



Donald Kennedy is
Editor-in-Chief of *Science*.

Acts of God?

THE VARIOUS INTERRELATIONSHIPS AMONG NATURE, GOD, AND THE LAW, IT SEEMS TO ME, ARE BECOMING more complex and confusing in the modern world. These three concepts, all important elements in the human narrative, carry historical understandings that are being rearranged by the needs of contemporary society and by our ability to affect the world around us. It is worth exploring how science has influenced the restructuring of these interrelationships and how it might contribute to a better understanding of them.

Charles Darwin's predecessor, the geologist Sir Charles Lyell, launched a stunning revision of the world's view of how nature came to be what it is. Landforms such as mountains were thought of not as the result of some endogenous process but as punishments dealt to Earth by a Creator disappointed at the misbehavior of its inhabitants. This "catastrophist" view affected public attitudes in ways that seem remarkable today. In her notable book *Mountain Gloom and Mountain Glory*, the historian Marjorie Hope Nicholson traces the literary transition from mountains seen as excrescences to mountains praised as glorious nature. It is said that in the 18th and early 19th centuries, well-born ladies making the Grand Tour in Europe would pull down their window shades to avoid viewing the Alps.

For the catastrophist idea, Lyell, Darwin, and their successors substituted the notion that the world is at work changing itself. Mountain building, subsidence, erosion by wind and water, floods, and earthquakes—these were the forces that have been making our landscape over millennia. The geological doctrine emphasizing such gradual changes—uniformitarianism—is accepted today even by schoolchildren, save perhaps those being taught that Earth is only 6000 years old.

Nevertheless, the law still sometimes speaks of unexpected events affecting Earth's systems as "acts of God." Of course judges and lawyers know this is nonsense; they might better be called "acts of nature" or "natural disasters." Both descriptions are useful because they distance such events from human hands, leaving no place to put human liability for the resulting damage. Earthquakes, tidal waves, landslides, floods, and wind damage occur unexpectedly and apparently randomly; nobody causes them. Thus, in insurance policies, exceptions are sometimes made for "acts of God" so that harms of this kind will be uncompensated.

But now serious difficulties confront the idea that some of these events, especially recent disasters, can fit comfortably into these domains of human exemption. Problems are already cropping up with the traditional insurance exemptions. For example, in the aftermath of Hurricane Katrina, some residents had their homes destroyed by floodwater, whereas hurricane winds damaged others. Victims in the second category received insurance payments, but most policies did not cover flood damage, so homeowners in the first group didn't, causing major distress for them and leaving open the prospect of endless litigation.

Contemporary science is making it difficult to sustain such distinctions, and perhaps it can do something to clarify matters. As Katrina and two other hurricanes crossed the warm Gulf of Mexico, we watched them gain dramatically in strength. Papers by Kerry Emanuel in *Nature* and by Peter Webster in this journal during the past year have shown that the average intensity of hurricanes has increased during the past 30 years as the oceans have gained heat from global warming. Emanuel's Web site at the Massachusetts Institute of Technology (<http://wind.mit.edu/~emanuel/holem/holem.html>) explains the thermodynamic aspects of the relationship. The winds around the low-pressure center (the eye of the hurricane) travel across the warm surface water in a circular pattern, picking up energy. As water molecules evaporate from the surface, they contribute their energy to the storm column as they condense to form droplets, becoming sensible heat. About a third of that energy powers the hurricane's wind engine.

We know with confidence what has made the Gulf and other oceans warmer than they had been before: the emission of carbon dioxide and other greenhouse gases from human industrial activity, to which the United States has been a major contributor. That's a worldwide event, affecting all oceans. When Katrina hit the shore at an upgraded intensity, it encountered a wetland whose abuse had reduced its capacity to buffer the storm, and some defective levees gave way. Not only is the New Orleans damage not an act of God; it shouldn't even be called a "natural" disaster. These terms are excuses we use to let ourselves off the hook.

— Donald Kennedy

10.1126/science.1124889

