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The director of the **Census of Marine Life** on

Broadening the scope of global change to include illumination and noise

Invited essay by Jesse Ausubel


Photo courtesy of Nate Bolt

"*Son et lumière*"—sound and light—may stir thoughts of a clamorous and brilliant display on a holiday evening, animating Versailles, the pyramids of Giza, or Delhi's Red Fort with guns, gongs, and fireworks. But I would like to draw attention to other more serious dimensions of sound and light. A quarter century ago, in 1983, I was the scribe for a report of the US National Academy of Sciences titled "Toward an International Geosphere-Biosphere Program: A Study of Global Change." To researchers in environmental sciences and many more people concerned about Earth's nature, the phrase "global change" has become familiar. Global change brings to mind shifts in the climate induced by humanity, perhaps 1°C since the first telephone rang and electric lamp glowed. Global change conventionally also embraces climate's cousins, such as alterations in land and ice cover, acidification of the oceans, and ozone depletion.

Yet, if the inventor of the telephone, Alexander Graham Bell, were to return to his beloved Nova Scotia in 2009, he would find this year's climate little changed from one of the warm years of the 1890s when he passed by Bras d'Or Lake. However, the night sky would shock Bell. In 1909, over Bras d'Or, Bell's *Silver Dart* made the first plane flight in the British Empire. Had the *Silver Dart* scouted by night, pilot J.A.D. McCurdy would have seen that Nova Scotia after sunset meant darkness except for moonshine and starlight. Illumination was dim and costly, more than 100 times per lumen the price today. The technology of Thomas Edison, Bell's light-working contemporary, had not yet diffused. When their generation looked up at the night sky a century ago, they saw swathes of stars. Today, however, our most familiar starry image may be satellites and

astronauts looking down, observing the lights on Earth at night. The populated regions of the developed world, as well as China and India, are ablaze.

Babylonians and Mayans would not have invented astronomy under a nighttime sky whitened by modern light. The loss may not only be our everyday closeness to the heavens, which we now approach instead with platforms in space. My concern is that we have scarcely begun to think about the ecological effects of nighttime illumination. Bats and night owls aren't the only oncs affected. A large fraction of insects behave sensitively to light, and the Moon modifies the action of microbes. So we may conjecture that the global change of nighttime illumination is rippling through Earth's ecosystems. I wonder if some of the changes experts attribute to carbon dioxide and global warming may owe more to nocturnal photons and their associates.

Now Bell, true to his name, was absorbed more by *son* than *lumière*. Bell was born into a world in which noise, except clanging hammers in a blacksmith's shop or flapping belts in a factory, was mostly natural. Had Bell placed one of his early audiometers in the Atlantic Ocean, it might have heard pattering rain, breaking waves, cracking ice, singing whales, snapping shrimp, and the occasional rumbling earthquake or marine landslide on the continental slope.

Humans added little noise to the ocean until the 1870s, when marine motors began to overtake the clipper ships that plied the China trade and the Beverly schooners that fished cod on the Scotian Shelf. In the 20th century, humanity multiplied the sounds of motors and propellers for shipping as well as the tones to detect fish and submarines, booms to explore the seafloor for oil, and the buzz of jet skis for leisure. In fact, humans are adding about three decibels more sound to the ocean each decade, roughly doubling the power of the added noise. Because sound spreads widely in the oceans, human clamor touches every corner.

As I wonder about life in a darker night, I wonder about marine life in a quieter ocean. Alexander Graham Bell left us no measurements of the sound in the sea before human additions boomed. I propose scientists, environmentalists, and maritime industries organize an International Quiet Ocean Experiment in which humans refrain from adding noise to the oceans for a few hours. Because of the speed sound spreads in sea water, we might, fortunately, need to turn down the volume globally for only four hours or so to achieve a great diminuendo. During this time researchers would observe the behavior of many forms of life in the ocean that might respond to the quiet change.

At their origins, *son et lumière* symbolized luxury. Courts in the 17th and 18th centuries cultured festive illumination. In turn, inexpensive and thus plentiful sound and light cheered the 20th century. Forty summers ago, attending the Woodstock music festival, I enjoyed the midnight strobes flashing around the Grateful Dead and the ear-splitting purple haze of guitarist Jimi Hendrix.

But, as with many goods, humanity may have overshot. In the 21st century, I propose we widen the lens to view global change. Let us appreciate that peace with nature may

involve not only choosing activities unlikely to disturb the climate but also restoring quiet and darkness. In fact, a noisy machine is an inefficient machine, as the noise is escaping energy. Cleverly engineered night-vision goggles already allow soldiers to see in the dark without floodlights or torches, and super-efficient, light-emitting diodes can offer the sparkle and safety of lamps without spilling photons that hide the true stars and disturb venerable nightlife.

While loud and glaring, the 20th century witnessed great, favorable transitions for environment. By the year 2000, some 60 countries whose forests were previously shrinking were enjoying net growth of their trees and woods. The 1912 Fernow Commission of Conservation reported that Nova Scotia's forest resource risked exhaustion in two decades, while today forests cover a rising 77 percent of the province. Evidence suggests that even in the Congo and the Amazon a great reversal is underway from deforestation to reforestation.

The 21st century should be the century of the great restoration of nature. We have successful cooperative global scientific endeavors, such as the Census of Marine Life, that show the way. We should conceive and conduct more programs, such as an International Quiet Ocean Experiment and a Global Change and Dark Night Survey, that illuminate science while exciting humanity, with ingenuity, to restore nature.

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