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Introduction

Ludwik A. Teclaff

LUDWIK A. TECLAFF*

Introduction

According to the dictionary definition, the hydrologic cycle is the natural sequence through which water passes into the atmosphere as water vapor, precipitates to earth in liquid or solid form, and ultimately returns to the atmosphere through evaporation. The cycle includes all the physical states of water—gaseous, liquid, and solid—as well as the transformations among these states—for example, the melting of ice. Although the oceans and the ice caps contain most of Earth's water, it is the small fraction present in the atmosphere, on the land in rivers and lakes, and under the land in soil moisture and groundwater, that is of primary importance for human beings, as well as for other terrestrial forms of life. This water is not static. It may linger in some parts of the cycle for thousands of years (as ice in a glacier) and move very fast in others (as a puddle evaporated from a hot pavement), but it flows. The water in the atmosphere comes from soil, plants, rivers and lakes, and the oceans. The water in rivers and lakes comes from precipitation, surface runoff, subsurface flows, and underground sources. The water in the oceans comes from precipitation, runoff, surface lakes and streams, and groundwater.

Because water flows through all phases of the hydrologic cycle, any change in the manner of flow in one phase, whether by natural causes or human intervention, affects other phases of the cycle. Human intervention in the hydrologic cycle has been evident from the earliest recorded times, when Neolithic farmers attempted to control floods and catch some of the flowing waters for irrigation. In the course of millenia, such intervention has grown ever more sophisticated and larger in scale, with good results and bad. Clouds are seeded to produce rain or divert storms. Long-range air pollution acidifies lakes hundreds of miles away. Dams and reservoirs store inland surface waters for myriad uses in agriculture, industry, municipal supply, and power production. They also affect local climate, disrupt ecosystems, and alter the regime of surface and underground waters far downstream, causing changes even in the estuarine and coastal zone where large rivers reach the sea. Canals and pipelines divert waters from their natural channels and out of their natural drainage basins.

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*Professor of Law, Fordham University School of Law. The author wishes to acknowledge receipt of a summer research grant from Fordham University School of Law which aided in the writing of this article.

This helps water-hungry areas, but creates artificial segments of watercourse systems.

Human interventions do not have to be related to water *use* to affect the manner in which water flows through the hydrologic cycle. One example of such intervention is the felling of upland forests, which may result in catastrophic floods downstream; another is pollution—of rivers and lakes, of soils and groundwater, of estuaries and coastal seas which have become the final resting place for much of the wastes of human society. The ultimate in interference with the hydrologic cycle is the production of greenhouse gases that, it is feared, will cause a global warming sufficient to melt the polar ice, raise sea levels, flood low-lying areas, change the flow of rivers, and alter patterns of precipitation in ways as yet unknown.

The cause-and-effect relationship between phases of the hydrologic cycle has not been reflected in law, either domestic or international, until very recently. For most of human history, the various parts of the hydrologic cycle were treated in law as if they were totally unconnected, distinct stocks of water. The law dealt separately, for example, with rainwater and runoff, with surface flowing streams, and with groundwater. The breakthrough came when the surface and underground waters of river basins, both national and international, began to be treated in law as an integrated whole. Then the 1982 Law of the Sea Convention recognized that, to protect the marine environment, laws must be enacted and harmonized to control pollution in the air and on land, as well as in the sea.

The concept of an international law of the hydrologic cycle is a step further in legal thinking. It requires that lawmakers take into consideration that the unity of the aquatic environment extends beyond the surface and underground waters of the river basin to encompass atmospheric waters, frozen water in the polar regions, brackish water in estuaries, and the salt seas which return water to the atmosphere as vapor and complete the cycle. It requires that the existing rules dealing with water in a particular phase of the hydrologic cycle be interpreted in light of an awareness of the cause-and-effect unity of the cycle and that future rules reflect this awareness. It requires that prevention take precedence over liability and that liability reach far enough to enhance prevention.

We have not yet reached that stage, however. The most that can be expected at present is to indicate trends, for the hydrologic cycle still awaits its Helsinki Rules. The articles in this symposium, therefore, follow the sequence of the hydrologic cycle, beginning in the sky and ending in the ocean. They describe the status of international law in various phases of the cycle and indicate whether it links up with the international law in "neighboring" phases to deal more effectively with water as a flow resource. They set the stage for harmonizing rules of international law pertaining to all phases of the hydrologic cycle, rules of effective cooperation for using and protecting water in every part of the aquatic environment—in the atmosphere, in rivers and lakes, in deep underground pools, in glaciers and ice sheets, and in the oceans.