No. 3, Oct. 1988

Acid News

A Newsletter from the Swedish and Norwegian NGO Secretariats on Acid Rain

CHRISTER ÅGREN

CRITICAL LOADS

Figures continuing downwards

How much pollution can the environment take? The question is central to the debate on environmental matters, because from the answer one can see how much the emissions of pollutant will have to be reduced.

Last spring fresh scientific data on the subject emerged as a result of two meetings of international experts — one in Sweden dealing with sulphur and nitrogen depositions, and another in West Germany which considered critical levels for sulphur dioxide, nitrogen oxides, ozone, and ammonia. Both represented work that is being carried on within the Convention on Long-range Transboundary Air Pollution set up by the UN Economic Commission for Europe. The findings are intended to form a basis for continued negotiations to limit emissions of pollutants.

Sulphur

For forest soils the critical load was defined as the highest deposition that would not cause chemical changes in the soil which in turn would lead to long-term harmful effects on the ecosystem.

Any overstepping of the critical load would mean that the soil could no longer neutralize additions of acidifying substance. Subsequent leaching of mineral nutrients (in particular potassium, calcium, and magnesium) may then cause nutrient deficiency. Moreover the liberation of aluminium and other metals from the soil water can poison the trees' root systems.

The weathering rate of minerals in the soil is what determines its ability to neutralize acid input. Table 1 shows critical loads for soils with differing weathering rates — the limits being given as total acid input, expressed both as hydrogen ion equivalents (keq/km^2/yr) and as sulphur depositions in kilograms of sulphur per hectare per annum (kg S/ha/yr). A kiloequivalent of hydrogen ions per

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Acid News

A newsletter from the Swedish and Norwegian NGO secretariats on acid rain.

ACID NEWS is a joint publication of the two secretariats, whose aim is to provide information on the subjects of acid rain and the acidification of the environment.

Anyone interested in these problems is invited to contact the secretariats at either of the addresses below. All requests for information or material will be dealt with to the best of our ability.

In order to fulfill the purpose of Acid News, we need information from everywhere — so if you have read or heard about something that might be of general interest, please write or send a copy to:

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THE SECRETARIATS

The Swedish NGO Secretariat on Acid Rain is supported by the following environmental organizations:

- The Environmental Federation (Miljöförbundet)
- The Swedish Anglers' National Association (Sportfiskarna)
- The Swedish Society for the Conservation of Nature (Svenska Naturskyddsföreningen)
- The Swedish Youth Association for Environmental Studies and Conservation (Fältbiologerna)

Address and telephone: see above.

The Norwegian secretariat, "**The Stop Acid Rain Campaign/Norway,**" is organized by six non-governmental organizations concerned with the environment:

- Nature and Youth (Natur og Ungdom)
- The Norwegian Forestry Society (Det Norske Skogselskap)
- World Wildlife Fund/Norway (Verdens Villmarksfond)
- The Norwegian Association of Anglers and Hunters (Norges Jeger- og Fiskeforbund)
- The Norwegian Society for Conservation of Nature (Norges Naturvernforbund)
- The Norwegian Mountain Touring Association (Den Norske Turistforening)

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EDITORIAL

Say what you think

In the general debate on the environment, questions concerning pollution and its effects are coming ever more to the fore. The depletion of the ozone layer, the greenhouse effect, forest dieback, and injury to humans and materials are among the most prominent effects.

As a result of the startling surges of poisonous algae early this summer in the North Sea and adjoining waters, shortly followed by the equally shocking decimation of the seal populations in the same area, more attention that ever has been drawn to the state of the coastal waters. While the ultimate causes of these phenomena are still uncertain, it seems highly probable that the recent excessive blooming of the algae will be traceable primarily to a highly increased nitrogen input to the sea.

This brings us back to air pollution. According to a Swedish report, air pollutants account for a good two-thirds of the nitrogen input to the sea off the country's west coast, to Öresund, the Kattegat, and Skagerrak. Leakage from farming is responsible for about a quarter of such inputs, and discharges of sewage for less than one-tenth. Most of the airborne part stems from the emissions of nitrogen oxides from road traffic, although other combustion processes also contribute their share.

In view of the role of nitrogen oxides in the formation of oxidants, in causing acidification, forest decline, corrosion of materials, and eutrophication of coastal waters, the need for rapid and effective measures to limit emissions hardly needs emphasizing. Since nitrogen oxides are carried about all over Europe by the winds to about the same extent as sulphur pollutants, it must also be obvious that this matter will also have to be dealt with on an international scale.

For almost two years negotiations have been going on within the ECE convention on long-range transboundary air pollution to arrive at a so-called NO_X protocol, designed to bring about effective reductions of nitrogen-oxide emissions. It seems the outcome can only be accounted a failure. No agreement has been reached even on the smallest reduction of emissions — only a freezing in 1994 at 1987 levels. Moreover several countries have announced their intention of continuing to allow increases during the nineties as well.

We environmentalists had made known as early as 1986 that European emissions of nitrogen oxides would have to be reduced by at least 75 per cent. The latest information on critical loads (p. 1) indicates the need for a still greater reduction, up to as much as 90 per cent.

On November 1 the delegates of the countries adhering to the ECE convention will be assembling in Sofia, the Bulgarian capital, with the intention of signing the NO_X protocol in its present form.

Make sure that the public and the authorities in your country are informed well beforehand of what environmentalists think of that protocol.

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NOTE: Change of address

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LARGE COMBUSTORS

No intention to meet critical loads

The EEC negotiations to control the emissions of SO_2 and NO_X from power stations ended unsatisfactorily last June from the environmental viewpoint.

After five years of negotiations the original proposal from the European Commission of the EEC for a Large Combustion Plant Directive, which called for a 60-per-cent reduction of the emissions of SO_2 and 40 per cent for those of NO_X between 1980 and 1995, became watered down to such a degree, that in 15 years for instance (by 2003) more than 8,000,000 tons of SO_2 would still be emitted into the atmosphere every year by the EEC countries. (See Acid News 2/1988.)

While scientists and environmentalists are calling for a reduction of at least 90 per cent for SO_2 emissions and 75 per cent for NO_X in order to get down to nature's critical-load levels, it seems the EEC has no intention at present of doing anything to arrive at such levels even in the next 20 to 25 years.

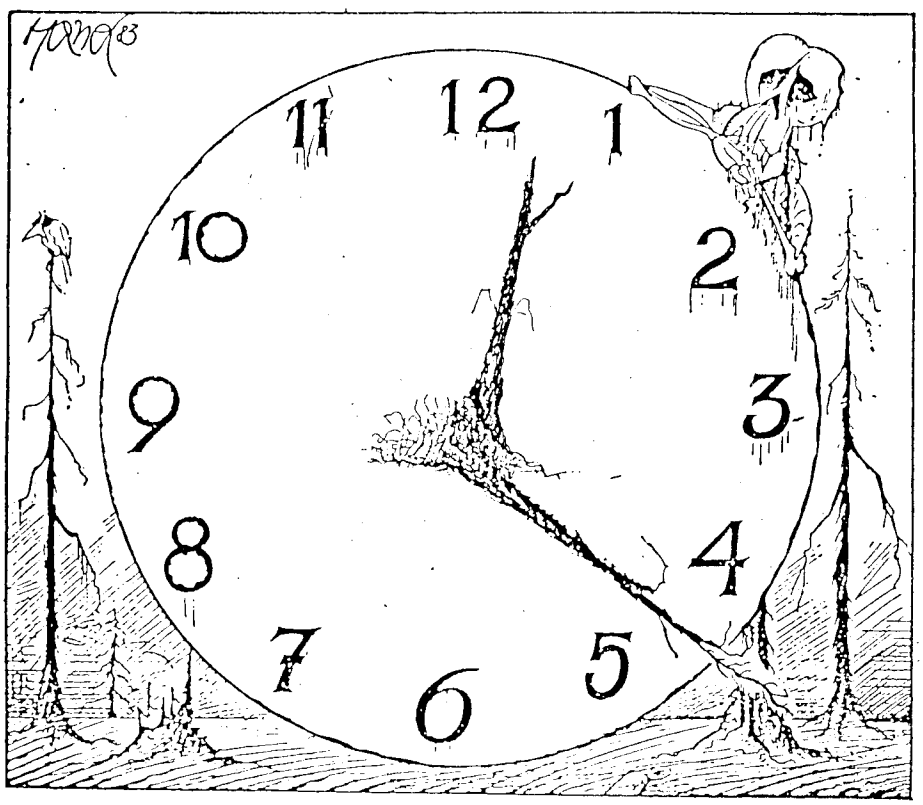
Dying of Europe's lakes and forests may continue for several decades

A Danish proposal to reduce SO_2 emissions by 80 per cent by 2010 was also rejected during the negotiations. The dying of Europe's lakes and forests will therefore probably continue for several decades.

During its June meetings the Environmental Council of the EEC took the following decisions concerning the Large Combustion Plant Directive: Overall emissions of SO_2 will be cut from existing plants, larger than 50 MW, by 25, 43, and 60 per cent from 1980 levels in three phases — by 1993, 1998, and 2003. However, the reductions to be achieved by each EEC member state may differ markedly according to their "economic, energy, and environmental situation", as the Council puts it. This means that Belgium, France, Germany, and the Netherlands are aiming at reductions of 40, 60, and 70 per cent. The UK is aiming at 20, 40, and 60 per cent, Spain at 0, 24, and 37 per cent, and Italy at 27, 39, and 63. Both Ireland and Portugal will be allowed to increase their emissions during the period before 2003.

This would mean altogether a reduction of only 6 million tons a year in emissions of SO_2 from existing power plants and oil refineries by 1998, and a halving of emissions by the year 2003. In 1986 the emissions of SO_2 from the EEC countries totalled 18,000,000 tons. NO_X emissions for existing plants will be reduced by 20 and 36 per cent from 1980 levels by 1993 and 1998.

The standards set down in the directive on new plants (commissioned after July 1987), will reduce emissions of SO_2 by more than 80 per cent and of NO_X by half from the amounts currently pumped out by unmodified plants. It was generally agreed that Spain should be allowed concessions for new plants burning solid fuel of over 500 MW until the end of 1999.



These installations would have to keep to a SO_2 limit value of 800 mg/m^3 as well as a 60-per-cent desulphurization rate where domestic high-sulphur coal was being burned. The deal sets ceilings for the total capacity of such plants, whether they burn domestic or imported fuel. These are also exemptions for peak-load plants and plants burning lignite and high-sulphur coal.

Reinhold Pape

Continued from page 1
square kilometre corresponds to 0.16 kg of sulphur per hectare.

Soils in classes 1 and 2 are composed of slowly weathering minerals from parent rocks such as granite and gneiss, in 3 and 4 from rocks such as gabbro and basalt, and in class 5 from limestone which weathers very easily.

The figures in the table should be set against the actual depositions of sulphur on forest land in various parts of Europe. In southern Sweden for instance the deposition is 15-30 kg/ha/yr, and in parts of West Germany 50-80 kilograms. In the worst affected areas of Central Europe it is more than 100 kilograms.

As regards the groundwater and freshwater ecosystems (lakes and streams) in sensitive areas the critical limits for acid input and sulphur deposition are 10-50 keq $H^+/km^2/yr$ and 2-8 kg S/ha/yr. Seeing that a greater part of the water entering the groundwater comes from precipitation that has run through the soil, the critical loads for aquatic ecosystems are, as might be expected, approximately the same as those for forest soils. If they are exceeded, the water will sooner or later become acidified.

Nitrogen

On account of a deficiency in relation to other plant nutrients, nitrogen has traditionally been a growth-restricting factor in most forest ecosystems in Europe. Extra inputs in the form either of fertilizer or airborne depositions have consequently brought about increased growth. If there should be a greater input than the vegetation can absorb the soil will sooner or later become saturated, thus increasing the risk of adverse effects, such as:

☐ Increased leaching of nutrients (acidification).

☐ Nutrient imbalances in the vegetation.

☐ Reduced frost resistance.

☐ Greater leakage of nitrogen in the form of nitrate to groundwater, freshwater ecosystems, and the sea.

☐ Changes in the flora. More than two-thirds of Central European vascular plants can only compete on nitrogen-poor soils.

For various reasons, it is not possible to set general critical loads for nitrogen as one can for sulphur. In the case of nitrogen they will depend on the productivity of the ecosystems, the activity of certain microorganisms in the soil, and the composition of the vegetation. It has still not been possible to determine the limits for several types of ecosystem.

It may however be said that in many cases the critical load will be 3-15 kg N/ha/yr, but that the most sensitive areas will stand no extra input at all. Changes will occur in the flora of shallow ponds, raised bogs, and some types of heathland with an input of 3-10 kg N/ha/yr. The risk of nitrogen leakage increases markedly in coniferous forest if the deposition is 3-15 kg/ha/yr, and in deciduous woodland when it is 5-20 kilograms.

The deposition of nitrogen over a great part of Central Europe is currently 30-40 kg/ha/yr. On forest land in southern Sweden it amounts to 20-30 kg N/ha/yr, and on coniferous forest in the Netherlands it may even exceed 100 kilograms. Since trees at the edge of the forest filter great amounts of pollutant from the air, the depositions both of sulphur and nitrogen at that point can be several times greater than in the rest of the forest.

It is important to bear in mind that depositions of nitrogen also contribute to the acidification of soil and water. In areas that are still unsaturated this applies particularly in winter, when plants are inactive and not taking up any nutrients. On saturated soils, nitrogen acidifies in the same way as sulphur. Consequently the deposition of nitrogen on saturated soils will mean that they can withstand lesser amounts of sulphur than appears from Table 1.

Critical levels

These were defined by the working group as concentrations of pollutants in the atmosphere which if exceeded may cause direct adverse effects, for instance on plants, ecosystems, or materials.

As concerns sulphur dioxide (SO_2), the critical levels are put at 20-30 micrograms per cubic metre ($\mu g/m^3$) for a yearly average, with 70 $\mu g/m^3$ as a peak value (daily mean level). If the annual mean value should exceed 30 $\mu g/m^3$, damage may be expected to sensitive cultivated plants, as well as a productivity decline in sensitive forest stands.

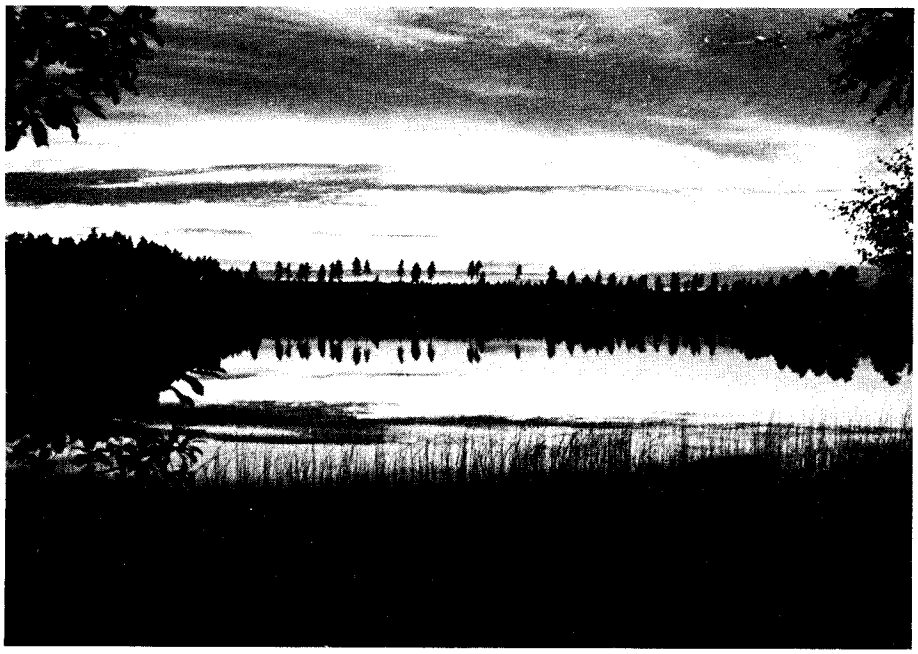
Crops are considered to be particularly sensitive to ozone (O_3). The most sensitive forest trees are Scots pine and European larch. The proposed critical levels are shown in Table 2.

Nitrogen oxides are generally regarded as less toxic to plants than SO_2 and O_3, while nitrogen dioxide (NO_2) is considered to be definitely more phytotoxic than the monoxide (NO). Because of its relatively low toxicity, no critical levels have been set for NO_2 alone, but only in combination with O_3 and SO_2. The maximum annual mean level would then be 30 $\mu g/m^3$ and the peak level 90 $\mu g/m^3$ (average for 4-hour exposure).

Ammonia (NH_3) and ammonium (NH_4^+) are much more of a local problem than the other

Table 1. Critical loads for acid and sulphur in relation to the weathering capacity of the soil in forest land.

Class	Acid input (keq $H^+/km^2/yr$)	Sulphur deposition (kg S/ha/yr)
1. Very slow weathering	< 20	< 3
2. Slow weathering	20—50	3—8
3. Moderate weathering	50—100	8—16
4. Rapid weathering	100—200	16—32
5. Very rapid weathering	> 200	> 32



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pollutants. Since NH_3 is converted to NH_4 in plants, figures are given in terms of NH_3, the critical concentrations then being a monthly mean of 100 $\mu g/m^3$, a daily mean of 600 $\mu g/m^3$, and an hourly mean of 10 000 μg.

It should also be borne in mind that these gases seldom occur alone in the atmosphere, and that their toxic effects will be intensified when they occur in combination. Consequently the critical levels figures, especially for SO_2 and O_3, must be regarded as maximum concentrations, and if the synergic effects are taken into consideration, the maximum levels should be lower.

Looking back, too, it can be seen that the proposed levels have always tended to be put lower as research methods have improved and more data have become available. It is therefore not improbable that today's critical levels will also have to be reduced after a few years.

Table 2. Critical levels of ozone for sensitive plants, plant communities, and ecosystems.

Exposure (hours)	Ozone concentration ($\mu g/m^3$)
0.5	300
1.0	150
2.0	110
4.0	80
8.0	60
Vegetation period*	50

* Daily mean value during the summer half-year.

Reduction of emissions

After a careful study and evaluation of the scientific data that was available at the time, the European environmental organizations agreed in 1986 to demand a reduction of emissions as follows:

Sulphur dioxide: down by 90 %
Nitrogen oxides: at least 75 %
Ammonia: down by 75 % in especially exposed areas.

It was also agreed that ozone concentrations should be reduced by 75 per cent, to be achieved through the said reduction in nitrogen-oxide emissions in combination with a concurrent drastic reduction of those of hydrocarbons.

Now, in consideration of the fresh information here presented, the environmentalists should revise and intensify their demands.

Christer Ågren

Publications

AMBIO — A Journal of the Human Environment, Royal Swedish Academy of Sciences/Pergamon Press
Ambio is an international journal publishing major articles, by experts, on all aspects of environmental policy and research. Selected papers from 1987-88:
☐ Acidification in Europe: A simulation model for evaluating control strategies
☐ Delayed nutrient responses to the liming of Lake Gårdsjö, Sweden
☐ Depressed mercury levels in biota from acid and metal stressed lakes near Sudbury, Ontario
☐ Changes in soil acidity in two forest areas with different acid deposition: 1920s to 1980s
☐ Acid Rain: UK Policies
A personal subscription (6 issues) costs UK 27 pounds, also Europe, Africa, Australia, and Asia. USA 43.00 dollars. Obtainable from Ambio, Royal Swedish Academy of Sciences, Box 50005, S-104 05 Stockholm, Sweden.

Acid Rain: The Relationship between Sources and Receptors (1987)
Proceedings of the third annual conference on acid rain in Washington DC, December 1986. Provides information about the current understanding of the source-receptor relationship while also establishing a common basis for devising strategies for the control of acid rain. 240 pp. Can be ordered from Elsevier Science Publishing Co., Crown House, Linton Road, Barking, Essex, England 1G11 8JU. Price 59.00 dollars.

Air Pollution and Plant Metabolism (1988)
Proceedings of the 2nd International Symposium on Air Pollution and Plant Metabolism, held in Munich, FRG, on April 6-9, 1987. Ed. Schulte-Hostede, Davall, Blank. 381 pp. Can be ordered from Elsevier Science Publishing Co., Crown House, Linton Road, Barking, Essex, England 1G11 8JU. Price 44.00 dollars.

How much needs to be reduced

On the basis of official data, the Stichting Natuur en Milieu has calculated the reductions of acidifying emissions that will be necessary in order to bring them down to maximum permissible levels in Europe as a whole and so prevent impact on the environment. This will mean reductions of 90 per cent for sulphur dioxide emissions and 75 per cent for nitrogen oxides from 1980 levels.

Moreover the emissions of carbohydrates (or volatile organic compounds, VOCs) will also have to be reduced by 75 per cent, compared to 1980 levels, in order to reduce the ozone load in the environment by about 75 per cent.

Table 1. Calculations for permitted annual emission levels.

Annual emission levels, Europe

	Total kton (10^6 keq)	per km^2 kg (keq)	per inhab. kg (keq)
SO_2 1980	58155 (1817.3)	5184.0 (162.0)	79.7 (2.49)
aim: 10 %	5815 (181.7)	518.4 (16.2)	8.0 (0.25)
NO_X 1980	19711 (428.7)	1757.6 (38.2)	27.0 (0.59)
aim 25 %	4930 (107.2)	439.4 (9.6)	6.8 (0.15)
NH_3 1980	8423 (495.5)	750.8 (44.0)	11.6 (0.60)
aim 25 %	2105 (123.9)	187.7 (11.0)	2.9 (0.17)
Total acid (eq H^+)			
1980	2741.5 × 10^6 keq	244.2 keq/km^2	3.68 keq/inh.
aim	412.8 × 10^6 keq	36.8 keq/km^2	0.57 keq/inh.

Total area of Europe including USSR: 11,219,280 km^2
Total inhabitants of Europe including USSR: 725 million
eq = equivalent acid (H^+); keq = kilo equivalent acid (H^+).
32 kg SO_2 = 46 kg NO_X = 17 kg NH_3 = 1 keq H^+.

Reduction factors for total acid emissions

The extent of the measures will however differ from country to country, mainly on account of differences in area and number of inhabitants, and this has been taken into consideration in the calculations of the reduction factors, as shown in Table 1. To calculate the overall reduction factor the emissions of SO_2, NO_X, and NH_3 are expressed in terms of the acidity they finally cause (in equivalents acid as H^+). The reduction aim for VOCs is not inserted in the calculations of the reduction factors, mainly because relevant data is available only for a few countries.

With the 1980 levels of SO_2, NO_X, and NH_3 in Europe as a reference, the permissible emission levels of acidifying substances in terms of total acid are calculated for every km^2 in Europe (about 37 keq per km^2 yearly). This permissible level is compared to the present emission level per km^2 in every European country. The reduction factor calculated on the basis of area shows how much higher the present level of emitted acidifying pollutants is, compared with the calculated permissible level per km^2. This figure indicates the countries that are the most acidifying.

Because densely populated countries obviously emit more air pollutants per km^2 than less densely populated ones, the permissible levels per capita have also been calculated (about 0.6 keq per inhabitant yearly). The calculated reduction factor expresses how much higher the level of emissions is at present than the calculated permissible level per inhabitant. The figure shows which countries have the most acidifying inhabitants.

Neither the reduction factor on an area basis nor that on a per capita basis will correctly indicate the extent to which emissions must be reduced. Some emissions are connected with the size of the country (with much extensive animal husbandry, transportation of goods over long distances), others are connected with the density of the population. For this reason a new reduction factor has been calculated on the basis of both the previous reduction factors. This final reduction factor is the mean of both and indicates the most acidifying countries with the most acidifying population (Table 2).

This method of calculation offers the following advantages:

- ☐ Countries differing in area (size) and population density can be compared.
- ☐ The acidity of all acidifying air pollutants together is taken into consideration.
- ☐ It makes clear to which levels countries must reduce their acidifying air pollution, because every European country is supposed to collaborate towards attainment of a common European aim. Countries contributing relatively much to the acidification must take stricter measures than others contributing less to the acidification of Europe.

Reduction factors for SO_2 and NO_X

To indicate which kind of measures are most urgent for any country, the reduction factors per acidifying air pollutant can be calculated too. The permissible annual levels for Europe are:
SO_2: 518 kg per km^2 and 8.0 kg per inhabitant
NO_X: 439 kg per km^2 and 6.8 kg per inhabitant.

The calculated data are pre-

sented in Tables 3 and 4.

The countries are ranked according to the mean of the reduction factor based on area and that based on population. An attempt has been made to analyze these two reduction factors. One has to realize however that analyzing the reduction factors based on area and population may be rather complex, since certain factors determining the reduction factors are interrelated.

Harm Smit
Stichting Natuur en Milieu

Table 2. Reduction factors for the various European countries.

		Reduction factor F
1.	DDR	28.2
2.	CS	22.3
3.	B	21.5
4.	NL	16.4
5.	GB	15.1
6.	MAG	15.0
7.	DK	13.6
8.	BRD	13.6
9.	LUX	12.1
10.	POL	12.1
11.	I	10.9
12.	BUL	10.2
13.	ROM	9.1
14.	F	9.1
15.	IRL	8.0
16.	E	7.5
17.	GR	6.5
18.	SF	6.2
19.	A	5.9
20.	CH	5.8
21.	USSR	4.8
22.	P	4.3
23.	YUG	4.2
24.	S	3.6
25.	TUR	2.8
26.	ALB	2.7
27.	ICE	2.6
28.	N	2.5
EEC (12)*		10.0
EFTA (6)*		3.8
East. Europe (9)*		6.6
Europe (28)*		6.6

1980. List of reduction factors for acidifying emissions from European countries. The ranking is based on the extent in which emissions must be reduced in each European state in order to attain the maximum permissible level for Europe as a whole. Permissible levels: 0.6 keq/inh/yr; 37 keq/km^2/yr.

* Number of (member) states. Europe including Turkey.

Table 3. 1980 — List of European countries showing the extent to which SO_2 emissions will have to be reduced if the aim is to be achieved of reducing the overall emissions of SO_2 in Europe by 90 per cent with reference to 1980 emission levels. Permissible levels: 518 kg/km^2/year; 8 kg/inh/year.

* Number of (member) states. Europe including Turkey.

	Reduction factor	Present emission level			Reduction factor SO_2		
		kton	kg per inh	ton per km^2	area basis	population basis	mean
1. DDR	50.5	4000	239.5	36.9	71.3	29.8	50.5
2. Czechoslovakia	36.0	3100	202.9	24.2	46.8	25.3	36.0
3. Belgium	32.5	856	86.9	28.0	54.1	10.8	32.5
4. Hungary	26.4	1633	152.5	17.6	33.9	19.0	26.4
5. Great Britain	23.6	4670	82.9	19.1	36.8	10.3	23.6
6. Poland	19.9	4100	115.4	13.2	25.4	14.4	19.9
7. Italy	16.4	3800	67.4	12.6	24.3	8.4	16.4
8. Bulgaria	16.2	1034	116.3	9.3	18.0	14.5	16.2
9. Denmark	15.7	455	88.8	10.6	20.4	11.1	15.7
10. F. R. Germany	15.7	3200	52.0	12.9	24.8	6.5	15.7
11. Romania	13.8	2000	90.5	8.4	16.2	11.3	13.8
12. Netherlands	13.5	455	31.4	11.9	23.0	3.9	13.5
13. Spain	13.0	3622	96.9	7.2	13.8	12.1	13.0
14. Luxemburg	12.5	23	63.0	8.9	17.1	7.8	12.5
15. France	10.4	3558	66.0	6.5	12.5	8.2	10.4
16. Greece	9.6	700	72.6	5.3	10.2	9.0	9.6
17. Finland	9.3	584	122.2	1.7	3.3	15.2	9.3
18. USSR	8.4	17176	87.3	3.1	5.9	10.9	8.4
19. Austria	7.0	354	46.9	4.2	8.1	5.8	7.0
20. Ireland	7.0	217	63.8	3.1	6.0	7.9	7.0
21. Yugoslavia	5.3	815	36.5	3.2	6.1	4.5	5.3
22. Sweden	5.1	483	66.1	1.1	2.1	8.2	5.1
23. Portugal	4.9	293	29.8	3.2	6.1	3.7	4.9
24. Switzerland	4.2	126	19.7	3.1	5.9	2.5	4.2
25. Albania	2.9	50	18.9	1.7	3.4	2.3	2.9
26. Norway	2.6	141	34.5	0.4	0.8	4.3	2.6
27. Turkey	1.9	714	16.0	0.9	1.8	2.0	1.9
28. Iceland	1.7	6	26.3	0.1	0.1	3.3	1.7
EEC (12)*	13.6	21839	68.7	9.7	18.7	8.6	13.6
EFTA (6)*	4.7	1694	55.8	1.3	2.4	7.0	4.7
East. Europe (9)*	11.2	33908	102.4	5.0	9.6	12.8	11.2
Europe (28)*	10.0	58155	80.3	5.2	10.0	10.0	10.0

Table 4. 1980 — List of European countries showing the extent to which NO_x emissions will have to be reduced if the aim is to be achieved of reducing emissions of NO_x in Europe by 75 per cent with reference to 1980 emission levels. Permissible emission levels: 6.8 kg/inhabitant/year; 439 kg/km^2/year.

* Number of (member) states. Europe including Turkey.

	Reduction factor	NO_x emission level			Reduction factor NO_x		
		total kton/y	per area ton/km^2/y	per inh. kg/inh/y	area basis	population basis	mean
1. Netherlands	17.9	500	13.4	35.3	30.5	5.2	17.9
2. F. R. Germany	17.8	3090	12.4	50.2	28.3	7.4	17.8
3. Czechoslovakia	16.5	1204	9.4	78.8	21.4	11.6	16.5
4. Belgium	14.2	317	10.4	32.2	23.6	4.7	14.2
5. Luxemburg	13.5	21	8.1	57.5	18.5	8.5	13.5
6. DDR	11.9	800	7.4	47.9	16.8	7.0	11.9
7. United Kingdom	11.5	1932	7.9	34.3	18.0	5.0	11.5
8. Denmark	9.8	241	5.6	47.0	12.7	6.9	9.8
9. France	8.9	2567	4.7	47.6	10.7	7.0	8.9
10. Italy	7.9	1550	5.1	27.5	11.7	4.0	7.9
11. Switzerland	7.7	196	4.7	30.7	10.8	4.5	7.7
12. Finland	5.3	284	0.8	59.4	1.9	8.7	5.3
13. Austria	4.9	211	2.5	28.0	5.7	4.1	4.9
14. Portugal	4.9	248	2.7	25.3	6.1	3.7	4.9
15. Poland	4.8	840	2.7	23.6	6.1	3.5	4.8
16. Hungary	4.6	240	2.6	22.4	5.9	3.3	4.6
17. Iceland	4.3	13	0.1	57.0	0.3	8.4	4.3
18. Sweden	3.7	328	0.7	39.5	1.7	5.8	3.7
19. Bulgaria	3.7	200	1.8	22.5	4.1	3.3	3.7
20. Spain	3.3	778	1.5	20.8	3.5	3.1	3.3
21. Greece	3.2	196	1.5	20.3	3.4	3.0	3.2
22. Romania	3.2	390	1.6	17.6	3.7	2.6	3.2
23. Norway	2.7	125	0.4	30.6	0.9	4.5	2.7
24. Ireland	2.7	71	1.0	20.9	2.3	3.1	2.7
25. Yugoslavia	1.5	190	0.7	8.5	1.7	1.3	1.5
26. USSR	1.6	2790	0.5	14.2	1.1	2.1	1.6
27. Turkey	1.2	380	0.5	8.5	1.1	1.2	1.2
28. Albania	0.6	9	0.3	3.4	0.7	0.5	0.6
EEC (12)*	8.5	11511	5.1	36.2	11.6	5.3	8.5
EFTA (6)*	3.7	1157	0.9	36.9	2.0	5.4	3.7
East. Europe (9)*	2.6	6663	1.0	20.1	2.2	3.0	2.6
Europe (28)*	4.0	19711	1.8	27.2	4.0	4.0	4.0

A sad forester speaks

Whitened tree trunks, lying over rocks, some still standing and pointing heavenwards. An unbelievable sight. Hectare after hectare of dead spruce, and no one has time to haul away the bare trunks.

"The forest is dying at an ever faster rate. We are forced to import forest workers from Romania, but still we can't catch up with the clearing," says Bogdan Skoluda, head of the forest administration at Wroclaw.

Bogdan Skoluda's territory is the most hard hit in Poland, and he is worried. He came to his post sixteen years ago, just when the first signs of damage appeared. Now he says the whole area of 470,000 hectares is threatened. The conifers are the worst damaged, deciduous trees do better.

"People blame me because it all looks so awful. But what can I do? I can't stop the discharges of poison from the smokestacks," he says despairingly.

Last year 1.8 million cubic metres of timber were extracted in this region, three times as much as the normal amount. But it has to be done because there are so many damaged trees — and still it is too little.

"We shall need more workers if we are to get all the necessary felling done, although we already have one and a half times as many as normal. Good forestry is impossible in this region. We plant new trees in the clearings, but the regrowth is poor."

Bogdan Skoluda can't say exactly how great an area will have to be replanted, but he knows that at 800 metres above sea level every other sapling dies within two years. It's the airborne pollutants that kill them, he says.

"We knew as much as fifteen years ago that air pollutants would kill trees. At that time forest dieback was already a fact in Czechoslovakia, and we got our information from there," he recalled. "But what help is knowledge when pollution only goes on increasing?"

There has been a startling increase in forest damage during the last few years. The Forest Research Institute in Warsaw reports that 83.7 per cent of Poland's forests are now damaged as a result of air pollution.

About 26 per cent of Poland's land area is covered with forest. The available statistics however only give an incomplete picture of the extent of the damage nationwide, and of its distribution among coniferous and deciduous trees.

Clearly the worst affected part of the country is the southwest. There, in the Sudeten mountains, are chemical deserts where nothing will grow. Any remaining forest may be said to be postindustrial. It is terrifying to tramp through a dying landscape like that.

In the Sudeten mountains is Karkonosze national park. The three million visitors that come every year now keep to the heights where no trees ever grew. In the belt between 800 and 1,000 metres above sea level the former forest is no longer there. It has died.

"We are now seeing more and more damage below the 800-metre level," Bernard Konca, the park director, tells us as he shows us around. "The best we can do just now is to prevent erosion. We are planting as many trees as we can manage."

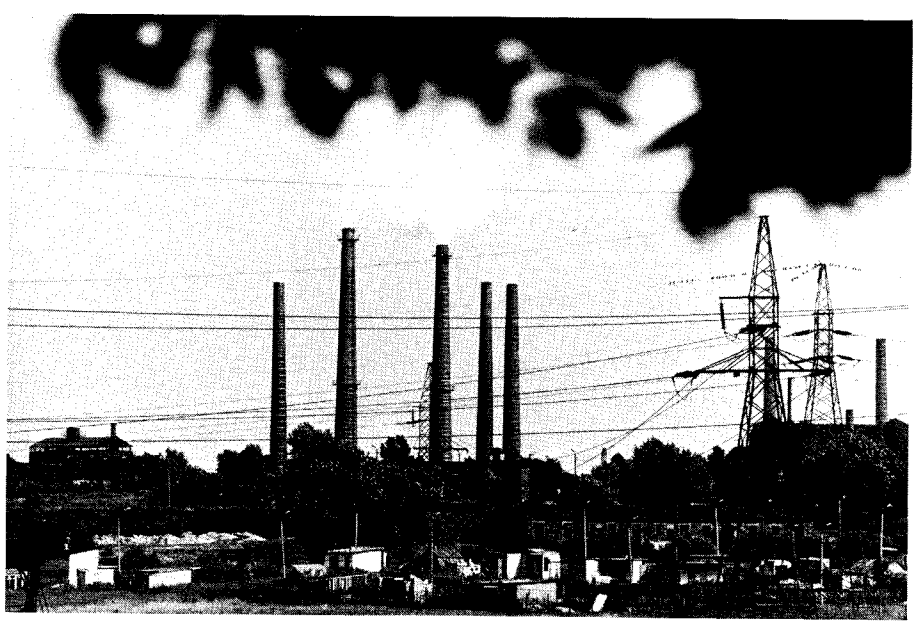
All kinds of trees are planted, but even if they are not threatened by air pollution, many get eaten by animals. Insect attacks, especially by bark beetles, are common in this area.

Like Bogdan Skoluda, Bernard Konca is very worried about the future of Poland's forests. In the words of Bogdan Skoluda: "All this about not being able to afford to clean our emissions is incomprehensible. It can never cost too much to save the natural environment."

During the last few years attempts have been made in Poland to put off forest dieback by liming the soil. In the southwestern part of the country 500 hectares of forest land have recently been limed for the first time, according to Bogdan Skoluda, who adds however:

"But maybe it is too late to save the forest here. Goodness knows, I don't. It is in my area that the forest is dying, and it is I who have to take the practical responsibility in the face of all the talk at international meetings where they try to agree on ways to reduce emissions of pollutants. Talk won't save Poland's forests. What we need now is action."

Catharina Andersson



Housing and garden allotments jostled by heavy industry. ANDRE MASLENNIKOV

POLAND

Opening up to cooperation

For many years neither the public nor the authorities in Poland noticed how serious the situation was in regard to the pollution of the environment. In the 1950s and 1960s less and less attention was given to environmental protection, and it was only in the 1970s that a need for greater effort was recognized. However, this coincided with an investment boom and so, despite a greater awareness of the problems, ever more that ought to have been done was left undone. It was only in the eighthies that any significant change occurred, and this was manifested in the following ways:

☐ Law on environment protection and formation /1980/,
☐ Setting up of the State Council for Environmental Protection /1981/,
☐ Establishment of the Office of Environmental Protection and Water Management /1983/, now the Ministry of Environmental Protection and Natural Resources,
☐ Creation of the State Environment Protection Inspection /1984/,
☐ Increased public awareness, seen for instance in the founding of the Polish Ecological Club /1980/ and later the Ecological Social Movement of the Patriotic Movement for National Revival /1986/.

Despite all this, the state of the natural environment has been steadily deteriorating. This is due to enormous past negligence on the one hand, while on the other the crisis in the economy makes it difficult to assign sufficient funds for making improvements.

In view of the actual condition of the environment as well as the need to meet vital social demands, such as for housing or food, and the necessity for repayment of the foreign debt, it will not be possible to solve the problems of the environment simply by investing in protection measures. In the present five-year plan for 1986-1990, 3-4 per cent of the total outlay will be assigned for this purpose, whereas the needs are four to five times as much. Thus a solution to the problem of environment protection will have to be found outside it, at least in fundamentals. This requires that the country's strategy of development be changed from being based on raw materials to a more ecologically oriented one. This will require the following measures:

☐ Rigorous savings of energy and raw materials,
☐ Change and/or modernization of existing technologies so as to produce less pollution,
☐ Structural changes in the economy to give priority to those industries that use up less natural resources and produce less pollution,
☐ Recognition of the environmental protection industry as an important element of structural change in the national economy.

Problems of the environment cannot be solved merely be investment in protective measures. Economy based on raw materials must give way to a more ecologically oriented one if the environment is to be saved.

The present crisis in any case requires fundamental changes in the management of the national economy. Therefore, an economic reform has been introduced during the last few years, the basic objectives of which are to reconstruct the economy so as to bring about much higher management efficiency and much better utilization of the country's economic potential.

Reforming the economy also implies opening up to much broader cooperation with other countries. For environmental protection this will mean primarily:

☐ Enlarged possibilities for technology transfer,
☐ The establishment of joint ventures,
☐ Exchange of information and experience,
☐ Technological and financial assistance.

The possibility of establishing joint ventures is of particular interest. Such companies can be established by legal entities, natural persons, companies without legal personality from abroad and by socialized-economy units on the Polish side. The socialized economic units may be state-owned enterprises, cooperatives and their unions, scientific institutions and research-and-development institutes, as well as commercial companies with socialized units having a majority shareholding. There is a possibility of combining foreign and Polish capital, but only in the form of limited liability or joint-stock companies, with the Polish partners holding at least 51 per cent of the initial capital.

Priority must be given to those areas of the economy that will help introduce modern technologies and organizational systems, are export-oriented and will improve the supply of modern high-quality goods and services to the domestic market.

The above presentation with foreign interests as a means of protecting the environment in a broad sense is aimed at motivating the need to establish cooperation. Such cooperation could result in various benefits, namely:

☐ Improvement of the condition of the environment in Poland, which would have an impact on

the environment in other European countries, particularly in Scandinavia.
☐ Create more possibilities of export-oriented activity in Poland and thus contribute to an improvement of the country's economic situation, including repayment of the foreign debt.
☐ Bring profits to owners of foreign capital.

In Poland the conditions exist for starting the production of goods and services for environmental protection in a broad sense. The areas in which cooperation could be developed are for instance:
a/ The setting up of small enterprises for producing equipment, instruments and installations.
☐ Small incinerating plants.
☐ Small installations for the reduction of various air pollutants.
☐ Wind-power plants.
☐ Equipment to convert solar energy.
☐ Equipment for producing biogas.
☐ Small water turbines.
☐ Control instruments of all kinds.
☐ Stationary and mobile monitoring stations for water, air, etc.
b/ Technological cooperation for solving large-scale problems.
☐ Construction of equipment for the removal of sulphur and nitrogen from the waste gases of large power-generating plants.
☐ Introduction of fluidized beds.
☐ Construction of mine-water desalination stations.
☐ Production of unleaded petrol.
☐ Manufacture of catalyzers for decreasing the emission of pollutants from motor vehicles.
☐ Construction of large municipal incinerating plants.
c/ Establishment of enterprises to use the raw materials contained in industrial wastes accumulated in Poland. At present there are about 1,400 million tons of various kinds of waste.
d/ The setting up of joint consultancy firms, in fields such as:
☐ Systems of environmental protection.
☐ Environment monitoring.
☐ Spatial planning.
☐ Technological consulting.

Andrzej Kassenberg

Glasnost frees debate

The environmental movement in the Soviet Union is growing steadily week by week. During the last two or three years, hundreds of ecological groups have been founded all over the country. The movement is especially strong in the Baltic Republics.

In Riga alone, the capital of Latvia, there are at least five groups active, such for instance as the Environmental Protection Club (VAK) and the Youth Ecological Centre. The VAK is organizing protest campaigns and writing petitions and recommendations to the public and the authorities. Recently VAK members collected 1,600 signatures for a petition from people representing a variety of social groups, professions and nationalities. The petition is a request to the Latvian Council of Ministers "to make available as soon as possible a publication that will inform people of the ecological situation in the republic; to organize ecological orientation and awareness and to mobilize the masses for constructive action." As a first result VAK members were able to meet a representative from the Council of Ministers.

Last April the VAK initiated a protest demonstration in Sloka, where a large papermill has been polluting the Gulf of Riga. For a long time groups in Latvia and Byelorussia have been criticizing the plans for a hydropower station near Daugavpils. More than 31,000 signatures were collected in protest against it. Protests are also being organized against the nuclear power station at Ignalina in Lithuania. With a capacity of 6 gigawatt it will be the world's biggest nuclear station of the Chernobyl type. On September 17 more than 10,000 people surrounded Ignalina and planted trees there. At the same time more than 50,000 people, attending a rock concert in Vilnius, the capital of Lithuania, gave their support to the action.

This year the protests against the hydro-power dam were finally successful. On advice from the Scientific Council for Problems of the Biosphere government authorities stopped the scheme. Unfortunately a new nuclear power station is being planned instead near Liepaja, which with a capacity of 4 gigawatt will again be the world's largest installation of its kind. Already more than 23,000 signatures have been collected against these new plans.

Many environmental activities are also going on in Estonia. An illegal group is carrying out actions like those of Greenpeace, organizing for instance the blocking of wastewater pipes from heavy polluting industries or running competitions where the participants have to wear gas masks. On May 23 the House for Political Education was covered with green flags. The meeting for the founding of the Estonian Green Movement (ERL) attracted 2,000 people. The hall being too small to contain them all, the proceedings were relayed into the street with loudspeakers.

In the meantime the ecological groups in Riga have obtained the permission to open their own bank accounts, and in other parts of the Soviet Union, too, environmental groups are now tolerated by the authorities. As early as 1986 Gorbachov had praised the opposers of the huge water-management project that would have redirected the water from Siberian rivers to the southern parts of the Soviet Union. The stopping of those plans was one of the first great successes of the Russian environmental movement.

Another big success for the environmental lobby has been in the Baikal region, where, after 20 years of protests from scientists, academics, and workers, the government has agreed to shut down the huge pulp and paper mill that has been polluting Lake Baikal — unless it is

Banner in Irkutsk: We're out to save Baikal and Irkutsk! APN

reconverted to the production of "ecologically safe products." The pulp and paper mill at Prioversky on the shores of Lake Lagoda has also been closed for conversion. Public pressure, too, led to the closure of an ammonia plant run by the Tula industrial association which was polluting the forests and orchards of the Leo Tolstoy memorial estate at Yasnaya Polyana. Instead, the association will make microchips and instruments.

In Irkutsk last July hundreds of people demonstrated against a government decision to divert part of the chemically polluted waters from factories near Lake Baikal to the Angara River, affecting a lot of other towns besides Irkutsk. Although the police have tried to stop people collecting signatures (10,000 to date) the protests continue.

In March 1988 an environmental conference entitled Baltic Sea 88 was held in Leningrad, drawing 400 participants, including officials and politicians, as well as many scientists. At another meeting on June 4-5, an Ecological Federation for the Northwestern Soviet Union and a Committee for the Defence of the Baltic Sea were set up.

In Leningrad there is an umbrella organization, Epitsentr, for all kinds of so-called informal groups, which regularly publishes a news bulletin, Merkurij. An action group called Delta is protesting strongly against the dam that is being built 30 kilometres from Leningrad, out in the Gulf of Finland. It would lead to heavy water pollution problems in the city.

An unusual "Save the Trees" action took place in last spring in the Eremitage Garden in Moscow. It was initiated by the Ecological Group Moscow and a number of informal groups. There are about a hundred of these groups in Moscow, meeting regularly, mostly in private flats. At the Moscow State University the Youth Council for Nature Protection is active with investigations, expeditions, conferences, street stands, discussions, etc. A new organization has also been started in Moscow, called Ecology and Peace, which aims at coordinating the activities of the ecological and peace groups in the Soviet Union. Ecology and Peace intends to inform the public truthfully and regularly about environmental problems in the spirit of "perestroika".

A group called Green World was also set up in Kiev last February. It has already 1,000 members distributed over the whole of Ukraine and organized in ten local groups. The first environmental demonstration took place in Kiev on June 5, when several hundred students protested against the destruction of trees in the centre of the city.

Two or three years ago it would have been hardly possible to imagine developments such as these in the Soviet Union. In the view of many people the environmental situation now seems to have reached a critical stage. According to the New Scientist, the chairman of the USSR's State Committee on Control of the Natural Environment, Yury Izrael, admits that pollution is a serious problem, although the situation is improving. The committee operates a network of weather observation stations and monitors the air in 450 cities as well as the water in all the major lakes and rivers of the USSR.

Under a new law that came into effect last February, the authorities will hold culprits financially responsible for any pollution of the environment or over-exploitation of natural resources, and will shut down plants that continue to violate regulations.

But legislation to control pollution has so far only had a limited effect. Air pollution from stationary sources has fallen by 15 per cent over the past 10 years and the equipment has been installed to treat more than 400 million cubic metres of air an hour. In 1986, air filtration plants were installed at iron and steel mills in Magnitogorsk, Aktyubinsk, and Chelyabinsk, at chemical plants in Barnaul and at other kinds of manufacturing plant in Krasnoyarsk, Ust Kamenogorsk, and Almalyk. Nevertheless, 65 million tons of pollutants still spill into the atmosphere each year from stationary sources, says Izrael, along with 40 million tons from vehicle exhausts. "Departmental interests," he explains, have been put before those of the state with "catastrophic consequences." Social and ecological problems have been ignored, while efforts have focused on fulfilling narrow economic tasks such as increasing production. "Evidently," he says, "the legal mechanism regulating ecological matters needs refining."

Reinhold Pape

UNITED STATES — CANADA

Clean air or clean coal

When Canadian and US officials met on January 25, 1988 to discuss a bilateral treaty on acid rain control, the Canadians suffered a major disappointment. After stalling for eight months on its response to Canada's proposed draft accord, US officials finally rejected it because it included specific targets and a specific timetable for sulphur dioxide reductions. Once again, the Reagan administration was unwilling to negotiate a binding treaty on emission controls. Instead, the administration's policy has been to keep discussions vague, making only token efforts toward a serious resolution of the acid rain controversy. Canadian officials blame acid rain for the destruction of many of its lake and river ecosystems. Since half of Canada's acid rain originates in SO_2 emissions from US sources, the issue of SO_2 abatement invariably arises at talks between the two neighbouring countries.

According to a study released by Environment Canada in mid-February, 1988, approximately 46 per cent (4 million square kilometres) of Canada's land area contains aquatic ecosystems that are susceptible to acid rain damage. This finding has reinforced Canadian concerns over the problems arising from uncontrolled sulphur and nitrogen emissions. Canada's response has been to push for a 50 per cent reduction in domestic sulphur-dioxide emissions by 1994, and a 45 per cent reduction in nitrogen-oxide emissions by the year 2000. Canada has been urging the United States to implement similar emission controls.

Besides harming aquatic life, acid rain has been linked to large scale damage to maple trees in Canada. This has dealt a crushing blow to the maple-syrup industry, which could vanish within the next 10 to 20 years if sulphur and nitrogen emissions continue at their present levels. One Canadian syrup producer claims to have lost 10,000 of his 14,000 sugar-maple trees as a result of acid rain.

In late April, 1988, Canadian Prime Minister Brian Mulroney held his final annual meeting with President Reagan, with the issue of acid rain high on his agenda. Mulroney has recently been criticized in Canada for not being forceful enough in his dialogue with the US. Accordingly, he needed an agreement to curb the transboundary flow of acid rain precursors from the United States into Canada to improve his domestic political standing. But President Reagan refused to accede to further emission controls, arguing that retrofitting or retiring America's older coal-fired power plants would be too expensive. Mulroney responded that "the cost of reducing acid rain is substantial, (but) the cost of inaction is greater still."

Rather than considering emission controls, the Reagan administration has focused on developing clean-coal technologies. They hope that by burning cleaner coal, the acid rain problem will diminish without harming US industry. But according to Michael McCloskey of the Sierra Club, money allocated to technological research "will not reduce acid rain by a single drop." Although the US is committed to spending 2.5 billion dollars on clean-coal technology development over a five-year period, none of this money will go toward the installation of (flue-gas desulphurization) scrubbers.

At recent negotiations in Geneva for a nitrogen oxides protocol to the ECE "Acid Rain" Convention, US officials demanded that the United States be permitted to increase NO_X emissions by up to 20 per cent. Reagan administration officials claimed that scientific evidence on the environmental impacts of nitrogen oxides is inconclusive. They also argued that the US began controlling NO_X emissions long before the Europeans, and thus should be allowed to expand to European levels. These arguments have aggravated Canadian concerns over Canada's escalating acidification problem.

Meanwhile, in a recent study carried out by a US non-governmental organization, the Environmental Defense Fund (EDF), acid rain was blamed for the degradation of marine life. Previously, it had been widely believed that the aquatic damages of acid rain were restricted to freshwater organisms. Acidity is responsible

for the problems arising in freshwater ecosystems, whereas damage to sea life is caused by eutrophication. The high nitrogen content of acid rain, derived from NO_X emissions into the atmosphere, apparently encourages excessive algae growth in coastal waters. EDF scientists now believe that this increased algae growth deprives other marine plants and animals of necessary oxygen and sunlight, leading to their eventual deaths.

The EDF study, which focused on the Chesapeake Bay region of the eastern United States, found that 25 per cent of nitrates entering the Bay come from atmospheric nitrogen oxides. (Fertilizers, sewage, industrial discharges and animal wastes account for the remaining nitrates in the Bay.) It is expected that as nitrogen emissions increase, so also will the problem of eutrophication in coastal waters. EDF's report concludes that if current trends continue, nitrogen-oxide emissions will be responsible for 42 per cent of nitrates entering Chesapeake Bay by the year 2030.

According to Tudor Davies of the US Environmental Protection Agency, the number of fish deaths in eastern coastal waters due to oxygen depletion has been steadily increasing. Over the past few years, catches of dead lobsters, crabs, and other marine animals have been reported in greater numbers than ever before. EDF's report emphasizes the importance of curbing nitrogen-oxide emissions to prevent further damage to ocean life. For several years, the US Congress has been considering amendments to the US Clean Air Act that would require greater reductions of nitrogen oxides as well as sulphur dioxide. Environmentalists are not very hopeful about enactment of this legislation in the near future, and according to one senior US official, "there will be no action on acid rain while President Reagan is in office."

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Reluctant US moves towards ECE protocol

In sharp contrast to its abstention from an earlier UN ECE agreement on sulphur dioxide, the United States has played a prominent role during the past two years' negotiations on the UN ECE Protocol on Nitrogen Oxides (NO_X). US efforts, however, have been directed primarily toward avoiding calls for a freeze on NO_X emissions levels, so that US emissions would be allowed to undergo a projected rise in the 1990s. While nominally supporting an emissions freeze proposed in Europe, the US sought to avoid its terms by seeking special "pollution credit" based on its early imposition of emissions controls.

The US sought to justify its request for pollution credit by claiming that it had undertaken unilateral reductions in NO_X emissions. In fact, emissions in the US rose about 10 per cent from 1970-1985. Emissions in the US currently are in a temporary downturn (about a 1 per-cent drop from 1980 levels) but are expected to rise again some time in the 1990s — dramatically upward by century's end. In terms of general emissions trends, the US's overall 10 per-cent rise places it about in the middle of the UN ECE pack: during the same period, NO_X emissions in the UK and Sweden rose only about 1 per cent; FRG and Canada are up about 20 and 36 per cent, respectively. Most damaging to the US position was its per capita NO_X emissions which remain the highest in the UN ECE, roughly double those of France, West Germany, the UK, or Sweden.

The US request for special pollution credit, first put forward at a Geneva meeting last November, was almost universally opposed and succeeded in stalling agreement on the Protocol. When negotiations on the NO_X Protocol resumed in February, a proposal was submitted jointly by eight nations, including Canada and the United States, calling for an emissions freeze by year-end 1994 at 1987 levels or those of any previous year specified by a party upon signing. The clause allowing a country to specify a year previous to 1987 as its base year was inserted at the sole insistence of the US, which, by specifying 1978 as the year previous, would receive a two million ton NO_X credit, allowing it to "freeze" emissions at about 10 per cent over current levels.

This joint proposal was hastily drawn up in Geneva the weekend before the February meeting. Although Canada joined in the submission, it apparently was unaware of (or underestimated) the increase in emissions the US could obtain under the "any specified previous year" clause. When the full import of the clause became apparent, Canada sought its deletion. In response, the US submitted a second, more express, credit clause, that would have allowed it something on the order of a 15-20 per-cent emissions increase based on its past reductions achieved through national highway emissions standards. This tactic essentially raised the ante, and shifted Canada's attention away from its initial concern over the 10 per-cent credit clause.

The prospect of signing a Protocol that would allow an increase in US acid rain export was a political impossibility for Canada, and became something of a small crisis for Environmental Minister Tom McMillan in Ottawa. Canada, having once joined in the initial submission of the 10 per-cent credit clause, felt compelled to seek its deletion, or at a minimum its amend-

ment to provide against an increase in US transboundary fluxes. A series of calls from Canada ensued to the missions across Europe.

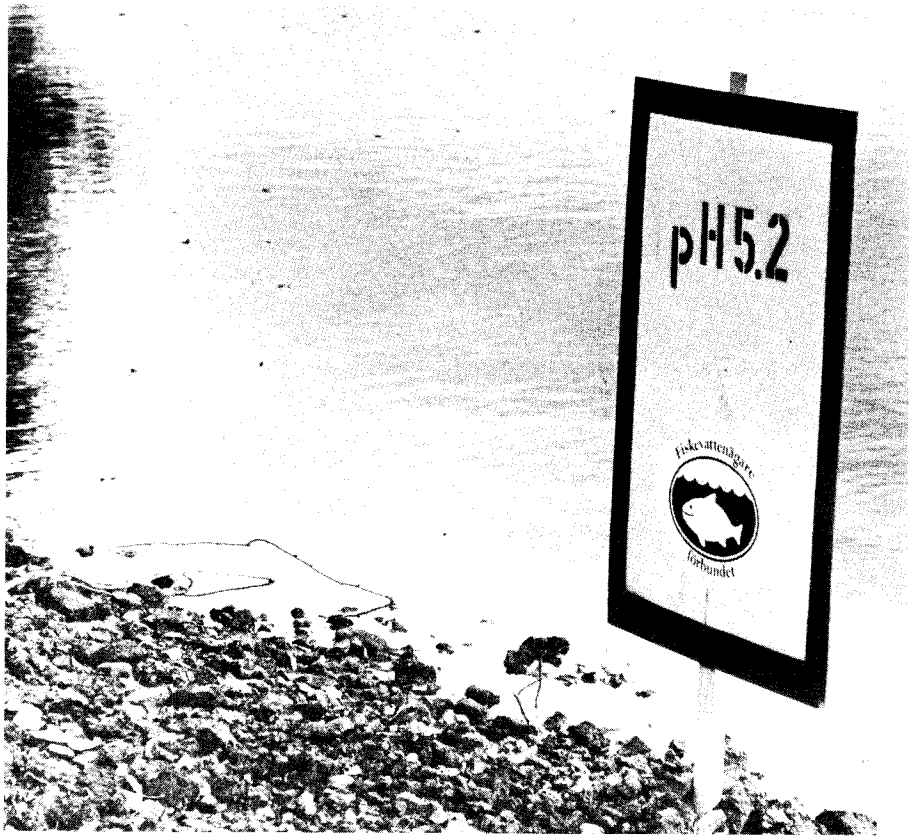
In April, a special Heads of Delegations meeting was convened at Geneva and devoted primarily to resolving the conflict over the US credit demands. The result could hardly have been more favourable from Canada's perspective. The 15-20 per-cent credit clause was deleted in its entirety, and the 10 per-cent credit clause was tentatively amended to prohibit an increase in transboundary fluxes.

While the revised Protocol draft still allows the US a 10 percent emissions increase, in practice the obligation to limit transboundary fluxes takes back most of the pollution credit given by the clause. Still, the US has been extraordinarily successful in wresting the 10 percent compromise, given the almost universal opposition in Europe to the pollution credit concept. The concession to the US indicates the importance that Europe attaches to having the US on the Protocol.

Richard Mott
Environmental Law Institute
Washington

Postscript

According to the Washington Post, August 6, 1988, President Reagan has agreed, in a policy reversal, to freeze emissions of nitrogen oxides at 1987 levels for at least the next seven years, and has authorized the State Department to continue negotiations aimed at ensuring US participation in the ECE protocol on nitrogen oxides. US officials had been expected to abstain from signing any protocol, as they did in 1985 when 16 other nations signed an undertaking to reduce sulphur-dioxide emissions by at least 30 per cent. The about-face is seen as an election-year concession to bolster Republicans on an issue of importance to the northeastern states of America.



ANDRE MASLENNIKOV

NORWAY

Southern lakes hard hit by depositions of acid

In a great part of southern Norway the lakes and streams are still being badly affected by acid depositions. Several thousand lakes where fish used to be plentiful, as well as many of the rivers in South Norway, are now empty of fish — on account of acidification. Most hard hit are the counties of Aust-Agder and Vest-Agder, Telemark and Rogaland. Most of the lakes and streams in those parts are acidic, with high concentrations of sulphate and nitrate. Some 70 per cent of the lakes that have lately been examined in the affected areas now lack any capacity to resist acidification.

Such are the results of a survey carried out by the Norsk Institutt for Vannforskning (NIVA) on behalf of the State Pollution Authority (SFT). The survey,* which was published last year, was a nationwide one, covering over a thousand lakes deemed sensitive to acidification. It was a part of the SFT program for monitoring long-distance transports of air pollutants.

The survey also revealed a doubling of the nitrate concentrations in most of the lakes of South Norway since 1974-75. This is regarded as a sign that the soil is becoming saturated with nitrogen.

Berit Kvaeven of the SFT calls this development disturbing. Nitrate is, like sulphate, acidifying, and an increased leakage of nitrate could offset any improvement resulting from a decrease in the emissions of sulphur in Europe. There is no tendency either for the emissions of nitrogen oxides to decrease. There is believed to be a great danger of nitrogen saturation of the soil leading to unbalance in the ecosystems, and so to forest damage.

* 1,000 sjøers undersøkelsen 1986. Norwegian only. Obtainable from Statens Forurensningstillsyn, Postboks 8100 Dep, N-0032 Oslo 1, Norway.

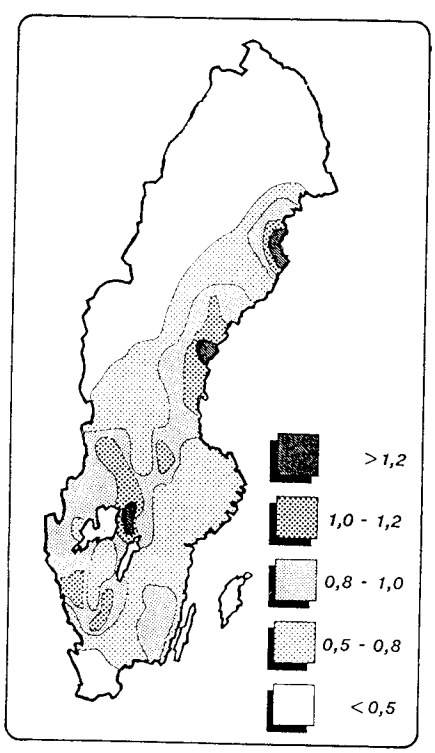
SWEDEN

High mercury levels in lakes

About 10,000 lakes in Sweden ought to be blacklisted on account of high concentrations of mercury. The number is growing all the time, so that by the mid-1990s there will be another thousand in similar state.

It was first during the seventies that Swedish scientists came across high concentrations of mercury in the fish of forest lakes that were poor in nutrients. Here it is a question of thousands of lakes where there have never been any direct discharges of mercury. To a great extent the high concentrations are due to cumulative depositions from the air over a long period of time.

A quarter of the mercury in the Swedish lakes is believed to be of natural origin, coming from soil and water and from volcanic activity. Another quarter may come from local emissions, from waste incinerating and industrial processes. Yet another quarter is assumed to have been transported from the European continent by the winds, as in the case of sulphur. Most of it will have come from the burning of coal. The remainder is thought to be associated with the emissions of other pollutants. Through various chemical reactions in the atmosphere, these can transform mercury vapour in the air (both of natural and anthropogenic origin) so as to cause an increased fallout of mercury.



The content of mercury in pike in different areas in the early 1980's. Figures in milligrams per kilo fish.

Because the deposited mercury becomes bound in the soil's upper layer (the humus layer), an accumulation takes place. After a time the mercury will be transported with the humus into the lakes, and so become available to fish. The accumulations in the soil will probably continue to increase, even at present emission and deposition levels, and thus the flow to the lakes will also increase. Even with a marked reduction of depositions, there will still be enough mercury in the soil to ensure continued leakage to the lakes for a very long time.

By means of a survey* covering some 1,500 lakes all over Sweden, it has been possible to form a picture of the general situation. The conclusion has been that the mercury concentrations in at least 9,400 of the country's lakes are so high that the lakes ought to be blacklisted. In some areas the concentrations in fish amounted to as much as 2 milligrams of mercury per kilogram (mg Hg/kg).

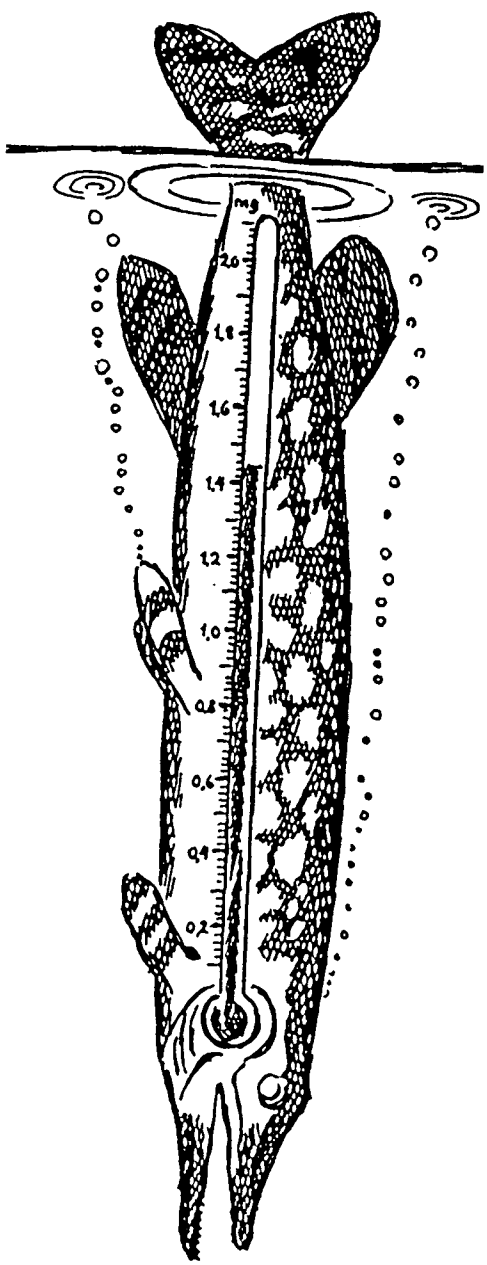
In Sweden the limit for concentrations in fish set by the National Food Administration, above which lakes have to be blacklisted, is 1 mg Hg/kg, and so far 370 lakes have been blacklisted due to high mercury levels in fish. If the limit were lowered to 0.5 mg Hg/kg, as in several other European countries, about half of the country's 100,000 lakes would come under the ban.

The reason for the Food Administration not blacklisting more lakes is that it has devoted attention primarily to those that are likely to be most fished. It advises people never to eat fish from blacklisted lakes, and warns women against eating any lake fish at all during pregnancy, since the foetus is exceptionally sensitive to mercury poisoning.

Christer Ågren

* Kvicksilver i svenska sjöar. SNV Report 3291. In Swedish, with a fairly lengthy English summary. Obtainable from the National Environmental Protection Board, Box 1302, S-171 25 Solna, Sweden.

Drawing: Claus Albrechtsen ©



WEST GERMANY

Important court case

Forest dieback compensatable and should be compensated

At the end of 1987 the Supreme Court of the Federal Republic passed judgment in a matter of principle concerning forest dying. The City of Augsburg and a farmer named Killguss from the Black Forest, both hard hit by forest dying, had claimed the relatively low sum of DM 358,000 in compensation. The case was important, however, in that it would be likely to set a precedent. Professor Lutz Wicke, scientific director of the federal environmental agency, has calculated for instance that the total cost to the country of forest dieback is 5.5 to 8.8 billion DM yearly, as against DM 48 billion for all damage due to airborne pollution.

The Supreme Court, while denying liability on the part of the state, nevertheless maintained that forest dieback was compensatable and that it should be compensated. The legislators had however neglected to make this legally possible. In giving judgment, the court put forward various suggestions for solving the dilemma, including

☐ Making the state liable with or without the co-responsibility of forest owners for the damage.
☐ Setting up a compensation fund, with contributions from polluters and on occasion the public purse.

The judges also noted the difficulty of establishing proof — recognizing that the individual would hardly ever be in a position to identify the owner of the plant that caused the damage and to prove that the damage was due to emissions from a certain source. They added however that there could be no doubt about the cause: forest dieback was due to air pollutants (in particular sulphur dioxide and nitrogen oxides and their products of conversion) that emanated from the said sources.

In 1986, 52.3 per cent of all the trees in the Federal Republic showed reduced or damaged vitality. For fir (Abies alba), the worst affected, the figure was 79 per cent. The figures for the states from which the plaintiffs came were higher than the federal average, being 62 per cent for Bavaria and 60 per cent for Baden-Württemberg. In Killguss's forest, "an intensively cultivated small holding," only nine per cent of the spruce (Picea abies) and fir were in good health, and in the Revier Siebenbrunn belonging to the city of Augsburg only three per cent of the Scots pine (Pinus silvestris) and 21 per cent of the fir were healthy.

Reinhold Pape

RICHARD BAKER

Well water in Bavaria causes children's death

This summer two children in northern Bavaria died from copper-poisoning, and a third became ill. Food had been prepared for the infants, who could not be breast-fed, with water obtained from private wells and led through copper piping. According to Peter Schrammer of the Society for Radiation and Environmental Research near Munich, copper poisoning caused cirrhosis of the liver, from which two of the babies died, the third only being saved at the last moment. The cases were discovered only by accident, because the children were brought to the University Hospital in Munich.

The water in the wells is acidified with a pH under six and has a copper concentration of up to 10 mg per litre. A child's liver can not stand such a high concentration. Up to now only six cases of copper poisoning have been recorded anywhere, five of them being in India, and at first the Munich doctors had suspected genetic causes for the children's death. The environmental minister in Baden-Württemberg in consequence called on several communities to check their drinking water. Those where the copper concentration of the drinking water is more than 2 mg per litre will be obliged to inform parents of the potential danger.

Reinhold Pape

WEST GERMANY

Showing how emissions can be curbed

The Umwelt- and Prognose-Institut in Heidelberg has made a study of the amounts of acidifying pollutants that will be emitted from power stations, industrial plants, traffic, and domestic sources in the Federal Republic up to the year 2000. Unless there is a change in the present government measures, the emissions will add up to 53 million tons. In particular no reduction is to be expected for nitrogen oxides, the chief cause of forest dieback.

During the last few years the emissions of nitrogen oxides have in fact steadily increased. After 1991 the annual emissions of SO_2 could, relative to the expected figures, be reduced by something less than half. Moreover the pollution from traffic will have to be brought down to Japanese levels, and the limit for sulphur in fuel oil reduced to 0.1 per cent. The reduction for light fuel oil from 0.3 to 0.2 per cent that has recently been decided by the Federal government will have little effect, since the average content of sulphur in such oil is in any case around 0.2 per cent.

The study describes in detail how emissions can be curbed. By the year 2000 the emission of 24 million tons of acidifying pollutants could be prevented. This amounts to more than 3 kilograms of acid for every single tree in the Federal Republic. During the last four years alone, the ineffectiveness of the Bonn government's Clean Air policy has resulted in the unnecessary emission of 3.3 million tons of sulphur and nitrogen oxides — in other words, 400 grams of unnecessary acid per tree.

Dieter Teufel
UPI-Institut Heidelberg

Copies of the study can be obtained by prepayment of DM 15 to the UPI-Institut, Handschuhsheimer Landstrasse 118a, D-69 Heidelberg, FRG.

Deal gives two-way gain

West Germany has signed a five-year agreement with Czechoslovakia to cooperate on environmental protection. The two countries will exchange experts and information "on technologies for the care of the environment." Environmental Minister Dick of the West German state of Bavaria has visited Czechoslovakia to discuss in detail the possibilities of desulphurization technology for the country's coal-fired power stations. In 1986 equipment for flue-gas desulphurization was installed in the power station at Prunerov with a loan from West Germany. This showed that the technology can be successfully employed at Czech power plants.

Minister Dick also presented proposals for joint measures to reduce SO_2 emissions, with possibilities of joint financing. Desulphurization equipment for the power station at Tisová and others along the German-Czech border was discussed in particular. The agreement could mean big business for German equipment makers, as well as relief for Bavaria from the heavy air pollution from the Bohemian power stations, which burn brown coal. The agreement will open the way for German companies to offer the Czechs equipment for pollution control at prices heavily subsidized by the German government.

Reinhold Pape

NUCLEAR

Big power company could well phase out

From the technical and economic points of view, there would be no difficulty for West Germany's largest power company, the Rheinisch-Westfälischen Elektrizitätswerk AG (RWE) to switch electricity production from nuclear to coal-fired plants, no matter what may happen elsewhere. Such is the outcome of a detailed study carried out by a research group at the University of West Berlin, headed by Dr Lutz Mez.

The company's brown-coal mining subsidiaries have been in difficulty for a long time, and can only be saved by eliminating the production of power from the RWE nuclear plants. According to the study, this would not only save existing jobs, but create others. A detailed calculation for the period up to the year 2000 shows how production would be divided in principle between plants fired with brown coal and ordinary coal after the phasing out of the nuclear ones.

A quarter of the company's brown-coal plants date from before 1959 and will soon have to be closed down. Depending on the way the demand for power develops, capacity varying between 1,000 and 6,400 MW will have to be replaced. Modernization would also bring environmental advantages. New plants are more efficient, producing considerably more power for a given amount of fuel, and are more economic in that they can be kept operating for more than 7,500 hours per year. For the same power output as from the old plants, less coal will need to be transported, too.

The new plants could also be designed for district heating as well as the production of electricity, and so make for a further saving of energy. According to the proposed scenario, renewable energy in the forms of wind, sun, and biogas could also contribute to the RWE power producing operations.

Reinhold Pape

Further information can be obtained from Dr Lutz Mez, Forschungsstelle für Umweltpolitik, Otto-Suhr Institut, Freie Universität West-Berlin, FRG.

NETHERLANDS

The great problem of manure

Manure from livestock is creating tremendous problems in the Netherlands, especially in districts with poor sandy soil where there is intensive livestock farming. The manure affects the environment in different ways. Firstly, the ammonia volatilizing from the sheds and from manure spread over the land contributes to its acidification. This does not only occur close to the farms, but also elsewhere, since ammonia is believed to be transported over long distances, just like other acidifying air pollutants.

Secondly, the groundwater, which often provides the drinking-water in these areas, is polluted by nitrates leaching through the soil. Moreover, on account of runoff from the land, enriched seepage water, or ammonia deposition, the nitrogen causes eutrophication of poor terrestrial and water ecosystems.

Large amounts of artificial fertilizers are also used in Dutch agriculture, and contribute to the environmental limit for nitrogen being exceeded.

The Dutch NGOs consider that the amounts of manure and chemical fertilizer applied of arable land should both be reduced by at least 50 per cent. Otherwise the drinking-water supply will be endangered (nitrate levels over the EC-standard of 50 mg/l have already been noticed) and the natural environment be irreversibly affected.

Since it contained essential nutrients, in particular nitrogen, for plant growth, and improved the soil structure, animal manure used to be considered highly valuable by farmers. It could all be disposed of close to the farm, and there was never a surplus — in fact there was too little for fertilizing the fields sufficiently to grow enough crops to feed the growing population.

Now, however, due to the increased numbers of livestock in Holland, there is a surplus of manure. This development could take place because of the increased use of fertilizers and the possibility of importing large quantities of feedstuffs from abroad, especially from Third World countries. About 3 million hectares of land abroad go to feeding Dutch livestock. In this way the Netherlands contributes to soil degradation elsewhere and creates the need to use fertilizer in order to maintain the fertility of the soil artificially.

Dutch livestock produces about 100 million tons of manure (500 k-ton N) a year, of which forty million tons can be considered surplus if related to the optimal N-uptake by crops. Added to this is another 450 k-tons of fertilizer-N.

The high livestock densities in the Netherlands give rise to high ammonia (NH_3) emissions. Due to volatilization of NH_3 from the sheds, from manure storage and from the fields where the manure is spread, up to 250 k-tons being emitted annually. That is 17.2 kg per inhabitant and 6.9 tons per km^2. For Sweden the corresponding figures are 8.5 kg and 0.2 tons.

Dutch NGOs call for a halving of the animal manure and fertilizer applied to arable land

Not all the ammonia emitted in the Netherlands is deposited within the country. Some 75 per cent is exported, being carried by the wind, whereas 25 per cent of the local deposition comes from abroad. Thus the Netherlands is an overall exporter of ammonia. It is considered that the ammonia emitted domestically causes over 40 per cent of the acid deposition in the Netherlands. The total annual nitrogen deposition from ammonia (75 per cent from home sources and 25 per cent from sources abroad) is estimated to be at least 20 kg N per hectare. This figure is, however, a nationwide average. Locally the N-deposition from ammonia may amount to 40 kg/ha a year. In border vegetations depositions of as much as 150 kg N/ha annually have been measured. The vegetation of nature reserves, forests, and heathlands on poor sandy soils and in poorly buffered lakes and fens can stand only 5-10 kg N without serious effects on the long term.

Nitrate adds a further 20 kg N/ha/year, making the average deposition of nitrogen 40 kg N/ha annually or 2,800 eq potential acid/ha/year.

Increasing awareness of the problem is causing the government to take measures to decrease ammonia emissions in the Netherlands. The present aim is to reduce emissions by 50 per cent before the year 2000. Since May 1987 a Directive on Ammonia and Livestock Holding has been in force to restrict expansion of herds and new buildings within a 500-metre zone around nature reserves in vulnerable areas where NH_3 depositions are already very high. It seems that this directive has been effective, as the number of pigs decreased last year by 3-4 per cent (there are still some fourteen million pigs being raised in the Netherlands).

Livestock farmers in the 500-metre zone are moreover compelled to install closed storage facilities for manure. It is not permitted to spread the manure over the land during certain periods of the year (during winter on account of the possibility of run-off and exceptionally high evaporation of ammonia), and the manure must be ploughed under within one day after spreading. Moreover, the Soil Protection Act, in effect

since May 1, 1982, restricts the amount of manure that may be applied annually per hectare on arable land.

The milk quota that was introduced in the Common Market to reduce overproduction seems already to have had some effect, the number of dairy cattle in the Netherlands having decreased by some 20 per cent since 1980, and thus indirectly affecting ammonia emissions.

The government also intends to compel farmers to use closed manure storage not only near nature reserves but everywhere. The method of spreading is also being discussed. The manure should be spread over the land in such a way that there will be no time for ammonia to evaporate in significant quantities, e.g. by injection (to 10 cm beneath the surface) on grasslands and ploughing the manure under immediately after it has been spread.

As the Dutch Minister for Agriculture and Fisheries, Mr Braks, is of the opinion that livestock industry should remain at its present level, he proposes to achieve the government's aims by taking a number of technical measures, such as:

☐ Optimizing the transport of manure to crop-growing areas and other areas deficient in manure. A National Manure Bank should coordinate the transports.

☐ Treatment of manure in central processing plants. The dried or dewatered manure briquettes might be sold abroad (to Third World countries).

☐ Reduction of the mineral content (phosphorus and nitrogen) in the fodder. This may lead to a 10-20 per cent reduction of ammonia emissions.

In the first place the reduction proposed by the government (50 per cent by the year 2000) is too little. If we are to protect the ecosystems in Holland's most vulnerable areas, which can only stand a maximum deposition of 5-10 kg/ha annually, a 75 per cent reduction of emissions is required.

Furthermore the Dutch NGOs doubt if the government's package of measures will prove sufficient even within the limits set by the government. The Ecological Directive does not take into account nature reserves at a distance of more than 500 metres from emission sources, although scientific data prove more and more that ammonia can also be transported over long distances (Asman, 1988).

☐ Because of the different amounts of manure that may be spread — for grassland 250 kg/ha/yr, and maize land 350 kg/ha/yr, the NGOs fear grassland will be converted to maize land.

☐ A Manure Bank will not solve the problem, since the NGOs consider there are no areas deficient in nitrogen.

☐ The industrial treatment of manure is still at an experimental stage. The one treatment plant that has recently been opened will be able to handle only 100,000 tons of manure yearly, and another that will be opened this year is also a small one. Moreover, the treatment costs are too high (up to 60 guilders per ton).

The NGOs consider that a more structural approach is needed. Additional measures to reduce the number of livestock will be necessary if manure production is to be reduced.

☐ Creating better possibilities for alternative farming and integrated farming systems. Some successful results have already been seen in the subsectors of pig and poultry farming. Production of alternative crops must be made financially attractive.

☐ Research will be necessary in environmentally sound measures and cost-saving models that do not entail an expansion of production.

Finally the Dutch NGOs are of the opinion that the problem of ammonia is not confined to the Netherlands. High cattle densities are also found elsewhere in Europe (in Denmark, Belgium, Brittany, and parts of West Germany and Great Britain).

Harm Smit
Jan Fransen
Stichting Natuur en Milieu

Acidification by ammonia

The impact of ammonia on the vegetation is direct as well as indirect. The latter is, however, considered the most important. It has been established for quite some time that acid deposition resulting from European emissions of sulphur dioxide and nitrogen oxides is one of the major causes of soil acidification. However, research in the Netherlands (Van Breemen et al, 1982) indicated ammonia as a third major factor in soil acidification, since it is converted in the soil into nitrate by microbiological nitrification.

In calculating the emissions of ammonia from livestock the following emission factors are used

Type of animal	Ammonia emission
horses	9.43
cattle	18.2
pigs	2.83
sheep	3.08
goats	3.08
asses	3.08
poultry	0.26

Average values based upon age or weight distribution within each animal category for 1980
Source: Asman and Drukker, 1988

References and advisable literature

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CONFERENCE

Call on UN to draw up a law of the atmosphere

A major scientific conference on "the changing atmosphere" of Earth ended in July with a call for international action to avert an "impending crisis" because of atmospheric pollution.

A statement from 330 scientists and policy makers called for a 20-per-cent cut in emissions of carbon dioxide by the year 2005. This gas is the prime cause of the "greenhouse effect" which, by trapping heat from the sun, is warming the planet.

Half of the reduction could be achieved by increased energy efficiency. The other half must come from alternatives to burning coal and oil, the main sources of carbon dioxide in the atmosphere. Alternatives include natural gas, biomass burning and, if safety and technological problems can be solved, the nuclear power option.
power option."

The conference also called on the UN to draw up a "law of the atmosphere" to be ratified at an inter-governmental Conference on Sustainable Development planned for 1992.

"This conference is the Woodstock of the greenhouse effect," said one climate modeller, Stephen Schneider, summing up the meeting on The Changing Atmosphere, Implications for Global Security, held in Toronto, Canada.

The meeting was hosted by the Canadian government and supported by the United Nations Environment Programme and the World Meteorological Organization.

The conference considered the greenhouse effect, acid rain, and the destruction of the ozone layer. Its final statement concluded: "Humanity is conducting an enormous, unintended, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war." It is "imperative to act now." The conference decided that wealthy industrialized nations have a responsibility to lead the way, and to demonstrate new approaches through their national energy policies and their aid programs. The conference adopted a suggestion by Michael McElroy, from Harvard University, that a world atmosphere fund should be established, paid for by a tax on the consumption of fossil fuels by industrialized nations. The fund would support technological developments and an international program of climate research and monitoring.

Delegates called for governments to ratify immediately last year's Montreal Protocol on Substances that Deplete the Ozone Layer. The Toronto statement said that the protocol should be tightened in 1990 to ensure "nearly complete elimination" by the year 2000 of chlorofluorocarbons, which destroy ozone.

Key areas of research identified at the conference included investigating the way regional changes in climate relate to global change. That would help establish whether, for instance, the greenhouse effect is causing the current American drought. There is also an urgent need to evaluate the role of oceans in the warming of the Earth.

The Toronto statement warns that, failing rapid remedial action, the world's temperature will rise by between 1.5 and 4.5 °C before the middle of the next century. The warming will accelerate the present rise in the sea level, possibly by as much as 1.5 metres by the year 2050. That would devastate coastal areas and islands by flooding, contamination of water supplies by salty waters, loss of farmland, and a dramatic increase in the number of tropical cyclones.

Similarly, the conference document warns that continued damage to the ozone shield protecting the Earth from ultraviolet radiation will cause a significant rise in cases of skin cancer and eye damage and will threaten many species. Increased acidity will reduce drastically the fertility of many lakes and soils. "These changes," says the report, "are already having harmful consequences over many parts of the globe."

New Scientist, July 7, 1988.

GREEN CLUB

Demonstrators in the Hungarian capital also call for clean air.

Campaigns for better air

Last spring, all around Europe environmental groups were again campaigning for better air quality, especially during the International Acid Rain Week at the beginning of June. Particularly encouraging were the activities in Eastern Europe.

In Budapest the Green Club of the Technical University organized "Green Days" at the end of April and distributed 25,000 leaflets criticizing the number of motor vehicles in the inner city and other sensitive parts of the capital. Here the concentrations of pollutants such as lead, aldehyds, CO, NO_X, and SO_2 are much higher than the permitted limits. Nearly 200 people demonstrated in the streets and organized a symbolic funeral of the "Health" of the inner city. An evening of public discussion about the problems of air pollution took place in the presence amongst others of representatives of the Ministry of the Environment, the municipal council, and public transport.

In Poland the Polish Ecological Club and the youth movement Wole Byc (I prefer to be) organized a campaign for a car-free day, accompanied by bicycle demonstrations and the distribution of leaflets. In Leningrad environmental groups assembled on June 4-5 to found an Ecological Federation for the Northwestern Soviet Union, with air pollution as its main target.

In Ljubljana, Yugoslavia, the Ekoloski Zbor Ljubljana staged an international ecological demonstration at the end of May to highlight the problem of damaged forests in Slovenia and Croatia. An international "Save the forests" conference was organized in Zagreb. There was also an information stall and performances by theatrical groups.

The Dutch Milieudefensie ran a traffic campaign against the recent government decision to raise the speed limit for cars from 110 to 120 kph, in which 15,000 stickers bearing the device "100 km is enough" were distributed. In England 100 local groups from Friends of the Earth organized a "Forest Alert" with public lectures and guided excursions to demonstrate the effects of air pollution on woods and wild plants.

During the Acid Rain Week the findings of a questionnaire concerning the views of politicians on acid rain were published in Ireland by Earthwatch.

Environmental groups in West Germany, Austria, and Switzerland started a big campaign for arrangements to avert the destructiveness of mass-tourism in the Alps region. Special emphasize is put on the contribution from transit traffic to the dying of the mountain forests. In Sweden a "Clean Air Week" was promoted in May by MOPS, the school project of several environmental groups, in schools all over the country to make pupils aware of and concerned about environmental destruction, especially as concerns the effects of acidification. A lot of educational material was produced in such forms as posters and projector slides, and thousands of copies of a "Clean Air Newspaper" were distributed.

The Swedish Environmental Federation stages a lecture tour with environmentalist from Poland and Hungary and a bicycle demonstration to make the centre of Göteborg car free. Activities in Norway during Acid Rain Week included a poster campaign for clean air in Oslo trams and ads in newspapers. A press conference was held with the environmental minister under the theme of "Health effects and forest damage as a result of pollution from road traffic," and there were also protest actions in central Oslo.

Once again, actions everywhere in Europe, but when will politicians finally start effective measures against atmospheric pollution?

Reinhold Pape

CALL for "Umweltfreundliches Reisen"

This autumn a whole lot of European environmental organizations are starting an international campaign for "environmentally friendly" travel.

The aim is to give the badly damaged Alpine forests a chance of surviving by getting people to travel more by rail, bus, or catalyzer-equipped cars when touring in the region or merely passing through.

The campaign for autumn 1988 will promote "environmentally friendly hiking and mountaineering." For the winter of 1988-89 the slogan will be "Environmentally friendly winter sports," and for the summer of 1989 "Environmentally friendly in the South."

The additional load of pollution from holiday travel regularly causes concentrations in the Alpine region to rise to heights that will mean inevitable death to the mountain forests. The dramatic increase of forest dieback in these parts can however be checked if an immediate reduction is made of the pollution load that is attributable to vacationing and transit traffic.

The only protection for roads and communities against avalanches and landslides lies in the ability of healthy forests contain water. This ability has already been markedly reduced in the Bavarian Alps, where 80 per cent of the trees are damaged, in the Swiss massif (60 per cent damaged), and in the Austrian Tirol (38 per cent). Least affected is South Tirol, with 15 per cent damaged.

Any further thinning out of these forests and consequent reduction of their protective ability will result in important highways becoming impassable both in summer and winter. Even normal precipitation will cause landslides and flooding.

To stop this threat we need the aid of all vacationers, both those who stay in the Alpine region and those who are only passing through. By means of this campaign for "umweltfreundliches Reisen" we hope to make more people aware of the threat as well as showing them the possibility of taking personal responsibility.

More information can be obtained from BUND Naturschutz, Geschäftstelle Südbayern, Theresienstr. 21/IV, 8000 München 2. Telephone 089-288654.

HISTORICAL

Will they ever learn?

There is nothing new under the sun. Not even air pollution. It has been a matter of observation for over two thousand years. The only strange thing is that until quite recently air pollution should have received so little public attention.

A year ago, in a lecture before the Stichtung Naturschutz in West Berlin, Dr Helmut Klein, of the Bund für Naturschutz Bayern, traced the history of airborne pollution and its effects from the time of the Roman Empire until the nineteen-twenties. Dr Klein, formerly of the Max Planck Institute, is a forest expert at what is probably the leading environmental organization in West Germany.

In his lecture, he noted that one of the earliest to complain about air quality (in Rome) was the Augustan poet Horace. But in his great work on Geography, Strabo had already described the problem of air pollution arising from the roasting of copper ore in Spain. Because the sulphur dioxide driven off in the process was considered poisonous, the roasteries were located on hilltops — thus anticipating the policy of high stacks.

The first death from sulphur dioxide poisoning was recorded in 79 AD by Pliny the Elder, who in his Historia Naturalis had taken much of his information on the matter from Strabo. By then all the vegetation had vanished from the copper-mining district in Spain.

With the growth of towns during the Middle Ages in Europe, problems also began to arise there, becoming acute in London for the first time in 1285. A commission appointed by Edward I found that the air was bad, and deplored the fact that nothing was being done about it.

And nothing was done until twenty years later, when the nobility intervened, with the result that the first smog regulation came into being. The firing of limekilns with coal was for instance prohibited. On a second offence, the kiln was torn down. In one case a lime burner was actually executed for defying the order.

The first administrative measure for attacking a similar problem was taken in Germany in 1348, when the city corporation of Zwickau in Saxony forbade the use of coal in smithies — "since the poisonous vapours damage the vegetation."

In the following century industrialization had already started in a small way, and in 1556 the mineralogist Georgius Agricola published a work on mining and metal working, in which he noted that certain diseases, such as asthma, stone lung, and consumption could be caused by polluted air. As a countermeasure he described a method for cleaning the waste gases by which the "smoke" was made to pass over an iron grid above pans filled with water, for dissolving the sulphurous fumes. He also proposed passing the smoke through dust chambers, to prevent dust from spreading into the environment. He emphasized: "We must lay more weight on gaining health than on making profit."

A counterblast came in 1695, when Professor Friedrich Hofmann wrote that far from being harmful, the sulphur in coal smoke actually promoted health. But Pliny knew better, and so now do we.

In 1754 the coal lobby made its appearance. In that year Frederick the Great ordered his soldiers' barracks to be heated with coal. Shortly afterwards a whole row of trades in Prussia were forbidden to burn wood. In 1793 the Berliner Brennstoff-Kontor raised the price of firewood and sold coal at less than cost, in order, it was said, to promote its use. It did, too.

While it is true that there is no record of any resulting damage in Brandenburg itself, in 1824 came the first report of a widespread dying of fir trees in the Sächsischer Wald. What do the authorities do in such circumstances? Only two things are possible: Issue ordinances, which will at least sound good, and commence research. That has always had a pacifying effect.

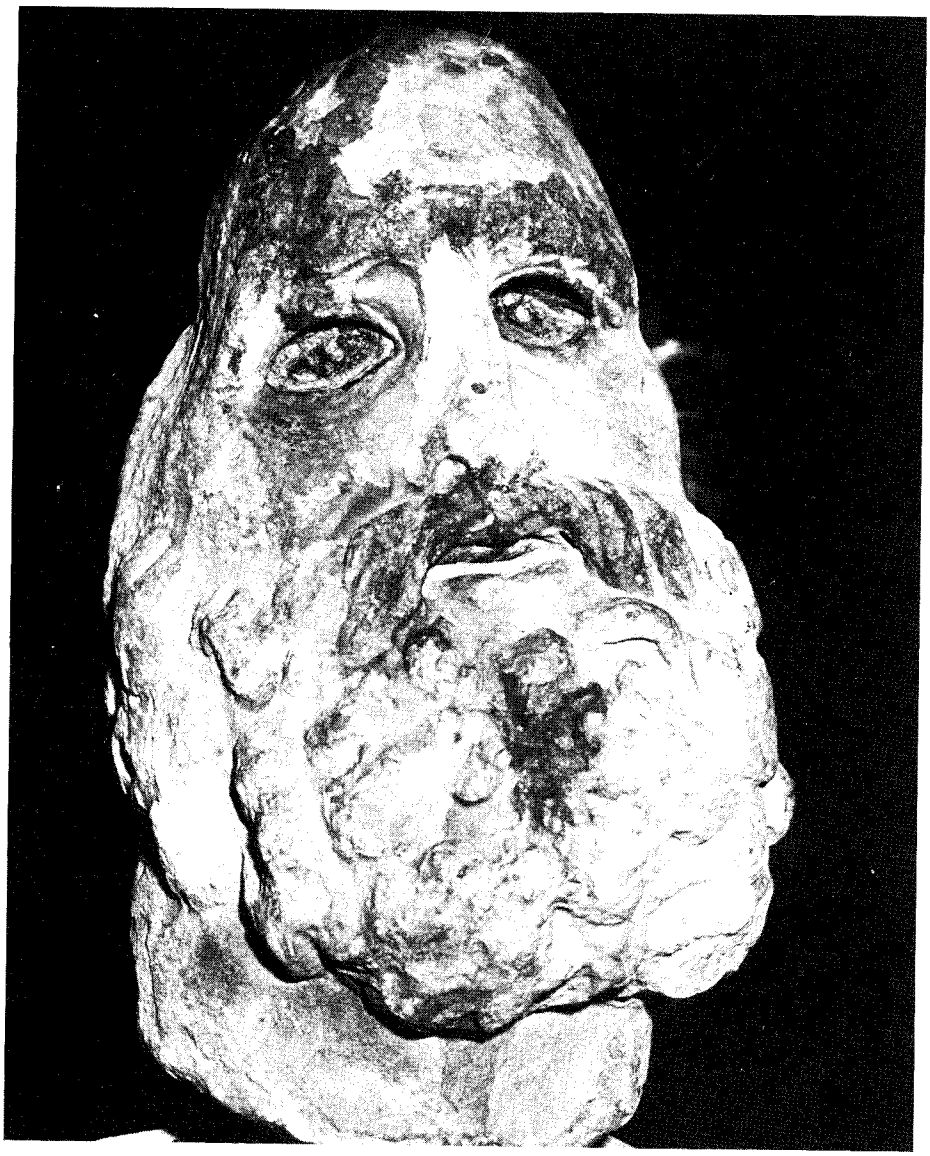
Back again in the neighbouring state: in 1831 a so-called cabinet decree was issued in Prussia, the first steam-boiler law. This required a) the greatest possible elimination of smoke, and b) the smoke stacks of industries in residential areas to be at least 60 metres high. Going in for dilution, just as they did in Spain.

The first time a study was made of the effects of fumigating plants with sulphur dioxide was in 1847. By fumigating reseda plants, a man named Wolf found that a dose of 300 milligrams of sulphur dioxide per cubic centimetre was sufficient to destroy the leaves within 48 hours. The effect was similar to that in the autumn when the leaves die naturally.

The following year a school of forestry was founded at Tharandt in Saxony, at which the problem was also attacked. There, in 1853, Professor Stückhardt was able to establish that not only sulphur dioxide but also heavy metals caused tree damage. In 1864 he started fumigating tests with spruce and sulphur dioxide. It was clear in any case that 300 mg/cm^3 were harmful, but Stückhardt found that as little as 3 miiligrams quickly led to plants dying, and that it was impossible to determine any lowest limit.

Naming it

In a book published in 1872, entitled Air and Rain, by Robert Andrew Smith, the term "acid rain" appeared, presumably for the first time. In that year, too,



ANDRE MASLENNIKOV

London experienced its first great smog episode, during which 1,657 people died in a single day. A warning of things to come.

In 1883 came a report from the Tharandt school of forestry that 358 hectares of blasted forest had been found in the Harz mountains. The trees had been destroyed by smoke. Two scientists, Schröder and Reuss, wrote a book about smoke damage, in which they described five stages, ranging from acute poisoning, where the vegetation dies, to "chronic" damage, causing the tree to be sickly over a period of years and yet die in the end. Thus chronic tree poisoning was described at Tharandt in Saxony as early as 1883.

It was perhaps inevitable that such assertions should be contradicted. In the Jahrbuch für das Berg- und Hüttenwesen im Königreich Sachsen, for 1873, one Gottschalk had in fact already, in an 80-page article, totally rejected the idea that smoke, in the form it came out of the furnace, could cause any kind of damage to vegetation, no matter how long it was allowed to act.

Taking a step forward in time, in 1925 a member of the Prussian diet, Hugo und Genossen, moved that the forests in the Ruhr coalmining district should be protected from extensive destruction by smoke.

The diet rejected the motion, arguing that too strict requirements might lead to an increase in unemployment.

Two years later, a centimetre-thick publication issued by the Siedlungs Verband Ruhrgebiet gave extensive treatment to the problem of the forests. It said

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More reading

Acid deposition and vehicle emissions: European environmental pressures on Britain (1987)

A study that examines the conflicts between Britain and some other countries in Europe as regards acid rain and vehicle emissions. Describes the policies of Britain as compared with those of Sweden, West Germany, and France, showing the differences in approach and action. An interesting report that needs careful reading, however, since it does contain factual errors, such as wrongly stating that no equipment for flue-gas desulphurization has been installed in Sweden. By Peter G. Brackley. 144 pp. Can be ordered from the publisher, Gower Publishing Company Ltd., Gower House, Croft Road, Aldershot, Hants., England GU11 3HR. Price 36.50 dollars.

Umweltberichterstattung in Japan (1987)

Gives an account of the highly efficient information systems that are all the time being produced in Japan and have much to do with the success of the country's environmental policies. In German. By Helmut Weidner. 139 pp. Can be ordered from edition sigma, Mittenwalder Str. 48, D-1000 Berlin 61, FRG.

Lufthandlingsplan (1988)

NOAH's Plan for Clean Air in the 90s in Denmark. 22 pp. Obtainable from the NOAH Sekretariat, Studiestræde 24, DK-1455 København K, Denmark. Price 10.00 kroner.

Der Wald stirbt an Stress (1988)

Describes the current state of knowledge concerning Waldsterben, with a consideration of the causes. By Peter Schutt. 261 pp. Verlag Ullstein GmbH, Nr. 34471. Price DM 19.80.

Dicke Luft in Europa (1988)

A review of European environmental policy. In German. By L. Grundling and B. Weber. 170 pp. Can be ordered from C.F. Muller Verlag, Im Weiher 10, D-6900 Heidelberg, FRG. Price DM 19.80.

on the title page: "This publication is intended to show how far forest death is already advanced in the Ruhr district, and how immediate remedies are urgently required in the public interest."

During the preceding forty years, 50 per cent of the trees in the Ruhr forests had died. The responsible minister in Berlin wrote a very handsome foreword to the book, but failed to conceal his fears for the economy.

What then can one do? Get on with research! In 1912 Wislicenus discovered "invisible damage" in trees — what we would now call latent damage. It means that even where the emissions are so diluted that nothing can be seen on the trees, their capacity for resistance may already have been affected. But any additional load of pollution will cause their resistance to break down. Our present classification of damage includes no such stage. Wislicenus describes however synergism, the combined effect of various substances, which is now at the centre of discussion on the clean-air problem.

Wislicenus also gave a description of a third phenomenon, which is no longer accepted. "Invisible" damage should reduce the trees' resistance to infection of all kinds caused by parasites. "The intensified occurrence of certain insects is a characteristic sign of smoke damage in spruce," he says. There is nothing of that in our present analysis of forest dieback.

Sixty years ago, fifteen years after Wislicenus, Dr Fritz Wissmann in Berlin published some extensive writings, in which he pointed to compounds of sulphur, chlorine, and fluorine as the real culprits. The amounts of sulphurous acid that are discharged into the air are becoming greater every day, he wrote. If from a kilogram of coal 13 cm^3 of combustion gases are released, 32 billion cm^3 will be emitted to the air in Berlin every year. That was in 1927.

Dr Wissmann described the effects of this, and listed all the methods that were then available for desulphurizing and cleaning the flue gases — and urged that they be used.

We are now in a situation where responsibility merges into guilt, said Dr Klein, and quoted from a joint publication of the two largest Christian faiths entitled Responsibility Towards Creation (Verantwortung wahrnehmen für die Schöpfung, 1985): "Although interests are intertwined, and thus we have a common guilt, responsibility will always attach to the individual, bringing with it a duty and a demand for an accounting. This applies to public officials and persons with great influence in particular, it applies to the mature citizen in his private life as well as in his possibilities for political activity."

Let us accept this duty, with all our heart, in private life and to the extent of our possibilities in politics as well. Responsible action must be fired by concern, anger, and maybe anxiety too, concluded Dr Klein when speaking in Berlin.

Erratum:

In the map accompanying the article on pollution in the tropics, in our last issue (p. 10), the hatchings showing where there are sensitive soils and emissions are greatest were unfortunately omitted. Below we show the map as it should have been.