-control study of this situation.

The Institute of Hygiene is currently carrying out a morbidity study of adults in 6 districts in the vicinity of the fertilizer plant which have been characterized in terms of industrial and motor vehicle exposures, and 2 control districts. Polyclinic records are being analyzed and direct examinations are being done. Quantitative findings are not yet available but I was told by the assistant director of the Institute of Hygiene that those living in "exposed" communities had more respiratory, skin, and immune system findings than in the control communities. These findings are somewhat offset by the fact that they also had more digestive, cardiovascular, and psychological findings, suggesting that there is a good chance that a population selection effect or a methodological bias may be operating.

Akmene--Dust emissions from the cement plant at Akmene are nearly as prodigious as in Kunda, Estonia. Like Kunda, it has not yet received the public health attention it deserves. The Lithuanian Cancer Centre reports that there are high rates of non-fatal basal and

squamous cell skin cancers there but no further work has been done to evaluate the prospect of an environmental etiology for this. The Institute of Hygiene is currently doing a study of respiratory disease among adults and children using polyclinic records, but no results are available as yet.

Jonava--In 1987, the Republican Hygiene Centre used a request for a permit to expand the Azotas fertilizer plant (to produce up to 475 tonnes of nitrogen acids and ammonia per year) to do a time series analysis of incidence rates of respiratory disease among children. This study showed that asthma rates and total respiratory disease rates, based on polyclinic data, had been increasing throughout the 1980s. This information was used to deny the permit. (It should be noted that the Republican Hygiene Centre also denied a permit to expand the Mazeikiai oil refinery based on air monitoring data. These appear to be the principal instances of the Centre exercising its permitting powers to control major polluters.) Further research was initiated in Jonava by the Institute of Cardiology after an accident at the plant in 1988. I was not able to get any further information about this study, except to find out that it is not yet completed.

Elektrenai--The Institute of Hygiene has done a polyclinic-based study of morbidity within 50 kilometres of the Lithuanian Power Plant, a point source of sulfur and nitrogen compounds, carbon oxides, and aromatic hydrocarbons. It was reported that rates of respiratory disease (upper respiratory tract symptoms, bronchitis and pneumonia), cardiovascular, nervous system and skin diseases were 2-3 times higher than in "clean" zones. These results would appear to share the same drawbacks as the study in Kedainiai, and, for that matter, most of the other polyclinic-based environmental health studies done in the Baltic countries.

Vilnius--The Municipal Hygiene Centre compared polyclinic visits in the Savanoriu District with Antakalnis District (the least polluted in Vilnius) for the past 3-5 years. A summary morbidity indicator was 20% higher in the Savanoriu District, but no adjustments were made for the age structure of the population, so the results are uninterpretable. Equally unhelpful was the finding that the overall mortality rate was 30% higher. More intriguing were the results of a study of pregnancy pathology, which suggested that miscarriages were 20% higher, "problem pregnancies" 30% higher, and congenital defects 50% higher in the Savanoriu District than in Antakalnis.

Klaipeda--There are several environmental health concerns in Klaipeda. The pulp mill is still a source of ammonia and sulfur dioxide emissions which create short-term exceedances of former Soviet standards, especially at night. There are concerns about the long-term impact of air, water and soil pollution from the battery plant and about water pollution from a meat packing plant. The ship repair facility pollutes the air and water with dust and paint residues, including arsenic, making it the likely source of the arsenic which is occasionally found in fish. Explosive chemicals and grain (whose gases can also be explosive) are been loaded and unloaded at the port under conditions of acute hazard and long-term exposure to those in the nearby downtown area. Similarly, toxic and explosive materials belonging to the former Soviet military are unloaded and taken through town by rail, close by residential neighbourhoods, without any notification or manifest system, and without special handling procedures agreed to by local authorities. *It is ironic to note that this is occurring because of the military evacuation of East Germany. The quicker the former Soviet military complies with the West's goal of a rapid withdrawal from Central Europe, the more dangerous it gets for the people of Klaipeda.*

The Municipal Hygiene Centre is currently doing a study of children and adults in the industrial neighbourhoods of Klaipeda compared to other neighbourhoods, once again using polyclinic data. No results are available as yet.

Kaunas--There is a three year polyclinic study of adults and children currently underway in Kaunas comparing two districts in the industrial area (the valley area described before and an area in downtown) with a more remote residential area. Preliminary results show a 50-fold increase in chronic respiratory disease incidence among adults in the valley area and a 3-fold increase among those in the downtown area compared to the controls. Among children there is a 3-fold increase in acute respiratory disease incidence in the valley compared to the downtown and the control area. These would appear to be impressive differences, especially among adults. Unfortunately, the data show 30 to 100-fold increases in the incidence of at least 6 other disease groups among adults in the valley, most of which likely have no relationship to environmental pollution. Therefore, the best interpretation of these data is that there is a massive reporting bias between the polyclinic which serves the valley and the one in the control neighbourhood, likely due to the degree of cooperation each clinic is giving the study. This is the best empirical example of why the "cookie cutter" style polyclinic study, so much favoured in the Baltic region, is unhelpful in environmental health investigations unless clinic reporting bias is controlled.

Fortunately, a mortality component has been added to the Kaunas study which is much more likely to give valid results.

Siauliai--Despite the fact that Siauliai has the highest air pollution index in the country and the highest measured airborne concentrations of carcinogenic benzo(a)pyrene in the Baltics, no environmental health study has been done here or is in the process of being done.

Ignalina--No human health studies have been done on the workers at the nuclear power station here or on the surrounding population. However, the Department of Hygiene reports that, so far, local food, drinking water, and soil comply with former Soviet standards for radionuclides.

Latvia

In Latvia, the crisis of transition has so far been less severe than in Estonia but certainly more severe than in Lithuania. This is because Latvia, like Estonia and unlike Lithuania, does not have its own oil refinery, and is therefore not able to barter for oil supplies from Russia with a promise of refined products in return. Thus, most motor vehicle traffic had disappeared from the streets and even buses were running irregularly when we were there. It was said that oil shortages would soon affect food supplies, since there would not be gas for trucks to bring dairy products to town from the countryside. This fear hung over Riga, once again making environmental health problems seem to be less urgent. But the reality of shortages had not yet hit the stores in the way it had in Estonia. In this respect, as in its geographic location, Latvia is mid-way between Lithuania and Estonia. But in another respect it is an outlier, since in Latvia the best documented human health problems related to environmental pollution come from water, and not air pollution. This is because Latvia relies more on is surface waters for drinking supplies than any other country in Central and Eastern Europe. These sources are especially vulnerable to contamination by sewage (the main problem in Latvia) as well as from industrial discharges.

Environmental Health Regulation in Latvia

Environmental Protection Committee--The leading environmental agency in Latvia is the Environmental Protection Committee, which operates under the auspices of the environmental protection committee of parliament. Unlike Lithuania, the Committee does not have a direct voice in parliament, but speaks only at the request of the Deputies. Everything is currently in transition, and parliament is in the process of creating reporting requirements, sorting out levels of responsibility, etc. Sometimes former environmental regulations have been voided without being adequately replaced, leaving the Committee vulnerable to being undermined. There is a prospect that the Committee will become a full Ministry in the future, but many of the staff do not want that. They would prefer a structure more like the one in Lithuania wherein environmental issues continue to be vetted in open debate in parliament, rather than stifled by cabinet secrecy.

The Chairman of the Environmental Protection Committee identified two main environmental problems in Latvia: outdated industrial technologies and the pollution of surface waters used for drinking. Outdated technologies usually exacerbate effluent control and waste management because they are dirty. But in Central and Eastern Europe they are creating another barrier to remediation, because the mammoth centralized industries of the Stalinist period are not attractive to Western investors, and therefore may never be retrofitted with pollution control equipment even if they continue in production for many years. The problem of surface water is primarily a problem of constructing and maintaining effective sewage treatment systems, which is currently a great strain on financial resources.

On the human resources side the Committee is struggling with the transition from a "distributional" to a "wealth-generating" mentality. One aspect of this is that, outside Riga, it has been difficult to get local officials to collect fees and fines from industry when they do not perceive an immediate need for the money to fund their own regulatory activities. The process of stimulating decentralized decision-making has also been slow since everyone in the bureaucracy is so used to taking orders and not thinking for themselves. Internalization of the authoritarian mentality was more apparent to me in Latvia than anywhere else I have been so far. As an example, one person told me, *"We used to think*

we were happy here with our Party, but now everything has changed and we find out that we weren't." This is the first time I have ever heard anyone speak as though they looked to the state to tell them, in retrospect, what their personal experience of life had been in the past. It should not be surprising for me to report that this mentality, in a less blatant form, has undermined the practise of critical thinking which is so important in the tortuous process of trying to understand the relationship between environmental pollution and human health.

One useful initiative of the Environmental Protection Committee is the appointment of a medical expert to help collate information on human health with environmental data. The individual holding this job is a physician with 30 years experience in public health who is on long-term loan from the Department of Health. At present she is concentrating on the multiple environmental health concerns of Leipaja, which include electromagnetic radiation, air/soil/water pollution, and congenital anomalies; as well as investigating problems with the quality of routinely collected health data in the past and liaising with her former colleagues at the Department of Health.

One obstacle to effective collaboration between Environment and Health is the difference in geographic organization between the two. Like in the other Baltic countries, Environment is organized by (relatively) large regions, in this case there are 9 of them; while Health is organized along municipal lines, with 7 city departments (Riga, Ventspils, Leipaja, Jelgava, Jurmala, Daugavpils, and Rezchne) and 26 rural administrative districts. In the Ventspils and Leipaja areas cooperation between municipal environmental authorities and their respective regional Environmental Protection Committee representative seemed quite close. However, cooperation between environmental and hygiene centre officials was much less evident. In Ventspils there was sharp disagreement about the interpretation of health data between municipal specialists and those from the hygiene centre. In Leipaja, the knowledge bases of environment and health officials were quite different from one another. This seemed to be due to a lack of information sharing between agencies and a lack of understanding of how inter-agency teamwork might improve environmental management. On the other hand, relations between hygiene centre officials and members of the medical community professionally concerned with environmental health (e.g. pediatricians, oncologists, and respirologists) seem to be stronger in Leipaja than elsewhere in Central and Eastern Europe.

Department of Health--Public health services are in an even greater state of transition at present than environmental services. After the failed coup attempt in August, the Ministry of Public Health was downgraded to a Department within a ministry of social services, labour and health. In part, this was done to eliminate the job of the deputy minister in charge of hygiene matters, who was a Stalinist. The current structure, which will be changed in the near future, is as follows. Agencies relevant to environmental health which report to the Department are the Republican Centre of Hygiene and Epidemiology, the Latvian Occupational Diseases Centre of the Academy of Medicine, the Medical Statistics Bureau of Vital Statistics, and the Republican Oncological Diseases Department. The local hygiene centres report to the Republican Centre and, also, cooperate with local occupational disease centres (which are part of the Academy of Medicine structure), giving them workplace inspection data useful for diagnosing and treating occupational disease.

The public health system in Latvia has been almost exclusively devoted to infectious disease control, at the expense of environmental health in particular and chronic disease control in general. Few of the local medical officers have knowledge and training in the chemical disease paradigm, but in some districts they have gotten involved in the field through exposure to occupational health issues. Also, there is no smoking data available for the country, not even data on per capita tobacco sales, no participating centres in WHO

studies such as the MONICA program, and a cancer registry which is not yet fully useable for epidemiologic purposes. This latter may be remedied soon, because the Latvian Cancer Registry is planning to participate in a European Community sponsored initiative to network cancer registries in Eastern Europe in order to "enhance identification of causes of disease and death and develop the means for their prevention". The coordinator of the PHARE program will be touring the Baltic countries in March and funding for the upgrading of the cancer registry will be on the agenda in Latvia.

Two clinical physicians (who are also members of the Green Party) have been seconded for a period of 2 months to propose a reorganization of public health services which will strengthen its efforts in environmental health and chronic disease control. Their proposed reorganization would see routine infectious disease control operating through a Branch of Hygiene which would report directly to parliament through a National Control Service, not through the Department of Health. Within the Department of Health a new Institute of Human Ecology and Public Health would be created for handling all issues associated with chronic and environmental disease control. The country's main clinical specialists would report to it, helping to identify important issues for investigation. The Institute would create a network of epidemiologists, both in the local areas and centrally, to carry out investigations on disease clusters and environmental exposure situations and to study other determinants of health status. The Institute would come under a Deputy Director & Chief of Human Ecology & Public Health, to which the Department of Medical Statistics would also report.

The rationale for this reorganization is to integrate all those activities which are directly related to preventive aspects of health. The statistical division would help identify significant health trends, such as temporal increases or regional variations in disease rates. The main specialists would report patterns of clinical disease which might be amenable to preventive action. The team of epidemiologists would be delegated to investigate, using rigourous methods, those problems deserving further study. Furthermore, the Institute of Human Ecology and Public Health would be mandated to evaluate and upgrade existing health data bases, work out computerization plans, and identify needs for new data sources. As an urgent practical priority they will have to work out ways of upgrading existing personnel and attracting new ones to conduct epidemiologic investigations.

As a plan for mobilizing scarce resources this one has a lot of merit. The principal weakness would appear to be in the process by which the plan was developed. Major reorganizations of professional services work best if those affected by them are in agreement with the plan. This is best achieved by an extensive consultation process, wherein all parties, even those likely to lose out in the proposed reorganization, get a chance to discuss the plan before it is fully worked out and propose modifications and revisions. This gives people a stake in the plan; ensures that everyone knows what is going on; and that no-one feels left out or left behind. So far, the proposal for the Institute of Human Ecology and Public Health has not undergone an extensive consultation process and runs the risk of being derailed, especially from the Republican Centre of Hygiene and Epidemiology which will see it as a scheme to limit their activities. This problem is typical of the general problem of lack of appropriate communication which was evident throughout the environmental health field in Latvia.

Environmental Conditions of Concern to Public Health

Air Quality--Air quality management is carried out by the Environmental Protection Committee, Hydrometeorological Service and the local Hygiene Centres. The program of the Hygiene Centres is mostly concentrated in the occupational environment. There are 18 stationary ambient air monitoring stations in 8 cities in Latvia and 15 stations conducting

episodic measurements. Although summaries of these data do exist, they are not published in an easily accessible form. Regional environmental protection authorities did not appear to be fully aware of the results of their own monitoring activities or have access to the data in a format which would be useful for environmental management actions.

Table 17 summarizes exceedances above the stringent Soviet standards for 5 common pollutants in the large cities and industrial towns of Latvia. With the exception of nitrogen dioxide from motor vehicles in Riga and formaldehyde levels in Ventspils, these data do not identify any areas with sustained air quality problems; at least, not of an intensity which would lead to regional concerns about human health. However, as in Lithuania and Estonia, there are local areas with air quality problems of potentially greater significance that are not reflected in the routine monitoring data. These include:
Leipaja--Exceedances of phenol arise from military sources and benzo(a)pyrene arises from motor vehicle traffic.
Olaine--Exceedances of ammonia, phenol, and benzol arise from the pharmaceutical plants and their waste water treatment facilities.
Riga--In addition to nitrogen dioxide, motor vehicles in the largest city in the Baltics contribute to exceedances of phenol and benzol, as do thermal plants and specific point sources, such as the chemical industry.
Valmiera--Exceedances of phenol arise from local industrial sources.
Ventspils--Exceedances of benzo(a)pyrene arise from motor vehicle and energetic sources.

Water Quality--The most well-documented human health problems from environmental pollution in Latvia are due to contamination of drinking water, which has occurred because of Latvia's reliance on surface waters for a large share of its drinking water. The problems which have arisen can best be understood with reference to several outbreaks of waterborne infectious disease which are an ongoing concern wherever surface waters are being used in Latvia.

In the winter of 1988/89 the city of Riga ran low on alum, an agent used in the coagulation and purification of drinking water. This was critical because the Daugava River provides approximately one-half of Riga's drinking water, and, by the time it reaches the city, is polluted with multiple bacteria and viruses from upstream discharges of sewage. As a result of the alum shortage, incompletely treated water was supplied to Riga, and a waterborne epidemic of Hepatitis A broke out. It lasted approximately 2 months and produced 500-2000 cases. The presence of Hepatitis A was unexpected in the water and was not detected until samples were sent to Moscow for examination by electron microscope. Subsequently, a "boil water" order was issued which helped end the epidemic. It is now the practise of the Republican Hygiene Centre to check drinking water samples for Hepatitis A, but since it takes several days for these samples to be analyzed, another outbreak could occur before the problem was identified. Because of the ongoing shortage of coagulants this is a serious concern.

Contaminated surface waters have also contributed to foodborne infectious disease epidemics in circumstances of negligence on the part of food handlers. The most dramatic example concerned a milk plant in Jelgava, where technical water became mixed with drinking water, contaminating milk bottles. This problem was not corrected at sterilization, since the pasteurizer was not functioning at the appropriate temperature. Nonetheless, milk was passed through. An epidemic of 5-6000 cases of dysentery occurred as a result.

The above two episodes are the most well-known but may not be the only ones. Shortages of alum for the treatment of surface waters are a common occurrence in Latvia, and sporadic waterborne cases of Hepatitis A and Typhus are suspected. Leptospirosis has become endemic in Latvia,a serious concern because 18-25% of cases are fatal. Although

Table 17: Summary of Air Quality in Latvia, 1990

Location	% of Samples Above Standard				
	NO2	SO2	Dust	CO	Ammonia
Ventspils*	1%	.2%	0%	.1%	1%
Daugavpils	1	0	0	0	1
Liepaja	4	0	0	.1	2
Olaine	8	0	2	0	---
Riga	17	0	3	.3	---
Jurmala	8	0	1	.2	---

**1991--methanol:average=0.1mg/m^3; long-term standard=0.5.*
:maximum=0.8;short-term standard=1.0
--formaldehyde:average=0.01;long-term standard=0.003
:maximum=0.068;short-term standard=0.035

Table 18: Risk Factors for Lung Cancer in Latvia, 1975

Risk Factor	Incidence of Factor	
	lung cancer cases (n=400)	controls (n=1175)
long term smoking	98.0%	60.3%
occupational factors (e.g. air pollution at work, special workplace exposures,etc.)	52.1*	8.6
recurrent non-specific lung diseases	53.3	11.6

**odds ratio=11.6*

most cases are spread directly by rodents, 2 cases among bathers were traced to leptospira in a small tributary of the Leilupe River near Iecava.

Other threats to surface water have come from accidents due to negligence in the handling of industrial waste discharges into rivers. In the last 2 years there have been 3 major incidents affecting the Daugava River upstream of Daugavpils. The first occurred in November, 1990 when a factory in Belarus accidently released 8 tons of cyanide into the river. No warning was given to downstream users, but a large fish kill was reported to authorities in Daugavpils in time to close the water supply for a few days. Only one person was hospitalized after eating a fish which had been found dead, presumably from cyanide poisoning. There were two more episodes in November 1991 and January 1992, when untreated chemical wastes entered the Daugava River from Belarus. Local authorities in Daugavpils took preventive action and no human health impacts occurred.

Contamination of the Daugava and Lielupe Rivers from sewage and industrial emissions have also contributed to beach closures in Jurmala, which is one of the prime summer recreation areas on the Baltic Sea coast. During the pre-independence period, "stop swimming" orders were rarely issued. Water samples were not frequently taken at the beaches, and public health officials were reluctant to take actions which might affect the summer vacations of those who went to Jurmala. However, over the last 3 summers such orders have become common in Jurmala, lasting the whole 1991 bathing season. Cases of skin rash have been reported among some of those who have ignored the stop swimming orders. Bathing has also been frequently prohibited in the Venta River (Ventspils region and Kuldiga), the Daugava River (Jekabpils and Plavinas) and the Guuja River (Cesis region).

A unique problem exists at the beaches of Liepaja on the Baltic. The Soviet military has used, and is continuing to use a stretch of beach approximately 45 kilometres south of Leipaja for bombing practise. Phosphorus wastes from these exercises are carried north along the coast and are deposited on the heavily used beaches on the south side of Leipaja. Small pieces of phosphorus are mistaken for amber, particularly by children, and often put in pants pockets. When they spontaneously ignite, the children receive third degree burns to the upper leg and groin. This is a common occurrence, with local pediatricians reporting approximately 13 cases last year.

Soil Pollution--I was unable to identify very much information about soil pollution which was of relevance to public health. I was shown one map of Latvia with concentrations of lead in moss (sphagnum magellanicum) outlined on it. This showed that, in the Riga area, the average concentration was 98.4 mg/kg, while in most of the country it was less than 20 mg/kg. The other area of smaller scale increase was in the southwest, just across the border from the oil refinery in Mazeikiai in Lithuania, where the average concentration was 36 mg/kg. Unfortunately, these data are not as helpful for estimating public health risks, especially among children, as direct measurement of soil lead levels because no-one has calibrated blood with moss concentrations as they have done with blood and soil concentrations.

Occupational Health--There is reason to believe that the most significant environmental chemical exposures in Latvia occur at work, rather than in the community. The example of Broceni, given in the next section of this report, illustrates this point quite clearly. Another indication of it may be found in table 18, which presents the results of a case control study of risk factors for lung cancer. It shows that the odds of a lung cancer case having had a significant workplace exposure were 11.6 times higher than controls who did not have lung cancer. Unfortunately, this work was done a long time ago, in 1975, and has not been

repeated since. Nor have there been any more detailed investigations of cancer or other chronic diseases in the workplace in Latvia.

Table 19 summarizes occupational health statistics for Latvia for 1990. The Latvian Occupational Diseases Centre has estimated that 166,000 workers, 12.3% of the workforce, are working under poor conditions. It is not clear how this estimate was made. More concretely, 56% of 2255 monitored enterprises in Latvia do not meet current exposure standards. Despite these estimates, there were only 240 occupational diseases reported in 1990. Table 19b shows the distribution of these diseases. The number of lung and bronchial diseases has been increasing in recent years, occurring most frequently among workers in the building material industry, mechanical engineering industry and glass and china industry. In 1990 there were 14 cases of pneumoconiosis (e.g. silicosis, asbestosis) diagnosed, mostly from the "electrotechnical" industry. These figures are likely to be gross underestimates. For example in Broceni, polyclinic records show that more than 400 asbestos cement workers are suffering from obstructive lung disease, yet no more than a handful of them have found their way into the national statistics. Like Lithuania, the individual workplace must pay some, though not all, of the compensation to disabled workers. I am not sure to what extent this disincentive has reduced occupational disease reporting and to what extent underdiagnosis and political manipulation have been contributing factors.

Health Problems Associated with Environmental Pollution

Very few human health studies have been carried out in relation to pollution in Latvia. There are three principal reasons for this. First, the hygiene centres have mostly been restricted to infectious disease control and not been very involved in pollution issues. Second, expertise in the design and execution of valid environmental health studies is largely lacking. Third, there has been a long tradition of secrecy surrounding investigations into environmental contamination and its impact on human health. One notable example of this is in Leipaja, where approximately 6 investigations into human health problems associated with electromagnetic radiation and industrial pollution have been carried out in recent years. The results of these studies are scattered around different agencies in the country and no-one seems to have a complete overview and understanding of them.

National Issues--As in Lithuania, follow up of the Chernobyl cleanup workers is an important priority for Latvia. 6475 Latvians took part in the cleanup. The Occupational Diseases Centre has established a cohort of 5500 of them to meet three goals: to create a data base that will be used in the future for risk estimates for various diseases, to estimate the workers' present state of health and to work out methods of therapy and prophylaxis. The results of the first follow-up are quite striking. In 1991, 5036 diseases were registered among 3180 patients. Yet it is hard to estimate how many of these might be attributable to radiation exposure. For instance, 39.1% were musculoskeletal diseases which might be related to the physical labour aspects of work at Chernobyl but are unlikely to be due to radiation exposure. On the other hand there are only 25 blood diseases and cancers so far, 4 years after exposure. The most impressive result is that 80% of 120 specially tested individuals have evidence of "serious deviations in immune status", which has been attributed to absorption of radionuclides during the cleanup.

There is special concern in Latvia about regional variations in the incidence of congenital anomalies. Routinely collected data from 1981-1990 suggested that the overall incidence rate of congenital anomalies was 65-110% above the national average in the four contiguous districts Leipaja-Ventspils-Kuldigas-Talsu. This was of interest because of industrial and military facilities in Leipaja and Ventspils. A careful review of medical charts

Table 19: Overview of Occupational Health Conditions in Latvia

a. Miscellaneous facts

*166,000 workers (12.3% of workforce) working under "poor" conditions
*56% of 2255 monitored enterprises in Latvia "do not meet the current requirements in terms of exposure levels"
*despite these estimates, reported occupational diseases are few in number (240 in 1990, 213 in 1991)

b. Most commonly reported occupational diseases, 1990

Disease	Percentage of Cases
lung and bronchial illnesses	23.2%
cochlear neuritides	33.1
musculoskeletal & peripheral nervous system	18.2
vibration-induced diseases	9.8
allergic disorders	9.8

c. Industries reporting the most occupational disease, 1990

Industry	Percentage of Cases
light and textile industries	26.6%
agriculture	15.5
building materials	9.6
machine-building	8.1
power stations and electrotechnical	5.9

Table 20: 'Slates' Asbestos Cement Plant, Broceni

a. exposure conditions in the plant

operation	average dust level (mg/m^3)
loading	16.3 asbestos dust
pressing empty sacks	336.6 asbestos dust
shaping roofplates	2.2 mixed dust
sorting process	3.8 mixed dust
cutting up bad roofplates	45.9 mixed dust

b. respiratory disease in the plant (in approximately 1050 workers)

year	COPD cases in plant	new cases of resp. cancer
1987	359	5
1988	376	0
1989	392	0
1990	422	1
1991	436	3

has been done since these data were produced. It suggests that the best explanation for the apparent increase is underreporting of congenital anomalies in other jurisdictions compared to these four contiguous districts. However, within this area the reported annual incidence rate increased 50% from 1981-1990. This justifies the further investigation which will take place: two case-control studies, one in Leipaja and another in Ventspils.

Broceni--Broceni is the site of an asbestos cement plant which has heavy exposures of asbestos in the workroom air . Table 20a shows the exposure conditions at 5 workstations in the plant under worst case conditions. These data show periodic exposures to asbestos and asbestos-laden dust which are as much as 1-2 orders of magnitude above accepted norms in the West. Table 20b presents data from the local polyclinic, showing that a very high proportion of the workers in the plant are diagnosed as having obstructive lung disease. In Latvia, this diagnosis is a catch-all, which includes what we would normally call obstructive lung disease, but would also include dust deposit diseases such as asbestosis. This is because many of the screening X-rays done for chest disease in Latvia are not of high enough quality to make the diagnosis of a dust deposit disease. Therefore, all diseases involving chronic cough and breathlessness tend to be lumped together. Table 20b shows that between 1987 and 1991, the proportion of those so diagnosed increased from 36 to 44%. During those 5 years, 9 respiratory cancers have been diagnosed. Since the plant is only 20 years old and the minimum latent period for respiratory cancer due to asbestos is 10-20 years, it is possible that this is the beginning of an epidemic curve.

It is important to realize that, despite the very high dust levels in the plant and associated respiratory morbidity, this plant was not identified to us as a principal concern by environment or health authorities in Latvia. The data in table 20 were obtained by purely informal means and do not seem to be in the possession of any officials in Riga. Perhaps environmental officials were not concerned because the plant only emits 5000 tonnes of dust per year into the general environment. In general, concerns about asbestos exposures in the region are not as high as they deserve to be on the basis of the human health impact of asbestos and the exposure conditions which exist in plants like Broceni.

Leipaja--Leipaja is a seaport of 114,000 on the Baltic Coast. It was a commercial port until 1966 but was made a closed city by the Soviet military from 1966-1976. Two thousand hectares of town is taken up by the military base, which still houses approximately 15,000 personnel and 25,000 family members. There is quite a bit of tension between the military and the civilians in town, largely because the base commander declared himself in charge of the town during last August's coup attempt and because the outcome of negotiations on the withdrawal of the military is still uncertain. The base dumps raw sewage into the artificial harbour, contaminating the beaches on the north side of town. Among health authorities in Leipaja the principal environmental health concern is the effect of electromagnetic radiation from the radar stations along the "Tallinn line" and at the air bases at Skrunda and Vainode. Until 3 years ago the Soviet military controlled all data and information on electromagnetic fields in the area, so public investigations are only 2 years old. In November 1990 the hygiene centre took measurements of the electromagnetic fields at a school in the Ezerkrasts neighbourhood within 200 metres of a point source. The field intensity was reported to be 8 times the Soviet standard (which is similar to the European standard). At a farm house and another house which were both approximately 2500 metres from the same point source, the field intensity was reported to be 3 times the standard. During the summer of 1991 the military built a fence between the point source and the Ezerkrasts neighbourhood which reduced the field intensity at the school to twice the standard.

The following series of investigations and observations have been made among people living and working in the Ezerkrasts neighbourhood and other areas near major radar facilities.

a. A study of 180 children who had lived for at least 3 years in Ezerkrasts or another exposed neighbourhood showed that 60% had enlarged thymus glands (an organ important for the body's immune function). Similarly, 60% of a subsample of 34 children had increased lymphocyte counts in blood and other "non-specific" evidence of increased immunological activity. Among the full sample of 180 children problems with headaches, nervousness, and lassitude were reported much more frequently than expected by examining physicians.

b. Routine investigation of all "well babies" less than 1 year old in Leipaja revealed that those living on the military bases had a prevalence of thymomegaly 20-30% higher than those living off the base.

c. The Institute of Oncology examined 481 blind adults who worked at a sheltered workshop in Ezerkrasts, within 500 metres of the radar facility. 107 study subjects had evidence of anemia and leukopenia (reduced numbers of white blood cells) and a further 4 had lymphadenitis (inflammation of the lymph glands).

d. Investigators at the Institute of Oncology report that there is a cluster of leukemia among teenagers at school near the military airbase in Vainode.

These reports indicate that further investigation and more careful documentation are warranted.

There are several point sources of air pollution in the core city including several heating plants, factories, and naval vessels. The most important of these is the Leipaja Metal Worker. This steel mill is 109 years old and uses open hearth furnaces, despite the fact that these were installed in 1965, long after basic oxygen technology had been perfected. In addition, it has a casting process which uses silica sand and, also, waste oils for binding which give off carcinogenic products during pyrrolysis (non-oxygen burning). At present, the plant has 76 workers on pension for permanent disability. Some of these are due to trauma, but they also include dust-related chronic bronchitis, silicosis from the casting operation (which they say is underdiagnosed due to poor X-ray quality), and lung cancer, likely due to exposure to the above-mentioned pyrrolysis products. The community impact of this plant has not been fully evaluated. The major emissions are sulfur dioxide and mixed dust, which contains relatively low concentrations of metals. Three years ago radioactive dust was discovered on site. It turned out that the plant, which is largely a recycling facility, was melting down Soviet military equipment. This has now stopped, and no-one investigated its impact on the local community.

Local pediatricians believe that the incidence of asthma and allergic dermatitis among children under 15 years of age is increasing in Leipaja, but they have not done a study of this. There is also controversy over lead exposures to children in the centre of town. Local hygiene and environment officials were not aware of any soil sampling in Leipaja, but the Environmental Protection Committee in Riga had obtained data produced by the Institute of geology five years previously. Soil mapping suggested that metal levels were higher in the town centre than elsewhere, so two blood sampling exercises have been carried out. The first, done by the Latvian medical academy, was suppressed because the data appeared to be unreliable. Having seen it, I agree. Several blood samples showed absolutely no lead and several others showed lethal levels! Another set of samples was taken by a Swedish team last autumn and the results have not been reported in Leipaja. However, the data had

been seen by a special consultant to the Environmental Protection Committee in Riga who reported that they were "low".

Despite the fact that all the relevant agencies agree that there are several important environmental health issues in Leipaja, adequate information sharing has not taken place. In addition to the confusions identified in the previous paragraph, local physicians and public health officials had contributed to studies organized by the Environmental Protection Committee without hearing about the results. In another case, work had been done on electromagnetic radiation by the local cancer and public health specialists which had not been made available to the Environmental Protection Committee. No-one was working with the same set of facts or priorities, even though Leipaja was supposed to be subject to a coordinated investigation by the Environmental Protection Committee.

Ventspils-- Ventspils is a port on the Baltic Sea at the mouth of the Venta River. The main concern there is the potential explosion hazard from an export facility which stores ammonium, methanol and acrylonitrile on site and manufactures liquid fertilizer from phosphoric acid and ammonium. The raw materials are brought in by railway, and some of the rail cars are left on tracks across the street for residences. Beside this facility is an oil tank farm and a few hundred metres away is a Soviet army munitions dump. This juxtaposition of facilities was approved directly from Moscow, over-riding local permitting procedures, in the 1970s.

Recently, a quantitative risk assessment was conducted to estimate the explosion hazard from the ammonium storage facility and fertilizer plant and estimate how much the risk could be reduced by instituting a series of technical and procedural controls there. This was made necessary because the facility is within a few hundred meters of residences on both sides of the Venta River. The initial risk was found to be highly unacceptable (i.e. a 1 in 10 chance per year of an explosion involving at least one fatality), but it was estimated that the control program could make the risk much more acceptable (i.e. reduce the risk 1000-fold). This program involves making engineering and administrative changes at the plant and not closing facilities or moving the nearby community further away.

The facility is currently owned by the Latvian Ministry of Agriculture, which uses hard currency earnings from the export operation to buy phosphoric acid to produce fertilizer for domestic use. This might explain why the government of Latvia has already accepted the proposed risk management program and the facility has begun to implement it. The city of Ventspils, however, is yet to approve the plan and there is concern about whether this exercise in arithmetic is really credible. For instance, it does not seem that the plan takes into account certain other explosion hazards, such as the nearby oil tank farm and the munitions dump. However, Ventspils,too, has a considerable interest in its continued survival. In addition to providing over 1000 jobs, the export operation will be providing substantial hard currency to the town on the basis of tonnage fees from ammonia, methanol and acrylonitrile. Workers apparently receive $80 per month in hard currency in addition to their rouble salaries, making them extremely well paid by Latvian standards.

Ironically, another benefit of the explosion hazard is that Ventspils has attracted the attention of the United Nations Inter-agency Group on Risk Assessment and Human Health. The Dutch government is sponsoring a project in which physicians, chemists, architects, sanitarians, and a lawyer are working with Dutch experts to develop an environmental strategy for Ventspils, to extend the risk assessment and management process to all firms in town, to develop further preventive strategies, and to create an overall town plan. This group has some interlocking membership with the municipal ecological department and reports to the steering committee of local government. It is one year old now and it is too early to evaluate its output.

Finally, there have been human health concerns about emissions of hydrocarbons from the oil tank farm and motor vehicles, as well as daily emissions of toxic and irritant gases from the export/fertilizer facility. A polyclinic study was done under the auspices of the municipal ecological department which compared medical visits from people living in the centre of town, 1989-1992, with a control town called Segulda. Predictably, the study showed increased rates of virtually everything such that, like in Kaunas, the credibility of the exercise was called into question. There were sharp differences of opinion between municipal and hygiene centre officials about the study's value. The head of the special hygiene centre for the port seemed to understand the problems of the study but the municipal officials did not. It was clear that there had been no inter-agency cooperation in designing and carrying out the project and little useful discussion afterwards.

Olaine--Olaine is the centre of the Latvian pharmaceutical industry. It has two large facilities, known as Biolar and Latbiofarm, which are of environmental health interest because both are within a few hundred metres of town. It is also of occupational health concern because of the complex chemistry of their production processes. Latbiofarm is a large facility with a wide range of products, including anti-cancer agents which are themselves carcinogenic. In one special investigation of workroom air, the MAC was exceeded in 17-21% of measurements for ethanol, isopropanol, butanol, benzene, benzaldehyde, chloroform, dichloride, or acetone. At a distance of 1200-1300 metres, 9% of short-term air samples exceeded the MAC for isopropanol, ammonia, aliphatic amines, nitrogen oxides, hydrogen chloride, or formaldehyde in 1986-88. In another air monitoring exercise, 8 substances (hydrogen chloride, formaldehyde, isopropanol, phenol, acetone, nitrous oxide, sulfuric acid and methanol) were measured at five locations in the area, three months a year for three years. It was reported that 41% of the samples exceeded the MAC.

The water effluent includes toluene, formic acid derivatives, various alcohols, and certain carcinogenic substances such as benzene and anti-cancer agents. Thus, the waste water is both toxic and mutagenic. It is treated at the plant's facility which is 500 metres from town. City sewage and waste from Biolar also go into the facility. The facility has technical problems with the complex mixtures of sewage, domestic detergent, and industrial chemicals it must treat. There are problems with creating new toxic agents through chlorination, airborne discharges of volatile hydrocarbons, and contamination of groundwater with toxic sludge. In addition, the plant has been burying solid waste in 1200 metre deep dolomite deposits. It is suspected that these have contaminated the groundwater, but there does not seem to be reliable data on this matter.

The pharmaceutical workers and the town's inhabitants have been the subject of health concern for several years. There appear to have been 3 investigations, 2 by outside agencies and one by Latbiofarm, which is not yet complete. The first investigation, by the Riga Medical Academy, compared children in Olaine with Segulda, the same control community used for the Ventspils study. It was reported that 27% of Olaine newborns were "unhealthy" compared to 9.5% in Segulda. Children under 3 years old in Olaine were also said to have higher rates of respiratory disease and "4 times more allergic disease" than in the control town.

The second study was a more impressive effort. It involved workers from Biolar, residents of Olaine, and controls from Aizkraukle. Results are shown in table 21. They show that the workers and, to a lesser extent, the residents of Olaine, differ from the controls on 4 important immunological measures. Also, it was demonstrated that residents and workers had higher rates of bronchitis and allergic rhinitis than controls. The workers, but not the residents, also had higher rates of chronic hepatitis and allergic dermatitis than

Table 21: Allergic and Immunological Observations of Persons Working at Chemical Factories in Olaine, Population of Olaine, and Controls

Variable	Workers (n=560)	Olaine (n=200)	Controls (n=200)
Sensitization to chemical allergens	41.0%**	18.0%**	0%
Immunosuppression of local immunity	53.2**	32.5*	19.6
Interference with humoral immunity	31.5**	26.4*	19.7
Interference with cell-mediated immun.	30.4**	23.8*	18.2

* $p<0.05$
** $p<0.01$

the controls. These results are reasonably credible because they are specific to the toxic properties of the exposures from the plants.

Conclusions and Recommendations

Most of my conclusions and recommendations apply to each of the three Baltic countries. Accordingly, I have placed them at the end of the report, with a small number of country-specific recommendations following those which apply across the region.

1. In each of the Baltic countries there was evidence that the resources available to the public health system for environmental health purposes were being misdirected. An appropriate targeting of resources would result in priority being placed on human health investigations in the places with environmental pollution of greatest threat to human health. In Estonia, this would mean Kunda; in Lithuania, it would mean Siauliai; and in Latvia, it would mean Broceni. Yet each of these locations has been underinvestigated, or investigated late. Each country needs to develop an environmental health strategy, *which uses a widely discussed and accepted methodology* to identify priority problems for environmental health investigation and control.

2. A lot of time and energy has been lost throughout the region doing polyclinic studies which usually cannot answer the questions that need to be asked. Unbiased estimates of clearly defined disease endpoints are needed in order to determine whether an exposed community has an elevated disease rate. Polyclinic records rarely give that because they record medical encounters, not validated new cases of clearly-defined disease entities. Moreover, the influences of toxic chemicals in the environment can only be identified by studies which focus specifically on the putative health effects of these substances and not on all aspects of health status. This is an issue both in validity and efficiency, because a study focussed on a specific health problem can make more careful measurements of this problem, using a given about of money, than one which collects data on just about everything. For example, it is more worthwhile to have properly measured lung function data on children living in a community with air pollution problems than to have polyclinic data on all the adults and children for all imaginable diseases. Generally speaking, the Baltic countries should abandon the "polyclinic" study in favour of problem-oriented investigations whose methods have been critically appraised before the study begins.

3. None of the Baltic countries has a critical mass of investigators who are adequately trained in chronic disease epidemiology and its application to occupational and environmental health problems. This needs to be remedied over the next few years through a combination of workshops for existing mid-career personnel and post-graduate training in the West for a smaller number of early-to-mid career individuals with strong quantitative aptitudes. These latter will hopefully take over the role of in-country professional training over time.

4. Information reporting and communication need improvement within and between environment and health agencies. First, both environment and health agencies must accept the fact that the other has a legitimate role in environmental health. Next, the information collected by each agency at both the national and local level must be made available to other agencies in a form which is useful to them. In particular, it is important that more than the standard non-quantitative, one paragraph summary of investigations and routinely collected data be made available. It is remarkable how often key officials in the Baltic countries seem to have access to no more than vague information about important investigations, even after taking several days to track down more complete details. As a result everyone is working

with a different set of facts, most of them false. A national clearinghouse for environmental health information may be useful if it is strongly oriented to disseminating information and does not degenerate into a power grab by centralizing information and denying access to those who need it.

5. Models of effective local cooperation between municipal-environment-health agencies and of control of the local environmental health agenda need to be further explored. The fledgling systems in Narva (Estonia), Kaunas (Lithuania), and Ventspils (Latvia) seem promising and deserve attention and imitation throughout the region.

6. Quality control protocols need to be put in place for all routinely collected environmental data in the region. In general, the analytical laboratories in the public sector ought to be fewer in number but better equipped and better regulated to ensure efficiency and validity of their output. In each country there should be an inventory of useable equipment and a review of its analytical capabilities, as well as an effort to reduce inter-agency duplication of environmental measurements. The efforts of Estonia to review their resources with a view to taking on new priorities, such as a soil testing program, are commendable in this regard.

7. Special analytic needs include portable spirometres for environmental respiratory field work, reliable methods of blood lead measurement, especially in children, and techniques to measure metals in soil. It will be important to replace existing air monitoring equipment with continuous, on-line systems as resources become available.

8. Vital statistics, cancer registration, and other routinely collected health data need to be computerized in ways which will allow them to be easily age-standardized, and comparable over time and between local areas in the country. Certain data, such as that on congenital anomalies, needs to be subject to careful quality control, as is being done in Latvia, before being used as a tool for environmental health surveillance.

Recommendations Specific to Latvia

1. Riga's water supply is as vulnerable now as it was during the hepatitis outbreak. The same may be true for other places in the country which use surface water for drinking. It is important for international agencies to ensure an adequate supply of coagulant for pre-treatment of these water supplies until the economic crisis is over. Also, Riga needs equipment and techniques for achieving much faster turn-around on water quality samples.

2. The cancer registry in Latvia would appear to be the weakest in the region and needs upgrading in order to be useful for chronic disease and environmental health investigation.

Recommendations Specific to Lithuania

1. The division of investigative and regulatory functions within the Ministry of Health system is perverse and needs to be reviewed. The reasons for this have been described in pages 14 and 15 of this report.

2. Lithuania, more than the other two Baltic countries, has a problem with duplication of laboratories and chaos in its environmental data collecting system. The system is in urgent need of rationalizing before it will be possible for international agencies to effectively help supply needed equipment and technology.

Recommendations Specific to Estonia

1. It is important for the environment and health agencies to get control of the air and water monitoring program in the country, regardless of who actually takes the samples and makes the measurements.

2. Ethnic rivalries need to be kept out of the environmental health field, especially those which poison the working atmosphere and inhibit inter-agency cooperation.

References

1. Baltic Sea Environment Programme. Pre-feasibility study of the Lithuanian coast and the Nemunas River basin. 1991.

2. Baltrukonis J, Vasiliauskas R. Organization of environment protection in Kaunas city. Aplinkos Apsaugos Problemos ir ju Sprendimo Budai 1991:7-8.

3. Brazauskas V, Budrys R. The problems of initial waste water cleaning in textile industry plants. Aplinkos Apsaugos Problemos ir ju Sprendimo Budai 1991:28.

4. Bridge DJ. Quantitative risk analysis of the ammonia storage and transshipment terminal at Ventspils, Latvia. Technica Ltd, 1991.

5. Eglite M. Protocol for a study of Chernobyl cleanup workers. Latvian Occupational Diseases Centre, 1992.

6. Eipre A, Tauritis G, Prols J. Environmental situation and project identification in Latvia. Nordic Project Fund, Helsinki, 1991.

7. Estonian Nature Management Scientific Information Centre. Environment '89. Tallinn 1990.

8. European workshop on human impact on environment: Northeast Estonia. Tartu, 1991.

9. Gurevicius R. Environment and cancer in Lithuania. from the workshop: The European Charter on Environmnet and Health in the Baltic Countries, Sweden, 1991.

10. Gurevicius R. Vezio paplitimas Lietuvoje. Sveikata 1991;9:40-41.

11. Hertzman C. Bulgaria: the public health impact of environmental pollution. HPRU 1991;8D.

12. Hertzman C. Environment and health in Czechoslovakia. HPRU 1990;23D.

13. Hertzman C. Hungary report. HPRU 1990;20D.

14. Hertzman C. Poland: health and environment in the context of economic decline. HPRU 1990;2D.

15. Kameneckas J, Vasiliauskas R. Environmental protection at Kaunas municipality, Republic of Lithuania. Environment Conference, Sweden, 1991.

16. Krumins J, Zvidrins P. Recent mortality trends in the three Baltic Republics. Population Studies (in press,1992).

17. Krumins J. Socio-economic differentiation of infant and adult mortality: experience of Soviet registration system and problems of comparability. Quetelet Seminar, Belgium, 1991.

18. Latvian Republic Environmental Protection Committee. Air quality management in Latvia. Riga, 1990.

19. Ministry of the Environment of Finland. Environmental priority action programme for Leningrad, Leningrad Region, Karelia and Estonia. Plancentre Ltd, 1991.

20. Ministry of the Environment Republic of Estonia. Environment '90. Tallinn, 1991.

21. Palm A. The content of heavy metals in children's teeth. Soviet Estonian Health 1988;1:79-80.

22. Psavke R(ed). Health in Latvia: yearbook of Latvian health statistics 1990. Latvian Ministry of Public Health, Medical Statistics Bureau, 1991.

23. Purde M, Rahu M. Cancer patterns in the oil shale area of the Estonian S.S.R. Environmental Health Perspectives 1979:30;209-210.

24. Rahu M. Cancer occurrence in Estonia. Proceedings of the Fourth International Symposium in Medicial Geography, England, 1990.

25. Rahu M, Aareleid T. Cancer in Estonia 1978-1987: diagrams. Estonian Cancer Registry and Finnish Cancer Registry, 1990.

26. Sabaliauskas R. untitled. Lithuania, 1992.

27. Silla R. The influence of environmental pollution on th children's health in North-east Estonia. Proceedings of the Conference, Development and Health of Estonian Youth, Tallinn 1991:27-29.

28. Study of environmental protection: Estonia and partly Latvia and Lithuania. Nordic Project Fund,1989.

29. Tefanova V, Kremerman I, Priimage L, et al. Evaluation of the health condition of children resident in the industrial oil shale chemical area of Estonia. Proceedings of the Conference, Development and Health of Estonian Youth, Tallinn 1991:41-43.

30. Teoste M, Soonets R, Piller M, et al. Results of children's bllod counts in connection with their residence.Proceedings of the Conference, Development and Health of Estonian Youth, Tallinn 1991:45-47.

31. Uibu J. Environment and health in Estonia. Ministry of Health of the Republic of Estonia, undated.

32. Valkonen T, Krumins J, Zvidrins P. Mortality trends in Finland and Latvia since the 1920s. Yearbook of Population Research in Finland 1991;29:61-72.

33. Van Arkadie B, Karlsson M, et al. Economic survey of the Baltic Republics. Swedish Ministry of Foreign Affairs, 1991.

34. Viitak A, Hodrejarv H, Silla R. The content of several heavy metals in the hair of population in the North- and North-east Estonia. Proceedings of the Conference, Development and Health of Estonian Youth, Tallinn 1991:52-53.

35. Vyjuli D. Skin pathology in children of North-east Estonia. Proceedings of the Conference, Development and Health of Estonian Youth, Tallinn 1991:54-55.

36. Weaver NK, Gibson RL. The U.S. oil shale industry: a health perspective. American Industrial Hygiene Association Journal 1979;40:460-467.