

Acid News

No. 2, July 1986

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

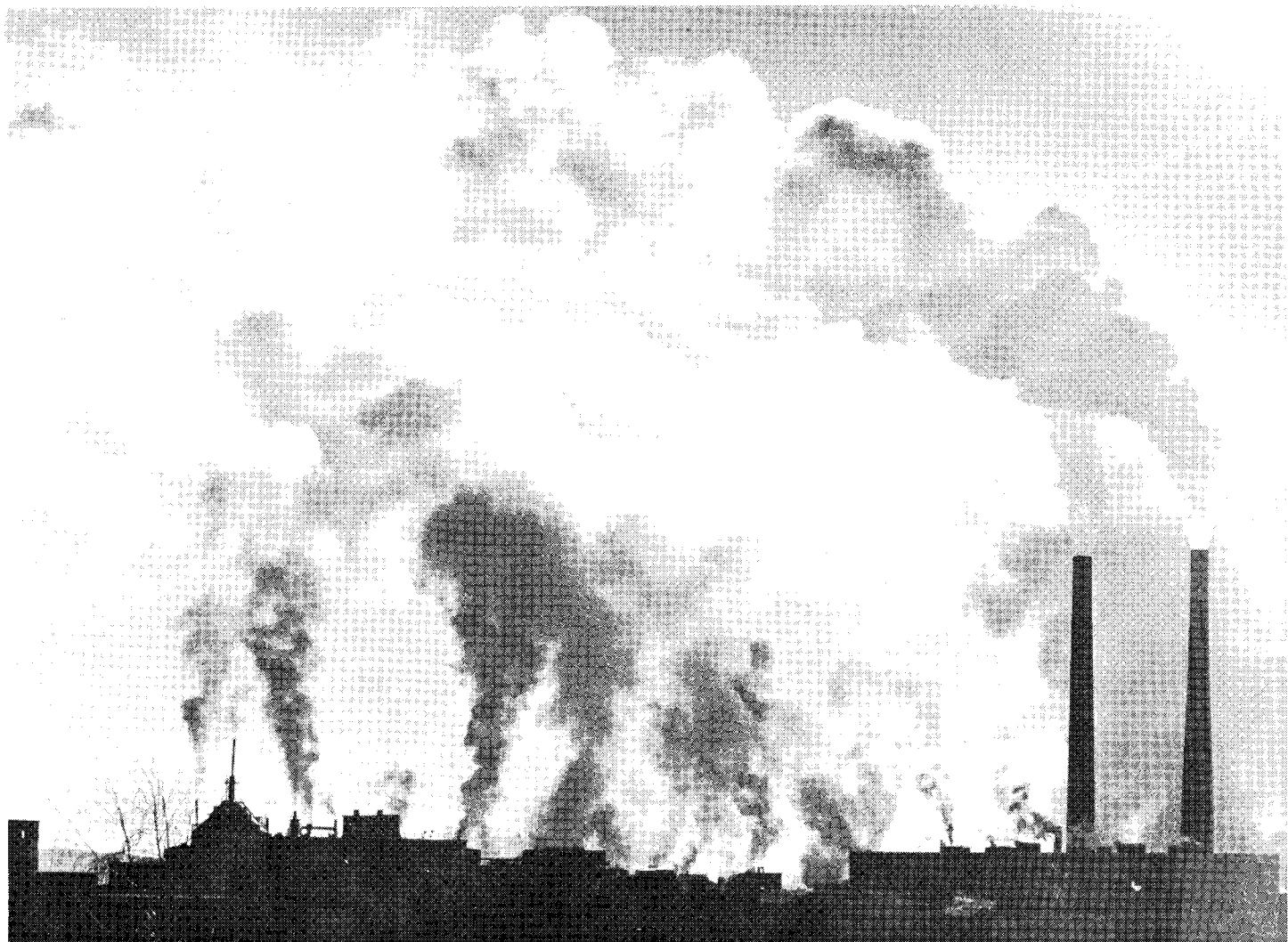


Photo: Hans Östborn

WORLD WILDLIFE FUND

Costs unacceptably high

Acid rain is destroying decades of conservation investment in national parks and nature reserves, warns the World Wildlife Fund International.

The damage to nature caused by acid rain is "already unacceptably high" says the WWF, but

the future effect is "potentially enormous." It has been shown "beyond any reasonable doubt that forests and freshwaters are seriously and detrimentally affected" said the statement, issued to coincide with the start of International Acid Rain Week.

WWF called on governments

and agencies to reduce industrial emissions in line with international obligations such as the Convention on Long Range Transport of Air Pollutants of the United Nations Economic Commission for Europe (UN ECE). Air pollution is now reaching Arctic and Antarctic ecosystems. ➤

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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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WORLD WILDLIFE FUND

Costs unacceptably high

► WWF fears that with the industrialization of developing countries, acid rain is spreading to vital tropical forests. It issued a strong appeal to industry to ensure that new facilities and technologies deployed in developing countries do not aggravate the problem. Acid rain is already being recorded in China and Brazil.

"Every country, developed or developing, will set its own pollution standards," said Charles de Haes, Director General of WWF today, *"but in doing so, no responsible government can ignore international obligations, or set standards so low that its people have to stand by and see their forests destroyed or their lakes poisoned."*

WWF concludes that further research on acid rain is not justified unless there is action to reduce emissions.

Statement from WWF International for Acid Rain Week

Acid rain (in the form of compounds of sulphur, nitrogen, hydrocarbons and allied or derived pollutants from sources such as vehicles, industry and power plants) is now a serious threat to natural communities in almost every developed country.

WWF is particularly concerned that:

1. Acid rain is a major threat to nature which need never occur at all: it is a problem that man has added to those arising from direct use of the land and natural resources (forests, oceans and soils). Damage to flora and fauna is already unacceptably high but the main concern of WWF is over the indirect and potentially enormous future effect of acid rain on nature.

2. As industrialization proceeds in developing countries, acid rain pollution will spread to new areas including tropical forests, unless stringent control measures are adopted. Tropical forests are not only ecologically vulner-

able but contain most of the world's plant and animal species. This makes them vital habitats for conservation worldwide.

3. It is now known that pollution-induced acidification of freshwaters was taking place for up to 100 years before it was detected and fully understood by scientists. In addition, forest decline has a 'latent period' of up to fifty years during which there is little or no visible sign of damage to trees. In other words, the acid rain problem may be affecting many more countries than is now realized.

4. Long-range transport of air pollutants is now reaching major ecosystems in remote areas of the world traditionally assumed to be free from such pollution such as the Arctic and Antarctic.

These biologically unique areas are of great importance to science and as global commons they are an international responsibility. Measures taken to reduce the concentration of pollutants in industrial areas by increased dispersion, for example using tall stacks, may lead to long-range pollution of these areas. Oceans can also be affected, for example by nitrogen deposition in coastal waters.

5. Acidification is destroying the value of conservation investment in establishing nature reserves and national parks, and in species protection measures. This investment has taken decades to make (for example WWF has spent over 100 million dollars in 25 years) and has saved many species and ecological communities from destruction. The effect of acid rain on both forests and freshwaters is not simply to eliminate one or two species: it can inhibit fundamental nutrient cycling, cause major losses of vital nutrients, interfere with primary production, and disrupt the main biological processes and relationships of an ecosystem (such as tree growth and mycorrhizae (tree-fungi symbioses)). Together ►



Drawing: Burki, © 24 Heures

► with long-term changes in soil structure, this leads to elimination of the existing natural and semi-natural communities, and the progressive destruction of biological diversity.

6. The need to persuade governments to take action to reduce emissions diverts valuable staff time, resources and effort of conservation groups from other vital tasks such as tropical forest, wetland and plant gene conservation.

WWF will issue a more detailed analysis of the effects of acid rain on wildlife, and a statement of its position on the acid rain problem, in due course. Several WWF National Organizations are already conducting research and have specific policy views on acid rain problems.

WWF International now notes and recommends that:

1. It has been shown beyond any reasonable doubt that forests and freshwaters are seriously and detrimentally affected by acid rain caused by emissions of industrial origin, and that the ecological and other costs are unacceptably high.

2. It has been shown beyond any reasonable doubt that in general, sulphur depositions (the major agent of damage to freshwaters) are directly proportional to regional sulphur emissions. WWF therefore recommends that all governments, industries and agencies take action to reduce such emissions in order to eliminate man-originated excess deposition, and take immediate steps to comply with internation-

al obligations such as those arising under the United Nations Economic Commission for Europe (UN ECE) Convention on Long-Range Transport of Air Pollutants.

3. It has been shown beyond any reasonable doubt that oxides of nitrogen and of sulphur, ozone (which can be formed from NO_x and hydrocarbons) and other chemicals, separately and in combination, cause damage to vegetation, and the dissociation of mycorrhizae. Forest damage is probably synchronized with and precipitated by natural stress events (e.g. frosts, droughts) acting in combination with these pollutants. Some effects, such as induced nutrient deficiencies, appear to be partly reversible, but the status of others is uncertain and the progressive decline and death of trees over wide areas is expected to continue unless pollutant levels are significantly reduced. WWF recommends that governments, agencies and industry comply with international obligations and take urgent action to reduce such emissions, by the adoption of clean-up technologies and avoidance strategies such as energy saving.

4. Although further study will determine more damage pathways, neither in the case of damage to forests, nor of damage to freshwater ecosystems, does the WWF believe there is any justification for further research without action to reduce emissions.

5. WWF appeals to industry, and calls upon governments and aid agencies, to ensure that technology, industrial systems, and industrial facilities exported to or established in developing countries at least meet the emission standards pertaining in the country of origin, so as to avoid the further spread of acid rain problems to developing countries.

Note. WWF, founded 25 years ago, is the largest worldwide private conservation organization. Its international headquarters are in Switzerland, and it has 23 national affiliates and many associates on all continents. WWF's aim is to conserve the natural environment and ecological processes essential to life on earth.

For more information, please contact: Chris Rose, World Wildlife Fund, World Conservation Centre, Avenue du Mont-Blanc, CH-1196 Gland, Switzerland. Telephone: 022-64 71 81.

The implications of research

At the invitation of the government of the Netherlands, the first international conference on acidification and its implications as regards policy was held in Amsterdam on May 5-9 1986. The purpose of the conference, which was organized in cooperation with the United Nations Economic Commission for Europe (ECE), was to support the work of the Executive Body of the Convention on Long Range Transboundary Air Pollution by holding international symposia to discuss the most recent scientific information related to acidification and long-range transboundary air pollution and what it will mean for policy making.

Representatives were present from more than 24 nations as well as from several international organizations. There were further approximately 120 observers attending in a personal capacity.

In his opening address, Dr P Winsemius, Netherlands, Minister of Housing, Physical Planning and Environment, affirmed that acidification is without doubt a serious international problem. Although knowledge concerning the causes and effects is still incomplete, it does not make sense to postpone action until we have 99-per-cent certainty, since then it would probably be too late. We have to accept uncertainty and to institute measures all the same. Another problem is that sometimes control costs must be borne by one country, while another country will enjoy the benefits. This may make a solution more difficult. It might however be found in an international fund — an idea that is already circulating in Western Europe.

Damage costs billion of dollars

Dr Winsemius recalled that the first step in international control of acidification was taken in Helsinki last July with the signing of the so-called 30-per-cent protocol for the reduction of sulphur

emissions or their transboundary fluxes. A similar step still has to be taken for nitrogen oxides. He emphasized that nitrogen oxides are a key component. They contribute to acidification and together with hydrocarbons are responsible for the formation of ozone. Therefore it is important to find out to what extent the control of NO_x is desirable.

We know that photochemical air pollutants, such as ozone, cause damage to vegetation, to agricultural crops as well as forests. Minister Winsemius thought it surprising that crop damage due to air pollution should receive so little international attention. The reduction in crop yield in the Netherlands is estimated to be about 5 per cent, costing approximately 250 million US dollars per year. Translated to the European scale, it would mean an amount of the order of four billion US dollars a year.

During the first three days of the conference 21 lectures were given, reviewing the state of the art in the various fields of acidification research. Some of them are briefly presented here.

Acidification in Scandinavia

Dr Dickson from Sweden reported that the acidification of surface waters is reported from most European countries. In Scandinavia some 30,000 lakes and altogether 200,000 kilometres of running waters are damaged. The recently reduced deposition of sulphur from the atmosphere is reflected in reduced concentrations in several lakes in southern Scandinavia, but not necessarily in reduced acidity. Nitrate concentrations are, however, increasing. Further acidification could be prevented by reductions of 70-80 per cent each of sulphur and nitrogen depositions.

Crop losses in the USA

Dr Tingey, United States, stressed that ozone is viewed as the most critical air pollutant affecting veg-

etation in the US, and that it is to be expected that it will also play an important role in Europe, next to acidic deposition, in damage to vegetation. Ambient levels of ozone are sufficiently elevated, in Europe too, to induce foliar injury and reduce the growth and yield in many plant species. Yield reductions of 10 per cent are predicted for several crop species when the seven-hour mean concentration exceeds 80 to 100 $\mu\text{g}/\text{m}^3$. Recent American studies indicate that elevated ozone concentrations are costing the agricultural producers and the consumers between 1.2 and 2.4 billion US dollars annually.

Trends and recovery

From Canada H C Martin and T G Brydges reported that studies of environmental damage due to acidification from acid deposition in Canada date from the 1950s. In the late 1960s acidification of surface waters and other forms of environmental damage near point source emissions in Canada and the United States led to the development of Clean Air Acts in both countries and the implementation of various control programs. Sulphur dioxide emissions reached peaks around 1970-1973, and thereafter decreased in both countries. US emissions decreased from about 28 million tons in 1973 to 21 million tons in 1984, and Canadian emission from 6.6 to 3.8 million tons during the same period, and a further decrease is ensured as a result of Canada's control program for sulphur dioxide.

The aquatic environment has responded favourably to these emission reductions. Sulphate runoff from 12 Nova Scotian and 8 Newfoundland watersheds decreased by nearly 50 per cent in the corresponding time. Rivers in both cases showed an expected increase in pH. The past reductions in SO_2 emissions and the favourable response in the environment is most encouraging, ►

►but there is still extensive surface water damage. Lakes in large areas of Eastern Canada have less than 20 per cent of the alkalinity expected from normal weathering processes, and as many as 14,000 lakes have become acidified.

Biological surveys have documented a continuing decline in the biological quality of lakes, and also the loss of aquatic organisms as a result of periodic pH depressions in streams.

In recent years a decline in sugar maple has been observed in Central and Eastern Canada. The trees have been subjected to attacks by tent caterpillar and to severe weather conditions. There is increasing evidence that the decline is caused by a complex interaction of insect damage, weather, and stress caused by acidic precipitation.

The conclusion from the eastern North American experience is that while emissions and depositions have been reduced and water quality improved, both the aquatic and forest situations are still far from acceptable.

Soil acidification

N van Breemen and J Mulder, both from the Netherlands, told of the effects of acid deposition on the chemistry of forest soils. Enhanced acidification of the surface horizons of forest soils is taking place in areas with a high input of acid atmospheric deposition. The evidence for increased soil acidification comes from measurements of old and new soil samples, from chemical analyses of soil solution, from input-output budgets of soils and catchments, and from geochemical studies of soil profiles. The results are supported by simulation models of soil acidification.

The levels of atmospheric deposition that are acceptable in the long run for terrestrial ecosystems vary, but are of the order of 1 to 1.4 equivalent kmol/ha a year for sulphur and 0.4-1.4 kmol/ha a year for nitrogen. Current deposition rates in many forests in central and western Europe are 2 to 8 equivalent kmol/ha a year for sulphur and 1 to 3 kmol/ha a year for nitrogen.

According to prof Molski from Poland there are now about 6 million hectares of damaged for-

ests in Europe, including more than 1 million ha that are seriously damaged. There is no doubt that air pollution is the primary cause.

Drinking water affected

Dr von Brömssen from Sweden stated that the acidification of drinking water in a strict sense occurs primarily in private wells in areas with shallow non-calcareous acidic soils and acidic rocks. Decreases in alkalinity and increases in hardness, sulphate, and nitrate, due to atmospheric deposition, occur however in other regions as well.

In Scandinavia and certain areas of Central Europe the effects are mainly seen in increased corrosion of the water pipes supplying private dwellings. The drinking water supply of about 6 million people in Scandinavia may be affected by acidification. The annual monetary cost of acidification in private indoor installations in Sweden in 1982 was reported to amount to 140 million kronor. The cost of the countermeasures for 100,000 private wells will amount to 500-1000 million kronor. A similar situation, although less well documented, is reported from Norway. In Finland the situation is less severe. Decreases in pH and increases especially in nitrates in the groundwater in Denmark and the Netherlands are mainly ascribable to agriculture. In the FRG especially sulphate increases have been reported.

General conclusions

Among the general conclusions that could be drawn on the basis of the scientific evidence put forward at the conference, as well as on the policy statements made by delegations, were the following.

- The scientific evidence confirmed that the primary cause of acidification is sulphur dioxide. It is also clear that nitrogen oxides play a major role in acidification processes. In combination with hydrocarbons, nitrogen oxides are also prominent in the formation of photochemical oxidants, and especially of ozone.
- Acidification has widespread and often irreversible effects on the environment and inflicts con-

siderable economic losses, as well as damage to the natural resource base and to countries' cultural heritage. The abatement programs that have so far been implemented in Europe and North America have not yet led to sufficient reductions for protecting the environment from acidification.

- Most of the delegates at the conference agreed that although the Helsinki protocol on the reduction of sulphur emissions or their transboundary fluxes by at least 30 per cent is an important step towards combatting the acidification of the environment, it is still not sufficient, and many countries have already announced further reductions. Those delegations holding such views maintained that further international cooperation, with more countries participating, was needed for the achievement of sound, scientifically based environmental aims as regards further reductions of emissions or their transboundary fluxes.

- The conference agreed that the transboundary problems arising from emissions of nitrogen oxides can only be solved through international cooperation. The conference welcomed the progress of the working group on NO_x under the ECE Convention. A number of delegations exposed the need of a binding international agreement for reducing NO_x and hydrocarbons. A number of countries have however found it necessary to take appropriate action without waiting for such an agreement. Some considered that action should be taken only after appropriate scientific investigations.

Also pointed out was the need of:

- Increased research efforts, for example on forest damage.
- Intensified international exchange of information and research programs.
- Development of innovative co-operative pollution abatement measures.
- Increased monitoring of air pollutants as well as of their environmental effects.
- Development of advanced pollution abatement technologies.

Unexpected acid rain damage

An international scientific conference organized by Friends of the Earth has unearthed acid rain damage in Cornwall — an area of Britain previously thought to be unaffected.

The conference was held in the London School of African and Oriental Studies on the 21st of April 1986. The morning session was chaired by Sir Hugh Rossi, MP, Chairman of the House of Commons Select Committee on the Environment, and the afternoon session by Professor Ron Edwards.

A number of scientists from Sweden, Norway, West Germany, the Netherlands, and the UK presented papers, but the report that attracted most media attention was given by Dr Nick Tregenza, chairman of the Cornwall Trust for Nature Conservation (CTNC).

The CTNC's research was done, according to Dr Tregenza, *"entirely without thought of acid rain, because nobody in Cornwall believed that we suffered from acid deposition at all. Our concern was with habitat loss..."*

The researchers started with a **Flora of Cornwall**, written in 1909 by FH Davey, which drew together the work of botanists for the previous fifty years. They then compared this with a **Review of the Flora of Cornwall**, by LJ Margitts and RW David, published in 1980, to find which species had increased and which had decreased. All of the data is checkable against published sources, and was entered against strict criteria, so in theory at least preconceptions as to the results were screened out of the exercise.

The survey found that of the native plant species, about a fifth were reduced and 7.5 per cent had increased. There would be a

number of reasons for this, including agricultural changes, habitat loss, observer error, etc. What was surprising, however, were the results relating to calcicoles — plants that usually grow on soil containing lime or other calcium compounds.

If the calcicoles had behaved in the same way as the rest of the native species, the researchers would have expected 25 species to be reduced. In fact, said Dr Tregenza, sixty species show reductions. *"This is statistically significant, at a probability of less than 1 in 1000."*

The researchers tested various hypotheses to explain the disappearance of so many calcicoles. They checked the possibility of a decline in agricultural liming, but found that species in wild habitats, unlikely to be affected by agricultural liming, also showed a statistically significant decline. They checked four different hypotheses for systematic error among the botanists, and seven for actual changes in the environment of Cornwall, but with no results.

They then looked at acidophilous (i.e. acid-loving) species. Of the 21 that they would have expected to be reduced, only 12 show reductions, and in addition to this, a number of acidophilous species had spread rapidly in Cornwall. They also found that the genus *Allium* (leek family), which contains exceptionally high concentrations of sulphur, showed increases in occurrence for 3 out of six species. A seventh species, *Allium triquetum*, showed *"an astonishing spread since it was first recorded in Cornwall in 1872."*

After detailed research and analysis, the researchers were driven to these conclusions:

Acid deposition from the atmosphere is causing a progressive acidification of the soil in Cornwall. This

- applies to all soils except those that are naturally rich in lime or have had lime added.
- has been progressing for many decades or longer.
- will continue to progress unless substantial declines of sulphur emissions occur in Britain and Northern Europe.
- had already caused the extinction of some plants in Cornwall and is likely to cause further extinctions.
- is causing reductions in some common flowering plants of hedges, cliffs, heaths, etc.

Acid deposition is also

- causing a progressive increase in sulphate content of soils in Cornwall and thereby favouring the spread of some alien species at the expense of native species.
- adding very small quantities of nitrate to soils in Cornwall with consequent damages in the flora of sand dunes and walls.
- probably contributing to the weak state of wild otter populations by damaging river ecosystems.

Put briefly:

Acid rain is upsetting the balance of nature in Cornwall much more than was previously known. If it continues it will probably damage more and more of Cornwall's wildlife.

Steve Elsworth

The address of CTNC is: CTNC, Trendine Zennor, St Ives, Cornwall, UK.

The survey report was on sale at the conference for one pound, but that would not include the cost of postage.

Streams becoming more acid

Hydrologists are warning that streams in the uplands of Britain are on course to become increasingly acid — despite recent reductions in acid emissions from factories and power stations.

Colin Neal and colleagues from the Institute of Hydrology say that a reduction of 50 per cent in current industrial emissions is necessary to prevent further increases in the acidity of streams in the southern uplands of Scotland, and probably elsewhere.

Their findings, due to be published in the *Journal of Hydrology* later this year, use data from Scotland plugged into the MAGIC model, a mathematical simulation of acid effects developed by British scientists from many government and university laboratories. MAGIC stands for Model of Acidification of Groundwater in Catchments. The warning is a sharp rebuff to the tentative conclusions of a government review group, which reported earlier this month that there was no evidence for widespread acidification in Britain.

Many of Britain's uplands are sensitive to acid rain, says Neal. And acidification of streams "with concomitant loss of fisheries is being observed probably on a large scale throughout the British uplands." Fish have disappeared in recent decades from streams and lakes in Scotland, Wales and upland areas of England such as the Lake District.

British scientists now accept the MAGIC model as the best method of predicting the likely consequences of changes in the acidity of rainfall. It has been used successfully to predict the past levels of acidity in Scottish lochs, as revealed in analysis of sediments.

The model attempts to quantify the role of soil chemistry, acid

rain and the weathering of neutralizing material from rocks in the long-term acidity of streams and lakes. It is now a central pillar of the five-year Surface Water Acidification Programme being organized by the Royal Society and the Norwegian and Swedish academies of science. Neal's study is the first to make use of MAGIC's predictive powers.

Neal's team has used the model to predict the future for a stretch of moorland in Galloway in southwest Scotland. The streams here have become steadily more acid since 1900, with a marked worsening between 1950 and 1970 as the rain became more acid.

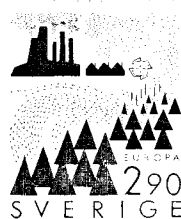
The model predicts that if deposition of acid remains at around 1984 levels (which is roughly what government projections show), average stream acidity will continue to worsen. The prediction is in line with recent work in Norway which warns that "it is reasonable to believe that the soils may become still more acidic at the present level of deposition."

Neal's team warns that, while acid rain is usually the main cause of acidifying streams, it is not the only one. The widespread planting of conifer forests in Scotland and Wales is also partly to blame in some places. Conifer forests filter pollutants from the air, especially from clouds and mists, and transfer the acid to the soil. Improved drainage in forest soils may also speed the transfer of acid water through soils to rivers, so reducing the chances of the soil neutralizing the acidity. Neal warns that plans to massively increase the amount of forest in upland Britain in coming decades could do serious damage to streams.

The report on *Acidity in United Kingdom Fresh Waters*, published at the beginning of this month by a review group of British scientists at the request of the Department of the Environment says there is "no evidence of widespread acidification of UK freshwaters generally." But it agrees that large parts of upland Britain are susceptible to acidification. The problem, says Alan Gee, from the Welsh Water Authority and a member of the review group, is that "the historical data is dreadful. Most routinely collected data is not useful because it is collected in lowland reaches of rivers, rather than head waters." There is also little data from before 1970, when rain stopped becoming more acid.

Also, the review group took a very rigorous view of the quality of data that it would accept. For instance, long-term data on the River Wye, which has become acid in recent years, was rejected because of a two-year gap in the data. "We hope that the report will stimulate people to come forward with data," says Gee.

New Scientist 15 May 1986



New source of acid rain

European environmental groups have condemned the British government's decision to bring on stream yet another major power station without pollution control equipment. Drax B, the final plant in Europe's largest coal-fired power station concentration, was connected into the National Grid at its site in North Yorkshire on May 24.

Drax B will produce 150,000 tons of sulphur dioxide (SO₂) annually; that will be more than the total annual emissions from Norway. Together with Ferrybridge, Drax A and Eggborough, the new station contributes emissions from a 20 km square area that are greater than the combined output from Ireland, Portugal, Norway, and Switzerland.

Adam Markham, Pollution Campaigner for Friends of the

Earth, speaking on June 3: *"The government is showing incredible insensitivity to international pressure in allowing Drax B to open without pollution control equipment. Only last week, the government stated in response to the World Conservation Strategy that it fully recognized international concern over the environmental effects of sulphur dioxide and nitrogen oxides. If the recognition is there, then why is there no action to reduce pollution?"*

The power stations of the Aire valley will produce 800,000 tons of SO₂ and NO_x during the next twelve months. Most of the fuel burnt at Drax B will be from the Selby coalfield, which has a higher sulphur content than nearly all other West European coals, including those from South Wales and Scotland.

The government, despite claims that it is doing all it can to reduce sulphur pollution, has allowed the average sulphur content of coals used in UK power stations to creep up from 1.4 to 1.6 per cent over the last few years.

Adam Markham, also said: *"The British government is acting with staggering hypocrisy in its dealings with other states on the issue of transboundary air pollution. Whereas on the one hand assurances come thick and fast from the Department of the Environment that substantial measures are being taken to reduce emissions, on the other the Central Electricity Generating Board is ignoring all calls to clean up its act."*

SWAP STUDY

Gag on reports protested

British scientists are being accused of trying to stifle the first results of a three-nation study as to whether acid rain is killing Scandinavian fish. They have refused to allow the production of annual reports on the work, which is already a year behind schedule and will not yield final results until 1990.

The five-year study, the Surface Water Acidification Project (SWAP), was announced at the Royal Society in London in 1983. It is costing 5 million pounds and is being financed jointly by the Central Electricity Generating Board and the National Coal Board. It involves scientists in Britain, Norway and Sweden.

Late last year, Britain's Prime Minister, Margaret Thatcher, angered her Norwegian counterpart, Kåre Willock, by saying that Britain would not act to reduce sulphur pollution from its power stations. She said she would wait until the SWAP programme had established whether the resulting acid rain is responsible for the

deaths of fish in thousands of lakes and rivers in southern Scandinavia. Britain is responsible for 17 per cent of the acid rain that falls on Norway, more than that from any other country, including Norway itself.

Early results from the project appear to underline the role of modern air pollution in making lakes acid. Rick Battarbee at Imperial College, London, has demonstrated from studies of organisms in the sediments of acid lakes, that the acidification has occurred in recent decades. And a large experiment in Norway, in which rain is collected and cleaned of modern pollutants before being sprayed onto soils, has already shown that the water percolating into streams becomes less acid.

So Scandinavian members of the project's management committee, which met last month, were angry that the five British scientists on the committee used their majority to reverse a previous decision to publish annual

reports on the progress of the project. Lars Walløe, professor of physiology at the University of Oslo and a member of the management committee, says: *"The formal reason for the decision was that there is too much work involved in collating the results. But the effect is that the new results will not receive the attention they deserve."*

The scientists engaged in the project are free to publish their findings in scientific journals. But their work will not now have the SWAP "seal of approval" until 1990.

There is little chance that the committee will change its mind. Regular quarterly meetings have now been abandoned. The next meeting of the management committee will not be until June 1987. And, according to Walløe, there may not be another until the presentation of results in March 1990.

Fred Pearce

New environmental group

A new Irish environmental organization, EARTHWATCH, was launched in Dublin on April 22.

The two immediate aims of Earthwatch will be to seek the closure of the Sellafield nuclear reprocessing plant and the fitting of emission controls at Moneypoint and other Irish power stations to prevent the spread of acid rain. Earthwatch will also campaign on other environmental issues besides pollution, such as renewable energy, waste recycling, wildlife, and the dangers of nuclear proliferation.

According to Mary O'Donnell, Earthwatch director and speaker for the organization: "There is a crying need for an effective environmental pressure group to counter the steady deterioration of the Irish environment. Ireland's record on environmental issues in recent years has been pitiful. We have dragged our feet over Sellafield, we have resisted international efforts to curb acid rain, and in a recent survey of environmental awareness in EEC countries, Ireland came bottom of the list.

"Earthwatch intends to change that situation before things get any worse. Our campaigns will combine accurate information with effective action."

Earthwatch will incorporate the Cork-based environmental organization HOPE (Help Organize

Peaceful Energy), which succeeded in persuading the government to oppose nuclear waste dumping in the Atlantic in 1983, and has since played a leading role in the Irish campaign to close Sellafield. Earthwatch is an associate member of Friends of the Earth (FoE) International, and will cooperate closely with FoE, Greenpeace, and other organizations in international campaigns.

Slams government on acid rain

In April Earthwatch wrote to the Minister for the Environment John Boland, TD, warning of the threat of acid rain from Moneypoint and other power stations and urging him to revise government policy on emission controls at ESB power plants.

In a hard-hitting briefing document prepared for the Minister, Earthwatch accuses the government of "penny-pinching parochialism" in its failure to pay more than lip-service to crucial European initiatives for preventing the spread of acid rain. According to Earthwatch, the government has "consolidated Ireland's reputation as the 'poor mouth' of Europe by failing to take even one step in the direction of applying emission controls to the largest source of acid pollution within our shores — the ESB power stations."

Earthwatch maintains that the government's failure to insist on emission controls at Moneypoint shows "great insensitivity to the plight of those European countries downwind of Ireland which are currently afflicted by widespread acid rain damage, as well as an extreme lack of foresight as regards the possible effects on Ireland in the future."

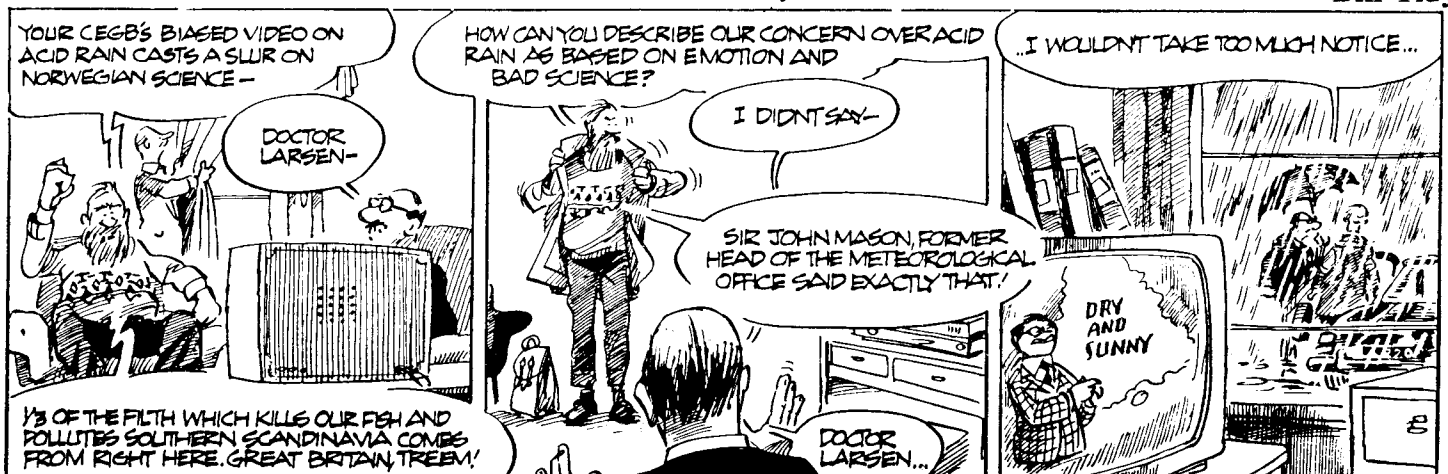
Regarding these effects, Earthwatch argues that as far as acid rain is concerned, "the siting of Moneypoint on the west coast would be unproblematic if proper emission controls were incorporated, but in the circumstances it must be regarded with grave concern." The Earthwatch document refers to agricultural and forestry losses, health damage, loss of tourist revenue, and increased corrosion of building and other materials, arguing that the costs of this damage in economic terms alone could well be greater than the costs of *not* applying emission controls.

Further information can be obtained from:

Earthwatch
Harbour View
Bantry, Co. Cork
Ireland
Telephone: 027 50968

GRIMBLETON DOWN New Scientist 6 February 1986

Bill Tidy



Taking things seriously

The last year or so has seen the gradual introduction of unleaded petrol and more environmentally attuned cars in the Federal Republic. At the end of 1985 more than 5,000 filling stations, spread all over the country, were selling lead-free petrol, and to encourage motorists to buy it the tax has been reduced so as to make it cheaper than the leaded sort. Moreover during this time a good half-million cars classified as "schadstoffarm" have appeared on the roads. This means they emit markedly less pollutants than ordinary vehicles.

As from last January the tax on unleaded petrol has been still further reduced, while that on new cars that do not meet the more stringent American emission requirements has been raised. These measures will almost certainly boost sales of cleaner vehicles. The German manufacturers expect half of the cars sold this year to be of the improved type, and that next year they will amount to 75 per cent of the total sales.

A step has also been taken towards bringing about a reduction of emissions from heavy road vehicles (meaning trucks and buses). The makers have agreed voluntarily to make arrangements for reducing the amounts of nitrogen oxides coming from such types by 20 per cent in relation to the January 1986 levels.

Improvement gives work

At the same time both power plants and industrial installations are being converted so as to reduce the emission of pollutants in accordance with previously adopted regulations. This is the result on the one hand of the "Grossfeuerungsanlagen-Verordnung" of 1983 (control of emissions from large combustors, which means some 1500 plants with a capacity of more than 50 MW) and on the other the new "TA Luft" rules which were applicable from March 1 and concern practically all sizes and kinds of plant.

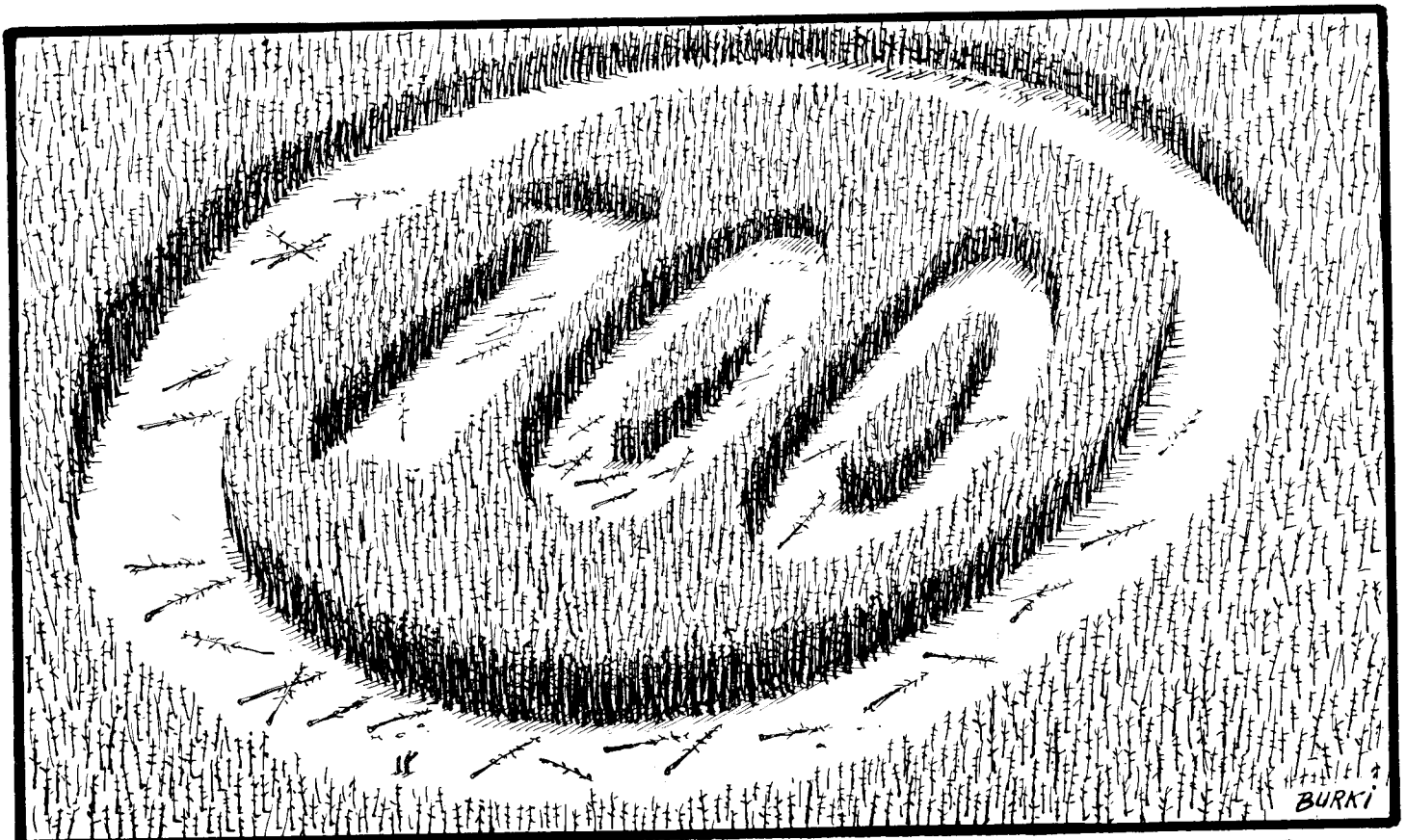
Taken together these measures will require capital investments

of about 50 billion deutschmarks, and give rise to some 400,000 employment opportunities. They will mean that the most up-to-date technology for protecting the environment can be applied without delay, as well as contributing to a general modernization of the country's industrial plant.

The total effect of the measure will be to reduce emissions of sulphur dioxide by 60 per cent compared with 1982, or from 3 to 1.1 million tons, and nitrogen oxides by almost half, from 3.1 million tons to 1.6 million. The emissions of hydrocarbons and heavy metals will also lessen.

Not always so easy

Perhaps the most heated controversy in 1985 arose over the proposal for introducing speed limits on the autobahns. Several studies made the year before had shown that pollutant emissions from motor vehicles increased in proportion to speed. It was calculated that in Germany a lowering of the limit to 100 kilometres per hour on the motorways, and ►



Limitation à 100 km/h.

Drawing: Burki, © 24 Heures

►from the present 100 to 80 kilometres per hour on other non-urban roads, would immediately result in reductions of up to 300,000 tons of nitrogen oxides a year. With this in view, all the environmentalist groups in West Germany put forward a demand for the immediate application of these limits, under the slogan "Tempo 100/80".

The idea met with strong opposition from the automobile industry as well as from great numbers of motorists. The latter regarded limits on speed as an encroachment on personal freedom, and set going a manifestation under the banner of "Freie Fahrt für freie Bürger" or "no limits on free citizens." The car makers, with their great influence in West Germany, claimed that their exports of powerful, fast, expensive cars would be threatened if speed limits were introduced.

Hard pressed, the government reacted in the autumn of 1984 by

launching a research project to determine the possible environmental effects of applying speed limits — although only on the autobahns. During nine months traffic volumes, speeds, etc., were recorded on about twenty test stretches where there were temporary speed limits. The project, called "Grossversuch Tempolimit 100," was to cost 14 million marks. The initial results were made public in November 1985, to the accompaniment of a government declaration that they did not indicate any need for speed limits on the motorways.

Challenged

According to the investigation, a speed limit of 100 kilometres per hour would result in a reduction of "no more" than 30,000 tons of nitrogen oxides a year, as compared with an expected reduction of at least 75,000 tons. (The total emissions in West Germany amount to 3.1 million tons, of which 1.7 million come from

motor vehicles and 300-400,000 tons from traffic on the autobahns alone.) One reason for the recorded reductions being smaller than expected was that only 30 per cent of the drivers kept within the speed limit on the test stretches — a remarkably low figure. Normally at least half of the motorists respect the limits, and in Bavaria figures of 63 to 75 per cent have been recorded.

The report was strongly criticized, not least by the environmentalists. A paper entitled "Tempolimit, Grossversuch und Abgasprognose der TÜV," written by the Institut für Energie- und Umweltforschung, reveals its many failings. The Institut concludes that the Tempo 100/80 limits would give a reduction of the emissions of nitrogen oxides by something between 170,000 and 210,000 tons.

West German environmentalists are now united in a strong drive for the introduction of Tempolimit 100/80 without delay.

Christer Ågren

USA

Bills for acid rain control

More than 150 members of the House of Representatives have joined in a nonpartisan coalition to co-sponsor a new acid-rain control bill, introduced on April 10.

The bill calls for a reduction in sulphur-dioxide emissions by 10 million tons in the next 11 years — 5 million tons by 1993 and 5 million more by 1997. Nitrogen oxides would be reduced by four million tons by 1997, and 90 per cent of the sulphur emitted by vehicles using diesel fuel would be eliminated.

Governors of each of the fifty states are free to decide how to meet the new standards, as no particular method of reduction is required by the proposal.

The cost of the measure is uncertain; however it is stipulated that the monthly electric bills for utility customers in the polluting

areas shall not increase by more than 10 per cent. Any costs for reducing pollution over and above that would be paid out of a new Federal trust fund, created by raising electricity charges throughout the country.

The measure, according to one speaking for Representative Sikorski, a chief sponsor, fused previous approaches to produce a bill that is flexible and cost-effective, that protects consumer electricity rates and coalmining jobs.

On the Senate side, Senator Robert Stafford has proposed a comprehensive acid-rain control bill based on performance standards rather than targeted tonnage reductions. The bill is called "The New Clean Air Act," and was introduced in March.

If this bill is enacted, each fossil-fuel-fired power plant would be allowed 3,000 hours of opera-

tion unless it emitted 1.5 pounds of sulphur dioxide per million Btu or less, in which case it would be allowed a maximum of 10,000 hours. Operation would not be limited for a source which emitted 0.7 pounds or less.

Stationary sources of nitrogen oxides must reduce emissions to the level obtainable with the best existing technology that has been demonstrated in any OECD country.

Mobile sources of nitrogen oxides, particulates, and hydrocarbons would be subject to exhaust-emission standards much more stringent than those currently in force in the US. Passenger cars and light-duty trucks would have to meet standards equivalent to the 1986 average certification level of the 25 per cent cleanest vehicles. Regulations are also provided for heavy-duty vehicles.

Cost-benefits of reductions

Abatement of acidification, including the concomitant problem of photochemical air pollution, can only be achieved by far-reaching measures, especially in the fields of energy supplies and traffic. The cost of such measures is considerable, although there are compensations due to avoided damage. To some extent the benefits can even be expressed in monetary terms.

Abatement is necessary

If abatement were omitted, it would not imply the avoidance of costs: the extensive and partly irreversible damage by acidification makes all European countries poorer and some remedial actions will need to be taken anyhow.

Because the cost of measures might still be regarded as an impediment to abatement, it may be useful to estimate to what level these costs may amount, and to what extent they can be set off against monetary benefits.

It should be made clear in advance that the question of whether abatement is necessary does not depend on the results of such a cost-benefit analysis. The first argument for this statement is somewhat philosophical: man should behave as a guest in his own environment; in other words: we have a duty to ensure that we pass on our environment to future generations in a sound state. In view of the serious effects of acidification, some of which are irreversible, the problem has to be tackled as thoroughly as possible. Other arguments which are also relevant include a number of principles of international environmental law. The 1972 UN conference in Stockholm formulated the principle that countries may not cause damage to the environment of other countries. Another principle, developed within the OECD, which is of equal relevance, is that the polluter pays. In view of the mutual influence of European countries each of them has the duty to reduce emissions to the level at which damage is no

longer inflicted on any other country. It is no longer a question of whether abatement measures must be taken, but which they shall be.

Cost-benefit analysis

A full-scale cost-benefit analysis can be subdivided into the numerous interconnected problems. On the one hand there are developments on the polluters' side. What are the expectations with regard to economic growth, technologies, energy savings, and supplies? What abatement programmes are conceivable? What are the costs and indirect effects, for example on employment? On the other hand the effect of abatement programs on acidification has to be ascertained. Where does the pollution go to? What damage is done? How do different types of pollution interact? What is the implication of abatement measures for the exposure of people, materials, vegetation, soil and water, etc.? To what extent will this result in less damage in the short and long term; or, in other words, what are the benefits?

For sulphur compounds a fairly advanced stage has been reached in indicating the links between the different aspects, but for other major substances this is much less so. It has only recently been realized that ozone (from nitrogen oxides and hydrocarbons) may be a major determinant in forest decline and other types of vegetation damage throughout Europe. For example, in the Netherlands damage to agricultural products due to ozone is estimated to be 120 million dollars per year; from studies in California it can be deduced that damage to grapes might be important in Europe too. Also the ambiguous role of ammonia is slowly becoming clear. Ammonium compounds can be converted into nitrates in the soil, especially if there is increased deposition. Thus rain which in itself is not acid may have a highly acidifying effect!

As yet, it is not known with

certainty how far emissions should be brought down to stop acidification. For Western Europe reductions by at least 70 per cent for SO₂ and by 35 per cent for NO_x may be necessary. Additionally, in areas where there is a lot of intensive animal husbandry, a reduction in NH₃ emissions is also needed (50 per cent for the Netherlands). The best approach for ozone cannot be indicated at present. Since acidification is an issue which transcends frontiers, cost-benefit analyses will have to be placed in a European context. At the moment analyses are being carried out within ECE and OECD for SO₂ and NO_x and for photochemical air pollution respectively. However, due to the fuzzy state of existing scientific information and because of intrinsic difficulties in assigning costs and benefits, these analyses will not give any definite answers. The value of cost-benefit analysis of acidification abatement resides more in its potential contributions to clearer statements of the problem than in its provision of accounts for social and ecological bookkeeping.

For the moment it may be acceptable to take the results of already existing though less comprehensive studies as guidance.

Cost-benefit studies

In the late seventies, the OECD made projections for SO₂ abatement in twelve Western European countries for the period 1975-1985. The cost of converting an anticipated rise of 25 per cent into a drop of 35 per cent compared with 1974 levels would ultimately be 12 dollars per person per year. Set against this there would be benefits of 8-70 dollars per year as a result of less damage to materials, agricultural products and health. No account was taken of such factors as longer life or reduced damage to buildings, monuments and archives. This study showed the importance of concerted action: countries would then get mutual benefit in addition to the benefits from their own measures. ►

Chernobyl and acid rain

What does the Chernobyl nuclear disaster have in common with acid rain? Answer: Both involve long-range transboundary air pollution; both seem to damage plants, animals, and human health; both come within the stated terms of the UN ECE Convention on Long Range Transboundary Air Pollution; both give rise to questions regarding an emitting country's liability for damages in other countries; and, of course, both derive primarily from the production of electricity to fuel industrial economies.

Coincidentally, Sweden and Poland — two of the major victim countries of wind borne radioactive fallout from the Chernobyl accident — are also two of the relatively few countries in Europe which receive more acid rain from other countries than they send to other countries. (Sweden imports about three times more than it exports; Poland imports about 15 per cent more than it exports.)

Undoubtedly, Soviet authorities will contend that windborne radioactive fallout is distinguishable from conventional air pollutants, such as sulphur and nitrogen oxides, and that it is only these conventional pollutants that the ECE Convention seeks to control when such substances cross national borders. However, Article 1 of the ECE Convention defines air pollution as the "introduction by man, directly or indirectly, of *substances or energy into the air* resulting in deleterious effects of such a nature as to endanger human health, harm living sources and ecosystems and material property, and im-

pair or interfere with amenities and other legitimate uses of the environment..." (emphasis added). It seems hard to construe this language in such a way as *not* to include windborne radioactive fallout.

Of course the Soviet Union will not accept liability and pay reparations to other countries or to injured foreign nationals unless it chooses to do so. Thus far, the Soviet Union has offered only a mere 200 rubles (280 dollars) as compensation to each of its *own* most seriously affected citizens. It would presumably accept liability only if a binding treaty governed the case, and international law experts seem to agree that no treaty governs the effects of accidents like the Chernobyl disaster. (The ECE Transboundary Air Pollution Convention, which evolved from a 1975 Soviet initiative, scrupulously avoids all questions of liability and compensation.)

There is, however, the general principle of international law, given renewed articulation in Principle 21 of the Stockholm Declaration of 1972, that states have the responsibility of ensuring that activities within their jurisdiction or control do not damage the environment of other states. And a legal principle seems to be developing which makes nations liable to each other for extremely hazardous activities. For example, when a Soviet Cosmos satellite crashed in northwestern Canada in 1978, Canadian officials asked Soviet authorities for 6 million dollars in clean-up costs. Although a 1972 treaty governed that situation,

Canada also based its claim for compensation on a principle of international liability for activities that carry "a high degree of risk." In 1980, the Soviet Union paid Canada 3 million dollars to settle this claim.

Since the Soviet Union has accepted only selective jurisdiction of the World Court, any Chernobyl-related claims would presumably be made through diplomatic channels — not unlike negotiations between Norway or Sweden and the United Kingdom on the issue of acid-rain abatement. Another possible route would be international arbitration. In the 1930s, Canada and the United States submitted to an international arbitration panel a dispute in which certain US citizens sought compensation for damage to their fields and orchards caused by windborne fumes from a Canadian smelter at Trail, British Columbia (the *Trail Smelter Case*). The panel found Canada strictly liable, without proof of negligence. It ordered Canada to pay for the damage and to stop the pollution.

If there were sufficient clamour for compensation from the many nations victimized by Chernobyl, the Soviet Union might find it expedient to submit the entire matter to an impartial *ad hoc* panel, and to abide by that panel's conclusions regarding liability and compensation. Such a development might well establish precedents that could govern other kinds of transboundary environmental damage, such as acid deposition.

Armin Rosencranz

► In a study for the Commission of the European Community (1983) the costs of control in the Community were compared with the economic benefits. It was estimated that an SO₂ restriction of 56-67 per cent between 1980 and 2000 for the EEC countries would cost 16-23 dollars per person per year in 2000. The benefits to these countries would be 10-50 per cent of the total. In this study damage to forests and aquatic

ecosystems as well as the effects on health were regarded as being of little or no importance.

For the Netherlands, it has recently been calculated that the cost of combatting acidification in 2000 will be about 20 dollars per person (for a 50 per cent reduction in NH₃, 30 per cent in NO_x and 55 per cent in SO₂). The benefits can be estimated at 15-40 dollars.

The cost of not abating acidifica-

tion is high. On the basis of general principles countries are in any case obliged to combat acidification, and by taking concerted action they would benefit mutually. The cost of abatement is not exorbitantly high: it may run to several tens of dollars per person per year around 2000. In addition to numerous intangible benefits, there are monetary benefits from abatement.

Jacob Swager *Naturopa*, No. 51, 1985

Acid Rain Week, April 1986

The third International Acid Rain Week, April 19 - 27, saw events taking place in at least ten European countries. Since the activities were very numerous and mostly of a strictly local nature, only the largest and most outstanding ones can be described here.

Friends of the Earth Holland started early, on April 14, by climbing onto the roof of the Shell head office in The Hague, and hanging large streamers over the facade in protest against the company's emissions of sulphur dioxide. Shell is the biggest sinner in this respect in the Netherlands.

Protests in the form of mass send-ups of balloons were made not only in Holland but also in Belgium, Britain, the Federal Republic of Germany, Denmark, and Sweden. All the balloons, large and small, bore the device Stop Acid Rain, and some carried messages to finders.

There was a scientific seminar, arranged by Friends of the Earth, in England, at which papers were read by experts from Sweden, Norway, West Germany, and Holland, as well as from the United Kingdom. Afterwards the participants were taken to study damage in the New Forest, near Southampton, in company with representatives of the media and of environmentalist organizations.

In Italy the International Acid Rain Week marked the start of a campaign that will continue throughout the summer, the plans for which were presented by the environmental organization, Lega Ambiente, at a press conference.

At Gothenburg, the important port on the west coast of Sweden, a big, badly damaged spruce was set up in a square in the centre of the city. Both in Gothenburg and Stockholm tours of damaged buildings and monuments were arranged to show the public the effects of air pollution. Mock warning signs were put up along the roads all over the country by youth environmentalists, urging motorists to

have consideration for the forests by driving more slowly and thus reducing exhaust emissions. As culmination for the Acid Rain Week in Gothenburg, a Family Day was organized in the big city park, with various attractions and informative activities such as trips to see forest damage. There was also an exhibit showing the effects of acidification.

In Ireland simultaneous demonstrations were arranged in six of the larger towns to protest against the decision of the state Electricity Supply Board to start up another large coal-fired power plant without proper equipment for cleaning the flue gases from sulphur.

City alerts, of the same kind as those in the Netherlands, were organized in Belgium to show people the effects of atmospheric pollution on the urban environment.

In the Netherlands acid rain groups were able to get support from local and national authorities as well as from public transport companies. The week started with an Acid Rain Train from Amsterdam to Nijmegen, in the east. The Dutch Railways offered this train to the acid rain movement at greatly reduced cost. The passengers included environmentalists, government representatives (including the Minister of Environment, Mr Winsemius), representatives from industry and scientists. At the end of the tour the group traversed the city of Nijmegen where they were shown the damage caused to buildings by acid rain. Also at twelve railway stations large rallies took place informing the traveller of the importance of public transport in relation to air pollution. These activities went on for the whole week in all these places.

The Dutch environmental movement brought thousands of people into the forests and cities to actually see the damage caused by acid rain. These actions, called "forest-alert" and "city-alert", were a follow-up of the large scale forest-alert action

organized during Acid Rain Week last year.

Tuesday the 22nd was Public Transport Day in the Netherlands. In many cities the local authorities were given a list of demands while several publicity actions were organized to attract the attention of the media. In Amsterdam public transport authorities offered specially reduced rates during Acid Rain Week and an "acid rain" tram with information drove through Amsterdam.

Wednesday the 23rd was "Industry Day" with actions organized at several outstanding industrial sources of air pollution. Shell was again one of the targets, and actions were aimed at a chemical plant and a smelter. The employers' organization had warned their members about these actions, knowing that groups tend to climb smokestacks these days, so these installations were heavily guarded!

The same day four large-scale balloon demonstrations were organized, one in the centre of Amsterdam, one in Groningen, one in the southeastern Netherlands and one in the south, near one of the country's largest chemical plants. These balloon actions comprised rallies with music, lectures, theatre, and information on acid rain. At most of them contests for children were organized, and in one case, the winner went up in a hot-air balloon! A representative of the Ministry of Environment also ascended in one of the balloons with a radio reporter for a live broadcast on the Dutch radio. This balloon passed over the most damaged areas of forest and wild country in the Netherlands.

The last action day concentrated on agriculture. On account of enormous overproduction in the Netherlands, manure causes a problem closely related with acid rain: emissions of ammonia. The role of this component and possible solutions to the problem were discussed during a large symposium that was held in South Holland.

Conferences

The Nordic Council's International Conference on Air Pollution, 8-10 September 1986.

Hitherto exchanges of views on the subject of air pollution have mostly taken place between officials and governments. Now the Nordic Council has called a conference of members of the parliaments of all the countries of Europe north of the Alps and the Pyrenees.

Also invited to attend are representatives of international bodies, such as the European parliament and community, that are all in some way involved in the matter.

The aim is to increase awareness of the problems of transboundary air pollution among parliamentarians, and try to reach some degree of consensus on the measures needed for dealing with these problems.

The Scandinavian environmental groups have been invited to send observers. Funds are also being sought for a parallel conference of NGO representatives from just about all the countries that have been invited to the official one. This would also be for coordinating aims and activities, but on the NGO level.

Air Pollution and Conservation — Safeguarding Our Architectural Heritage, October 15-17, Rome, Italy.

A symposium on the threat of air pollution to our cultural heritage. It will deal primarily with the interaction between air pollutants and facade materials, mainly natural stone, concrete and cement, ceramics and stained glass. The symposium is organized by the Swedish Institute in Rome.

UN ECE Executive Body of the Convention on Long-Range Transboundary Air Pollution, 4th session. November 10-14, Geneva, Switzerland.

Literature

Stop acid rain (1986)

26 pages A4. Report from the Norwegian Stop Acid Rain Campaign. Available in Norwegian and English. Describes the current situation in Norway and Europe; also gives a historic view of the acid rain problem and a description of international policy development. Free of charge from The Stop Acid Rain Campaign Norway, Skogselskapet, Wergelandsvn. 23 B, N-0167 Oslo 1, Norway.

Lake Gårdsjön: An acid forest lake and its catchment (1986)

Ecological Bulletins 37, edited by F Andersson and B Olsson. 336 pages. Price 44 US dollars. Available from the Publishing House of the Swedish Research Council, Box 6710, S-113 85 Stockholm, Sweden.

Symposium on the effects of air pollution on forest and water ecosystems (1985)

143 pages. Papers from a symposium held in Helsinki April 23-24, 1985. Available from The Foundation for Research of Natural Resources in Finland, Salomonkatu 17 A, SF-00100 Helsinki, Finland.

Luftforurening med kvaeststof-oxider i Danmark (1985)

Miljöprojekt No. 62. 164 pages A4. Description of the nitrogen-oxide situation in Denmark — emissions, concentrations, and effects. In Danish. Price 100 Danish kroner, from Miljøstyrelsen, Strandgade 29, DK-1401 København K, Denmark.

Om träd kunde gråta (1986)

280 pages. A book by the environmental journalist Bo Landin. Published by Prisma Förlag. Available from SNF, Box 6400, S-113 82 Stockholm, Sweden. Price 97 Swedish kronor.

Die Sache mit dem Wald (1986)

Edited by Franz Bauer. 396 pages A4. Price 57 D-marks. Published by BLV Verlagsgesellschaft mbH, Lothstrasse 29, D-8000 München 40, FRG. The book gives a thorough description of the damage to forest ecosystems, and is richly illustrated with 363 colour and 124 black-and-white photos, as well as maps and diagrams.

Waldschäden durch Radioaktivität (1985)

By G Reichelt and R Kollert. 22 pages. Available from Verlagsgesellschaft BUND mbH, Erbprinzenstrasse 18, D-7800 Freiburg, FRG. Price 16.80 D-marks.

Saure Wasserwelt (1985)

154 pages. Published by ÖKO-Institut and Institut für Umwelt-Analyse. Discusses the impact of acid deposition on soil, groundwater, freshwater ecosystems, and drinking water supplies. Available from ÖKO-Institut, Hindenburgstrasse 20, D-7800 Freiburg, FRG.

Zure regen — zelf schade herkennen in de stad (1986)

37-page booklet on the effects of air pollution on buildings and monuments, with a 22-page supplement and an excursion manual for Amsterdam. In Dutch. Published by WISE Amsterdam, Box 5627, NL-1007 AP Amsterdam, Netherlands.

Mutagenic and carcinogenic compounds from energy generation (1986)

82-page report by I Alfheim and T Ramdahl. Published by the Nordic Council of Ministers, Postboks 6753, St. Olavs Plass, N-130 Oslo 1, Norway.

The relative contribution of air pollutants from various sources to man and the environment (1986)

102-page report by the Norwegian Institute for Air Research, and published by the Nordic Council of Ministers (address above).

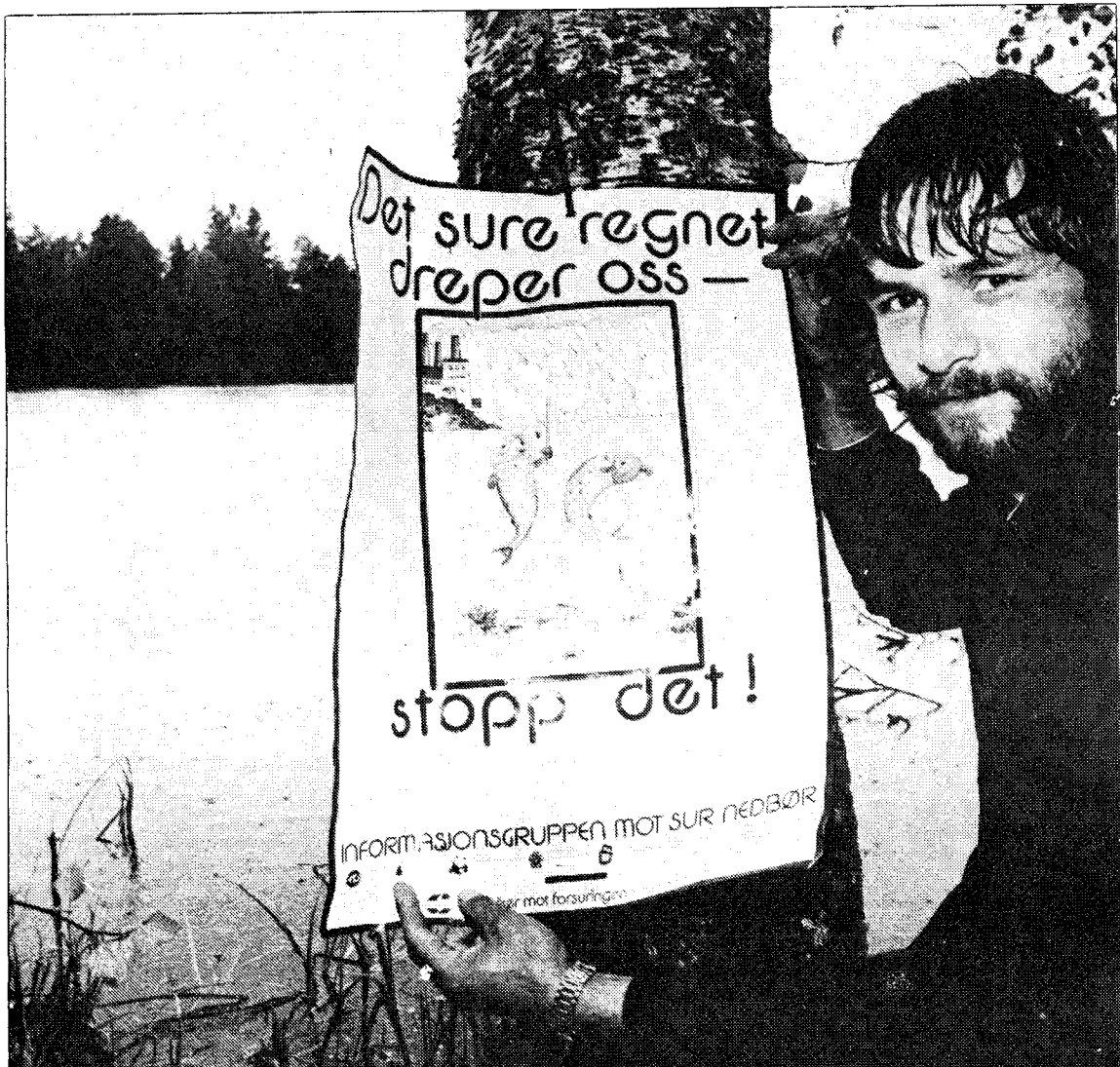
Försurningens inverkan på metallupptagning i växter och djur (1986)

40-page report in Swedish on the way acidification affects the uptake of metals in plants and animals, by G Tyler, et al. Published by the Nordic Council of Ministers (address above).

Miljökonsekvenser av energiformer baserade på förnybara energikällor (1986)

264-page report in Swedish discussing the impact on the environment of various renewable sources of energy, by I Stjernqvist. Published by the Nordic Council of Ministers (address above).

Almost as sour as vinegar



Biologist Stig Olsen in front of the most acidified lake in Norway.

The most acidified lake in Norway is Bukketjenna, a tarn near Grimstad in the southwest. So it appears from a search instituted by the Stop Acid Rain Campaign Norway this last spring. It not only showed that there were extremely acid lakes all over South Norway, but that the phenomenon is already beginning to appear further north.

This was all the result of a kind of competition to find the sourest lake, in which school children, anglers' associations, and individuals, as well as environmentalist organizations and

even public institutions were all engaged. The water of Bukketjenn was found to have a pH value of 3.85 — making it almost as sour as vinegar. At such a level the fish have long since disappeared, and only a few species of insects, plankton, and plants survive. Several of the lakes in the vicinity were almost as acid, with pHs of 4.0-4.2.

Previously the acidification of lakes and streams, and consequent loss of fish, had always been associated with southern and western Norway, where an area of about 35,000 square kilo-

metres is so seriously affected that most of the original stocks of fish have already gone. The trouble is however now spreading eastwards and northwards to still further parts of the country.

Note. Normally the pH of the water in lakes and streams is 6 to 7. The most sensitive animal and plant species begin to be affected if it drops below 6. As the water becomes more acid, the fish gradually disappear, and have usually vanished when the pH gets down to 4.5.

It should be noted that the pH scale is logarithmic, so that a fall of one unit, for example from 7 to 6, means that the water has become ten times more acid, and a fall of two that it is a hundred times more so.