US-Canada dispute

Acid rain settlement in sight?

Washington

THE seven-month deadlock between the United States and Canada over acid rain pollution may be breaking. Secretary of State George P. Shultz discussed the issue with Canadian foreign minister Allan MacEachen on 25 October; summary papers are now being exchanged between them. And representatives of both sides, whose last meeting ended stormily in June, plan to resume discussions in February.

One US official said he was "cautiously optimistic" that the deadlock could be broken "now that the two sides' foreign ministers have involved themselves personally" in the issue. The Canadian government, for its part, has modified the somewhat belligerent tone of its statements on the US position.

After taking office in 1981, the Reagan Administration rejected a Canadian call to reduce US sulphur dioxide emissions by 50 per cent a year, which, according to OTA, would cost as much as \$2,700 million per year and raise electricity rates for US consumers in the Eastern United States.

When, last fall, the National Academy of Sciences study essentially confirmed the Canadian view that the evidence of cause and effect was "overwhelming", the White House Office of Science and Technology Policy declared that the academy was not sufficiently unbiased to serve as a review group to the technical work of the joint working groups. It gave the job of peer review to a special group under the Office of Science and Technology Policy and headed by William Nirenberg, director of the Scripps Institution of Oceanography.

But within the US coordinating committee, as the US representatives are called, and within the US delegations to the joint working groups, there has been strong disagreement on how to interpret the evidence on acid rain. One scientist said that under the Carter Administration, the groups were encouraged to be liberal in their interpretation of the data. The new group, especially officials from the Environmental Protection Agency and the Department of Energy, are "much more conservative" in the way they extrapolate impacts from the limited data.

Acid rain has therefore become one of the Reagan Administration's most troubling science policy issues. It entails many scientific uncertainties (see accompanying story). It could cost \$2,000-2,700 million per year to reduce sulphur dioxide emissions of US utilities by half, to 8 million tons per year, if controls are implemented, according to Congress's Office of Technology Assessment (OTA). On the other hand, if controls are not implemented and it turns out that acid rain is the culprit in much environmental damage the US fishing, forestry and

agricultural industries could be hurt.

The US Administration, accused by Canada of ruining its lakes and fish, must decide when enough is known about the problem to justify a public policy decision. Says one congressional staff member who has studied the risks and benefits of controlling acid rain: "I would hate to have to decide this. That's what we elect politicians for."

Elected officials in Congress may take the initiative away from the Reagan Administration in coming months, when they take up the need to revise the Clean Air Act. The act is intended to control local air pollution and does not address the long-range transport of pollutants from high stacks across state and international boundaries. In the previous Congress, several New England congressmen sponsored amendments to the Clean Air Act that would have required clean-up by power plants — a burden that would fall most heavily on states in the midwest. But the revisions to the act were not passed.

The politics of acid rain may be different in the new Congress, however. A new study by James M. Omernik and Charles F. Powers of EPA's Corvallis laboratory suggests that surface waters in southern states,

such as Louisiana, Mississippi and Alabama, may be affected adversely by acid rain as well. So powerful midwestern Senators, such as Richard G. Lugar (Republican, Indiana) may have to fight a broader group favouring controls.

On 5 January, the State Department told Canada why the Administration feels that the scientific uncertainties are too great to warrant regulatory action now in the United States. The department is expecting a paper from the Canadian government explaining that country's position that enough is known to warrant interim and long-term measures. The papers are expected to be the basis for further talks between Shultz and MacEachen.

When it took office, the Reagan Administration reversed the Carter Administration's position that some kind of joint US-Canadian action might be necessary soon, and that joint studies should be made as quickly as possible to determine what that action should be.

In a joint statement in July 1979, the Carter Administration and the Canadian government agreed that some kind of environmental agreement should be sought on acid rain. In a memorandum of intent signed in August 1980, the two governments agreed to work towards such an agreement, to discuss interim measures, and to set up joint working groups to figure out the issues.

Deborah Shapley

Three points of contention

THE Reagan Administration's position is that scientific uncertainty over three major issues makes any new restrictions on power-plant emissions unjustified:

- Transformation of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) to acids. The complete chemical pathway of these transformations in the atmosphere has yet to be worked out, and variations in the acidity of rain over time and space are not well explained by current theory. Some evidence suggests that the limiting factor in the oxidation of SO_2 and NO_x to sulphuric and nitric acids may be the availability of atmospheric oxidants, such as ozone and peroxide. "Conceivably", said Courtney Riordan, assistant administrator for research at the Environmental Protection Agency (EPA), "you could have a significant reduction in emissions and see no improvement in deposition as a result".

- Transport and distribution of SO_2 and NO_x in the atmosphere. Not enough is known about either long-range or local transport of acid-rain precursors to refine models to the point where a specific power-plant's emissions may be linked to acid rain at a specific downwind site.

- Natural acidity of rain. "There is no good measure of when acidity in rain should be considered detrimental", said EPA assistant administrator Kathleen Bennett. Unpolluted rain may have a pH above or below pH 5.6, the theoretical natural level based on equilibrium with

atmospheric CO_2 .

The Administration has put itself at odds not only with Canada but also with its own National Academy of Sciences in taking this line. "Although claims have been made that direct evidence linking power-plant emissions to the production of acid rain is inconclusive", an academy panel said in 1981, "we find the circumstantial evidence for their role overwhelming".

And both the academy and the Canadian government maintain that the goal of being able to link specific sources with specific environmental damage is impossible. George Rejhon of the Canadian Embassy in Washington said, "When you start working towards 'scientific certainty' you can go on forever. There are certainly some people in EPA who seem to be demanding such a degree of scientific precision that they want the natural world to be like a man-made laboratory. That is not possible."

Rejhon said the Canadian view is that enough is already known to take action on limiting SO_2 emission from power plants. He said that although it may not be possible to say how much a given region will benefit from a given reduction in emissions, the evidence is that at least 90 per cent of the acidity in areas of concern is man-made. Thus reductions in overall atmospheric loading of SO_2 will produce overall benefits in the affected areas.

Stephen Budiansky

West German ecology

Ozone named as culprit

GERMAN forests, long admired as examples of sustained high yields through careful management, have in recent years suffered degeneration that has become a matter of national concern. Since 1976, highly visible damage to spruce (*Picea abies*) has been seen in the Black Forest and in Bavaria. Similar symptoms have occurred in fir (*Abies alba*) and last year damage was found elsewhere in West Germany and in other species, including broadleaves.

Typically, with fir, the needles become yellowish and fall off. Those below the crown are first affected, causing the tree to assume a "stork's nest" appearance. Damage is most frequent to trees exposed to sunlight and wind on south-west slopes more than 800 m above sea level.

A widely held view is that the yellowing and die-back are effects of "acid rain". Dr J. Bauch of Hamburg University has proposed that the increased acidity of the soil inhibits rootlet and mycorrhiza development.

In September 1982, however, the Pollution Control Establishment in the Land of Nordrhein-Westfalia began an intensive investigation. An interim report published at the end of December concluded that the real culprit is ozone, formed by the action of light on oxides of nitrogen in the atmosphere. An impressive amount of circumstantial evidence is presented, such as the appearance of symptoms after the sunny summer of 1976 and the correlation of damage with ozone content in the atmosphere rather than with the acidity of the precipitation. And in laboratory tests, the difference in the effect of rain of pH 4.5 and 3 was slight, but exposure of spruce to ozone at 100–400 $\mu\text{g m}^{-3}$ for 3–4 weeks produced chlorotic mottling. The lichens *Hypogymnia physodes* and *Pseudoverna furfuracea* appear to be more sensitive to acid rain but less so to ozone than trees.

The proportion of affected trees varies considerably. In parts of Bavaria bordering

Czechoslovakia and East Germany (GDR), more than 40 per cent of the trees are damaged, and nowhere in Bavaria is the proportion less than 10 per cent. It was estimated last year that 7.7 per cent of trees in all West German forests had some degree of damage.

So, inevitably, pollution control has become a political issue; indeed, it was a contributory factor in the break-up of the former coalition SPD-FDP government

Damage to forests in Bavaria in 1981

last October. Herr Baum, then FDP interior minister, had been pressing for more stringent control of industrial emissions, but was opposed by Herr Lambsdorff, finance minister, also of FDP. Lambsdorff has now found a place in the new CDU-FDP coalition where he is supported by Herr Franz-Josef Strauss, the Bavarian CSU leader, who has tried to play down the seriousness of the situation despite the signs of damage in his own Land.

In reducing pollutant levels, West Germany is not its own master. About half the pollution comes from outside, chiefly from East Germany, where about 270 million tonnes of brown coal (70 per cent of total energy) was burned in 1982, and France. West Germany itself is a substantial exporter of pollution, chiefly industrial waste gases given out by tall chimneys, but by 1990 most power stations should be equipped with gas scrubbers.

Internal factors have inhibited the development of an overall environmental protection policy. There is no federal environment ministry, a situation which SPD is likely to remedy if returned to power in the March elections, and even some of the Länder divide responsibility between the interior and agriculture departments. The fact that the LIS, in central-northern Germany, recently produced a report largely concerned with damage to forests in the southern Länder of Bavaria and Baden-Württemberg, shows that inter-Land barriers are being overcome.

J.S. Dunnett

Infrared astronomy

Satellite launch of telescope

If all went well, the Infrared Astronomical Satellite (IRAS) will have been launched on a Thor-Delta rocket from Vandenberg Air Force Base in California at 0220 GMT on Wednesday, 26 January. Once launched, IRAS will embark on the first sky survey at infrared wavelengths from outside the Earth's atmosphere.

The experiment is a joint venture by the United States, which supplied the main infrared telescope and the launch vehicle, the United Kingdom, which will be controlling the satellite and receiving and processing raw data at the Rutherford-Appleton Laboratory in Oxfordshire and the Netherlands, which supplied the satellite vehicle and cooling system, together with a subsidiary infrared telescope.

The detectors are housed in a cooling vessel whose hollow walls are filled with liquid helium at 2 K, minimizing thermal infrared noise from the detectors' environment. Previous space-borne infrared detectors have been cooled to about 12 K. IRAS will provide about a ninety-fold increase in signal-to-noise ratio over the earlier experiments.

Unfortunately, the lifetime of the liquid helium is limited due to vaporization, so IRAS is likely to be useful for no longer than seven months. For almost all of that time the main telescope will be devoted to a sky survey at four wavelengths: 8.5 to 15, 19 to 30, 40 to 80 and 83 to 119 micrometres. The additional experiment supplied by the Netherlands will be used to examine particular regions of interest with greater spatial and spectral resolution than can be achieved by the survey telescope. But the survey will be interrupted only if particularly interesting objects are observed. Data will be received twice daily at the Rutherford-Appleton Laboratory and, after preliminary processing, will be distributed to observatories around the world*.

Infrared astronomy from the ground is hindered by the presence of absorbing gases (water vapour, for instance) in the atmosphere. However, peering through "windows" in the absorption spectrum over the past few decades, astronomers have detected objects such as very young and very old stars whose main signatures are at infrared wavelengths. Infrared waves can also emanate from regions shielded by gas at optical wavelengths, such as the centre of our Galaxy. As well as such expected infrared sources (about a million in all), astronomers are anticipating discoveries of new types of objects.

Philip Campbell

*A summary of the data will be published in *Nature* every two weeks during the lifetime of the satellite.