by Harvey Black

In the early darkness of June 12, 1993, all was quiet in the woodlands of Tahquamenon Falls State Park, Michigan. Campers were sound asleep in their tents. The only sound was the rustle of the leaves, moved by a gentle wind.

Everything was just as it should be until, suddenly, the campers were jolted by a tremendous explosion that boomed through the forest.

The old ranger station had just blown up. Campers a mile and a half away reported hearing the noise. By the time daylight rolled around, the results of the explosion were clear, but the cause was a mystery.

“There was considerable damage to the building,” said Wayne Suida, the park manager who surveyed the shambles that the 16-by-40-foot wooden building had been reduced to. “All of the walls were damaged to some extent,” he said. The northeast wall of the building was blown out quite badly from the bottom up. The top of that wall came to rest 20 feet from the building. Concrete blocks from the building were strewn about the area. The roof at the north end of the building was damaged. “The roof at that end of the building was actually sagging down about 4 or 5 feet from its normal level,” Suida said.

“It was a very powerful explosion. Debris was scattered 150 feet away from the building,” said Sergeant Wally Helmila of the Michigan State Police Fire Marshal’s Office, who searched for the cause of the blast. Significantly, an enclosed porch that served as entrance to the basement was gone. “It was totally decimated,” said Helmila.

What or who caused such a destructive blast? Could someone have deliberately destroyed the building? A new ranger station had recently been built nearby and the old one was now owned by the construction company that built the new station. However, the company had canceled its insurance policy on the old building two weeks prior to the explosion. Foul play seemed unlikely because...
no one would profit from the building’s destruction.

What about a gas leak? Not very likely. The propane-fueled furnace had been removed from the building about a month previously, when the new station was opened. What’s more, the gas had been shut off at the tank, some 20 feet from the building.

But the electricity was still working. It was needed to run a sump pump because water from spring rains sometimes flooded the basement.

In the basement Helmila found a “tremendous amount of damage” according to his report. The beams supporting the floor above were shattered and scorched. It looked like the sump pump had triggered the explosion, but what was the combustible material that exploded?

As he continued his probing of the remains of the building, searching for a cause, something caught Helmila’s eye. It was a black substance on the ground under the remains of the basement entrance porch. It looked like bat droppings to Helmila.

Bats had been roosting in the attic for three years or more, and bat dung had accumulated in thick layers. Suida said that the bats had entered through a gap in the cedar shingles on one side of the building.

Was it possible that methane gas, which can be given off by decaying dung, was responsible for the explosion? Methane is an odorless, colorless, but potentially explosive gas. In fact, it is the main component of “natural gas” used in Bunsen burners as well as many kitchen stoves and home furnaces.

Helmila got in touch with a zoology professor at Michigan State University, and was told this was possible. Accordingly, the State Police report explained the explosion this way: The decaying bat dung emitted methane; being heavier than air, the methane sank to the basement; water entered the basement and drained into the sump, which

Left: After the blast. Fortunately this ranger station at Tahquamenon Falls State Park was not in use when it exploded. Because a new station had been constructed, this building was closed and the propane gas was turned off at the supply tank. The blast caused no injuries, but investigators found its cause elusive.

Above: Bats became the prime suspects in the explosion investigation when it was discovered that a large colony had been roosting in the attic of the ranger station.
caused the sump pump to switch on; the spark from the electric pump ignited the methane/air mixture; the building blew up.

When reporters got hold of this possible explanation, it became hot news. The local newspaper’s headline was HOLY BLAM, BATMAN! Bat dung brews methane; park building explodes. Radio commentator Paul Harvey repeated the story on his national program. And humorist Dave Barry wrote about it in his syndicated newspaper column. “There was a great deal of publicity,” says Suida. “We had calls from radio talk shows. I had telephone calls from as far away as England.”

But at least one person didn’t think it was funny. Biologist Merlin Tuttle, a bat expert, practically exploded himself when he heard this explanation for the destruction of the building.

“Preposterous!” is the way Tuttle describes that explanation. “There’s never been any case known in all the history of batdom of anything anywhere exploding from bat guano. In fact there’s no evidence that bat guano produces methane or any other combustible gas.” Tuttle is head of Bat Conservation International, an Austin, Texas-based scientific organization dedicated to informing the public about the ecological value of bats. “If bat guano produced methane, cave explorers would have been blowing themselves to smithereens for years. It doesn’t happen,” he explains.

Tuttle’s contention is borne out by bacteriologist Jorge Escalante of the University of Wisconsin–Madison. Escalante, who has specialized in studying the microbes that produce methane, says that these microbes can be found in the guts of bats and other mammals. But, he says, “the dung is very porous, and once it dries out, I don’t think there would be a sufficient amount of methane for an explosion.”

The microbes that make methane are anaerobic; they can’t live in the presence of oxygen. So they would simply die when air entered the porous dung.

Another strike against the bat dung hypothesis is that methane molecules, with one carbon and four hydrogen atoms, are far lighter than air, not heavier (see Table 1). Consequently the gas would not have sunk to the basement, as proposed by the Fire Marshal’s report.

If not methane from bat dung, what was responsible for the explosion? The state police began to reexamine the evidence and came to another conclusion. In the end, methane was blamed for the explosion, but it did not come from bat waste.

The toilets in the old ranger station were connected to an underground septic tank. Normally, U-shaped traps in the pipes are filled with water, and the water prevents gases from flowing backward into the building (Figure 1). Because the building had been empty for some time, the water evaporated, allowing the methane generated in the septic tank to back up into the building.

Then, as in the scenario that erroneously blamed the bats, a spark from the sump pump ignited the methane.

Just how does methane form? As Escalante explained, many microorganisms break down the complex organic molecules present in the waste of mammals. “This first stage will break down the polymers into a number of fatty acids, including acetate, formate, CO2, and hydrogen,” he says. “These are prime substrates for methanogens.” The methanogens metabolize these components, chiefly hydrogen and carbon dioxide, and produce methane, CH4. (See the article “Wastewater” in Chem Matters, April 1992) Methanogens are highly specialized microbes that eat, “at the end of the food chain,” in what Escalante calls the “phenomenally complex environment” of sewage. They can survive only in the absence of oxygen and live in city sewage systems, simple septic systems like the one at Tahquamenon Falls State Park, and our intestines.

So, after many false leads, the puzzle of the exploding ranger station was resolved. The explosion was caused by methane from mammal waste but the waste came, not from the insect-eaters that roosted upside down in the attic, but from their accusers.

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Table 1. Molecular weight of natural gas and air. The density of a gas is determined by the molecular weight of its molecules. Natural gas has a slight tendency to float upward because its molecular weight, 17 amu, is less than the average molecular weight of air, 28.95 amu.

<table>
<thead>
<tr>
<th>Natural gas composition</th>
<th>Air composition</th>
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<tbody>
<tr>
<td>Methane, CH4 16 amu 94.5%</td>
<td>Nitrogen, N2 28 amu 78.08%</td>
</tr>
<tr>
<td>Ethane, C2H6 30 amu 4.1%</td>
<td>Oxygen, O2 32 amu 20.95%</td>
</tr>
<tr>
<td>Propane, C3H8 44 amu 1.3%</td>
<td>Argon, Ar 40 amu 0.93%</td>
</tr>
<tr>
<td>Carbon dioxide, CO2 44 amu 0.03%</td>
<td>Average 28.95 amu</td>
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<tr>
<td>Average 17 amu</td>
<td>Average</td>
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