days of the League of Nations, the World Court decided a dispute between Belgium and the Netherlands on the diversion of water from the river Meuse. A notable recent case, decided by a specially appointed international tribunal, concerned a dispute between France and Spain about the alleged diversion of the waters of Lake Lanoux. Problems of the border waters between the United States and Canada are handled by a special body set up by treaty and called the International Joint Commission. Kellogg and Schneider mention our negotiations with Mexico; the problem of the salinity of the Colorado River has now been settled by agreement. Many other cases could be cited, most of them pointing to settlement by negotiation rather than by decision of an international court. The India-Pakistan agreement on the Indus River is a notable example. Barros and Johnston have recently published a documentary volume (*1*) on *The International Law of Pollution*.

There are fewer precedents for international litigation of atmospheric pollution, but on 20 December 1974, the International Court of Justice at The Hague (commonly called the World Court) handed down its decisions in the cases brought by Australia and New Zealand against France because of French nuclear tests in the atmosphere in the South Pacific area. The court did not hold that France was liable for actual or potential injury in the plaintiff countries because it found—by 9 votes to 6—that France has now bound itself to discontinue such atmospheric tests; the court therefore denied the plaintiffs an opportunity to prove that a state is liable if it deposits nuclear fallout on other states or on oceans where fisheries may be affected. Since I was counsel to Australia, it would not be seemly to comment on the court's judgment. The plaintiffs could invoke a much-cited decision of a special international tribunal set up by agreement of the United States and Canada, which found Canada liable for damages inflicted on livestock and forest on the U.S. side of the border by fumes emitted by the Trail Smelter located on the Canadian side. Had the Nuclear Test cases been argued on the merits, the World Court might have had its attention called to litigation in the courts of the United States, especially the case of the Reserve Mining Co., which is alleged to have discharged materials into the air and into the waters of Lake Superior, entailing risk of cancer and other health injuries. The case is still involved in procedural difficulties, but at a stage when it was before the Supreme Court, Mr. Justice Douglas, in a dissenting opinion, said:

> If, as the Court of Appeals indicates, there is doubt, it should be resolved in favor of humanity, lest in the end our judicial system be part and parcel of a regime that makes people, the sovereign power in this Nation, the victims of the great God Progress which is behind the stay permitting this vast pollution of Lake Superior and its environs.

International courts have fewer opportunities to decide such questions, since they can decide cases only where both parties consent. There is more hope for the success of international negotiation, as in the recent agreement of 16 coastal states to protect the Mediterranean against the growing threat of pollution. UNEP (United Nations Environment Program) with the aid of UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation), GEMS (Global Environmental Monitoring System), and other international organizations may provide the basis for the resolution of disputes, despite the reluctance of governments to allow their sovereignty to be questioned. Agreements already reached on outer space and on Antarctica are encouraging.

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References

1. J. Barros and D. M. Johnston, *The International Law of Pollution* (Free Press, New York, text ed., 1974).

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Methanol-Gasoline Fuels

While E. E. Wigg (29 Nov. 1974, p. 785) presents much of interest relative to the use of methanol-gasoline fuels in various models of automobiles, his conclusions are flawed by the narrow interpretations he affords them.

Wigg's claim that the presence of methanol in gasoline would result in vehicle carburetion beyond the lean limit for satisfactory performance, since automobiles equipped with emission controls are in many instances at that limit, ignores the fact that a methanol-gasoline mixture produces fewer emissions than does gasoline alone. If the greater flammability limits of methanol and the lower carbon

monoxide and hydrocarbon emissions of a methanol-gasoline mixture are taken into consideration, it seems likely that carburetion problems would be less severe with such a hybrid fuel than they are today.

Wigg's arguments that newer autos run more efficiently than older cars and that the addition of methanol to the fuel of newer autos will not result in fuel economies ignores, it seems to me, an important point—the addition of 15 percent methanol, by volume, to gasoline reduces by that amount our dependence on gasoline, other factors being relatively constant. The importance of such a saving in petroleum seems obvious.

Wigg makes the additional point that only older autos exhibit a significant reduction in hydrocarbon emissions when fueled with methanol-gasoline mixtures. Newer autos equipped with exhaust catalysts show no further significant reductions in hydrocarbon emissions beyond those attained with the catalytic converter. He does not address the possibility that methanol-gasoline fuels may eliminate the need for, and the expense of, such catalytic converters on new autos.

Finally, the test fuel used in Wigg's experiments contained 15 percent methanol, by volume. That amount of methanol approaches the limit that is soluble in gasoline, and at low temperatures, exceeds it. It would have been enlightening if the author had investigated fuels containing 5 and 10 percent methanol, as well as similar percentages of methyl-fuel (*1*).

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References

1. T. B. Reed and R. M. Lerner, *Science* **182**, 1299 (1973).

Mullen's broadened interpretation of the methanol in gasoline study does not stand up when examined in the light of the data. He suggests that the greater flammability limits of methanol should result in better driveability for methanol-gasoline blends. This is not the case, however, because the leaning effect of the methanol more than offsets the relatively small benefits due to greater flammability limits. This is borne out by the observations in my article, as well as by data generated in a subsequent study (*1*). It is not clear why Mullen relates lowered carbon monoxide and hydrocarbon emissions

to improved vehicle performance. Optimum vehicle performance occurs during slightly fuel-rich operation with resultant high carbon monoxide and hydrocarbon emissions.

Mullen also claims that my article ignored the basic advantage of gasoline supply extension via methanol use. However, he overlooks the fact that methanol could be used in other applications in which petroleum products are currently used. The thrust of my article was to quantify the specific advantages of methanol-gasoline blends to determine if this would be the preferred use of methanol. As I pointed out, the potential problems of methanol in gasoline far outweigh the advantages, making alternate uses, such as for gas turbines, preferred. The advantage of using methanol, if it does become available in large quantities, to extend our liquid fuel supplies was tacitly assumed. Mullen makes the common mistake of equating methanol to gasoline on a volumetric basis. In fact, due to its lower energy content, 15 percent methanol is equivalent to only 7.5 percent gasoline.

The use of methanol could not be considered as a substitute for advanced emission control systems such as catalytic devices. The basic finding of the study was that methanol's effect on emissions is primarily due to carburetion leaning. Thus, the effect of methanol could be approximated through carburetion adjustment. However, the lean carburetion approach to emission control is not suitable for the future stringent standards. For example, the lowest carbon monoxide and hydrocarbon emissions achieved with methanol-gasoline blends, using a lean-carbureted 1973 car, were about a factor of 3 higher than future standards will allow.

In reference to Mullen's last point, 15 percent methanol, by volume, was chosen for our studies because this is the upper practical blending concentration for most gasolines. The absence of significant benefits at 15 percent would rule out benefits at lower concentrations.

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References

1. E. E. Wigg and R. S. Lunt, "Methanol as a gasoline extender—fuel economy, emissions, and high temperature driveability" (Paper No. 741008 presented at the Society of Automotive Engineering International Meeting, Toronto, Canada, 1974).