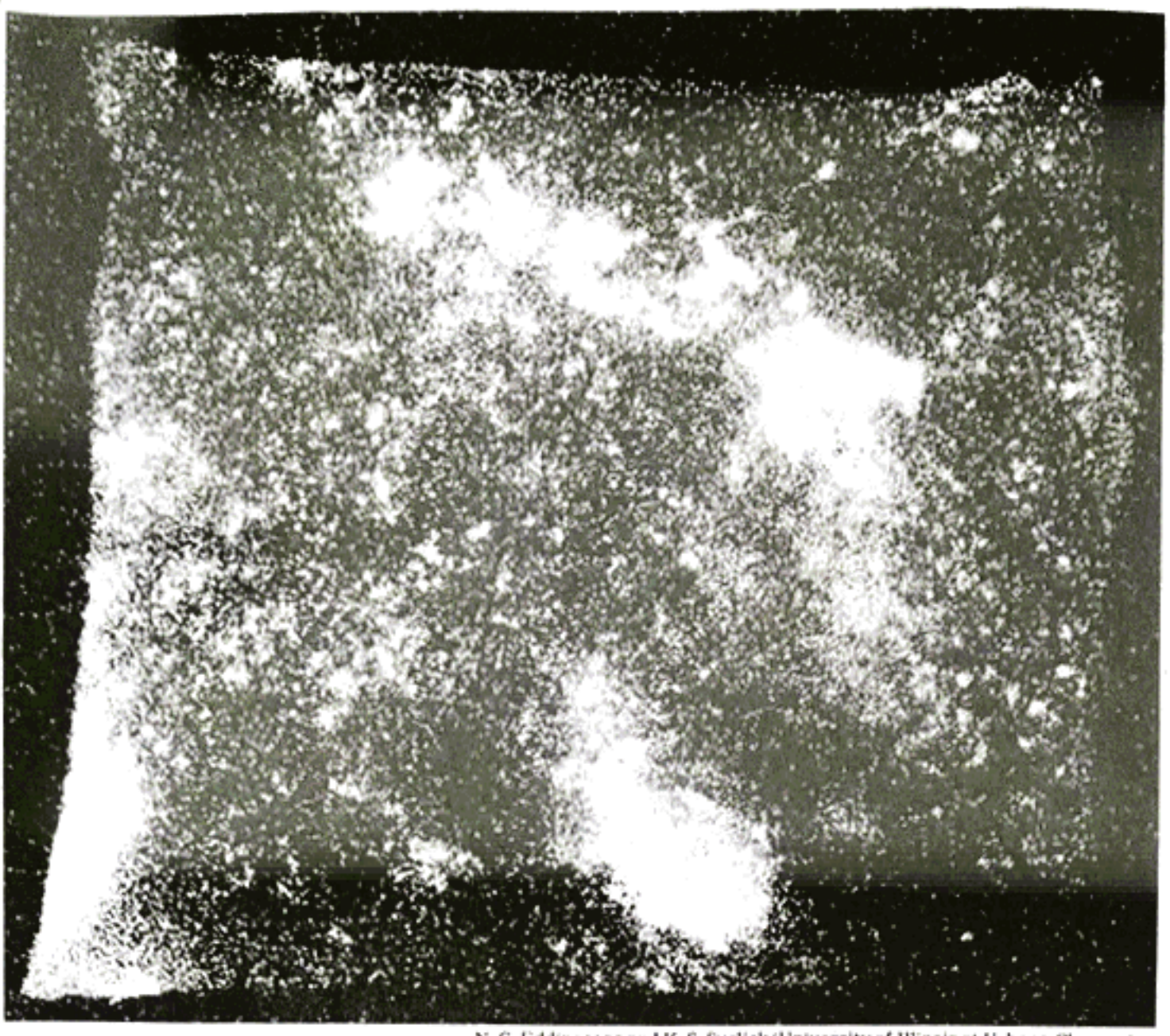

N. C. Eddingsaas and K. S. Suslick/University of Illinois at Urbana-Champaign

LIGHT WORK The Wint-O-Green Life Saver Effect, known as triboluminescence.

Sweet Spark May Hold Clue to How Things Break

By KENNETH CHANG

The Wint-O-Green Life Saver Effect, long of interest to children and adults chewing the candies in pitch-black closets to see the blue-white sparks shooting out of their mouths, could provide scientists a way to better understand how things break. At the atomic level, that is.

Last month, scientists at the University of Illinois at Urbana-Champaign reported in The Journal of the American Chemical Society that those faint sparks were energetic enough to power chemical reactions along the fracturing surfaces.

"When you break a pencil, you actually have to have broken chemical bonds," said Kenneth S. Suslick, a professor of chemistry at Illinois and one of the paper's authors. "Yet our understanding of that process is surprisingly poor. In fact when you look at the quantum mechanics of that, it isn't exactly clear how breakage occurs."

Determining the chemical reactions in an effect reported on for centuries.

Dr. Suslick said the sparks of light gave the opportunity to do spectroscopy, looking for specific colors of light given off by different atoms and molecules. That will give the scientists hints about how the bonds between atoms rearrange. "When you break materials, you're almost always going to be driving chemical reactions," he said. "It gives us a spectroscopic probe to see what's going on right at the fracture point."

Reports of the Wint-O-Green Life Saver Effect — the technical term is triboluminescence, which means light produced by rubbing — goes back at least four centuries to Sir Francis Bacon, the English philosopher often considered the father of the scientific method.

Bacon was of course not studying Wint-O-Green Life Savers, but he wrote in "Novum Organum," published in 1620, "It is also most certain that all sugar, whether refined or raw, provided only it be somewhat hard, sparkles when broken or scraped with a knife in the dark."

Within a couple of centuries, other scholars realized this was great fodder for practical jokes.

In 1753, Father Giambattista Beccaria wrote "A Treatise Upon Artificial Electricity." In it, he noted, "You may, when in the dark, frighten simple people only by chewing lumps of sugar, and, in the meantime, keeping your mouth open, which will appear to them as if full of fire."

In general terms, scientists understand the how and why of triboluminescence. In some materials, including sugar and quartz crystals, electrons build up as the fracturing occurs and chemical bonds break. The charge build-up requires an asymmetric crystal structure or the presence of impurities.

And then, just like a jolt of static electricity, the electrons jump to nitrogen or oxygen molecules in the air, which shed the excess energy by emitting light.

Wint-O-Green Life Savers are particularly well-suited for observing this effect, because of the oil of wintergreen — methyl salicylate — that flavors them.

Usually most of the light emitted by fracturing sugar is in the ultraviolet, out of view of human eyes. But the methyl salicylate absorbs the ultraviolet light and reemits the energy as blue-green light.

In the latest University of Illinois experiment, Dr. Suslick and Nathan C. Eddingsaas, a graduate student, started with a test tube filled with a slurry of small sugar crystals and liquid paraffin.

A vibrating titanium rod immersed in the test tube generated ultrasound waves that created millions of tiny bubbles growing and collapsing in the paraffin 20,000 times a second.

The shock waves slammed the sugar crystals together, and with nitrogen or oxygen bubbling through the slurry, the resulting bursts of light were typically 100 times, sometimes 1,000 times, brighter than the usual triboluminescence.

The spectral fingerprints revealed the presence of carbon monoxide, carbon dioxide ions and other products of combustion. Further work will try to determine the chemical reactions occurring during triboluminescence.

"It's basic science," Dr. Suslick said. "I don't see any applications, really. It's one of those things that have a long and illustrious history."