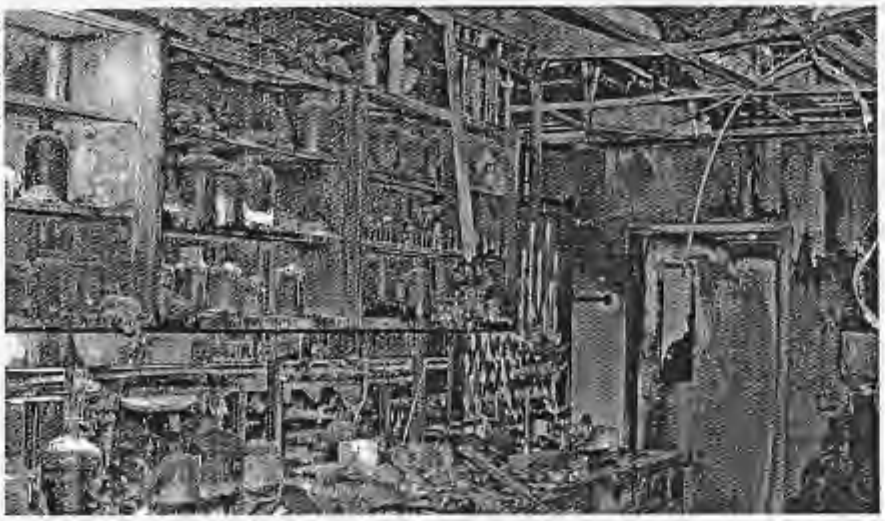

COURTESY OF OSU

DESTROYED Coleman's lab after the April 8 explosion and fire at Ohio State.

FIGHTING LAB FIRES

Explosion and fire at an Ohio State University chemistry lab highlight safety issues in academia

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FRIDAY EVENING, APRIL 8, SHOULD have been routine for the chemistry graduate students finishing up a day's work in professor Robert S. Coleman's lab at Ohio State University's (OSU) Newman-Wolfrom Laboratory building. Some students were at the bench; others were helping to unload a shipment of hexane into a solvent storage cabinet.

No one could have predicted that, by nightfall, a tremendous explosion and fire would render the lab a smoldering ruin and that only quick-thinking action by the students would mean that they escaped the lab with their lives.

The lab was, in fact, completely destroyed, including all of the research, lab notes, and other work by Coleman and his students. The Coleman group studies antitumor agents, including the bacterial agents azinomycins A and B.

An adjacent lab was also damaged, and the three-alarm blaze took firefighters from several Columbus, Ohio, area fire stations more than an hour to extinguish.

In the weeks since the incident, Coleman and his colleagues have pored over the details and tried to pinpoint exactly what happened in the lab that evening and how the explosion and fire might have been prevented. They have met with officials from the Columbus Division of Fire (CDF) to review the case and to determine how to work together better in the future.

CDF was still investigating the incident at C&EN press time. Fire officials say the cause was most likely accidental.

Coleman contacted C&EN about the incident because it "could happen to anyone who stores large volumes of solvents and because the accident could have easily resulted in the loss of life. I believe it is important to report the details of accidents and fires for analysis and as a way to inform and educate other chemists."

UNFORTUNATELY, dangerous explosions, fires, and other mishaps like the OSU incident are not uncommon for schools and other academic institutions, lab safety experts say. Many states, including Ohio, have adopted lab safety regulations from the federal Occupational Safety & Health Administration (OSHA), yet preventable accidents that maim and kill people continue to happen, sometimes with alarming frequency.

Coleman says it is often too expensive to fully implement safety regulations in academia.

Schools have a 10 to 50 times greater frequency of accidents than does the chemical industry, lab safety expert James A. Kaufman says. "It's 100 to 500 times greater than in places like Dow and DuPont," he adds. "I learned more about safety in my first day at Dow than I had in 25 years at school."

Kaufman, now retired from academia and industry, is president and chief executive officer of the Natick, Mass.-based Laboratory Safety Institute. The LSI website (www.labsafety.org) includes a free downloadable brochure on lab safety guidelines. Kaufman conducts workshops and seminars on lab safety year-round at colleges and universities nationwide.

At OSU, Kaufman says, "they were lucky." He says academics are often unwilling to follow rigorous safety protocols established by someone else because it's just not part of the culture. For graduate students, he says the situation is even worse.

"Ninety-five percent of the graduate students I have polled said they would not report a safety hazard" because they fear reprisals from faculty or staff, Kaufman recounted.

But Kaufman believes this difficult situation can change and that accidents and injuries can be prevented with greater awareness of lab safety issues and knowledge of simple but effective procedures. More frequent lab safety inspections is one of the easiest measures to establish, he says.

"When I talk to people about lab safety," says Michael J. Halligan, associate director for environmental health and safety at the University of Utah, "I tell them it almost always comes back to paying attention to proper procedure."

For example, Halligan says, people working in labs should never reuse copper tubing. In an accident at Utah, he says, copper tubing was reused for a laboratory hydrogen line, and it was run next to an electrical switch. A pinhole leak in the copper pipe led to an explosion and fire that could have been prevented if someone had just spent a few dollars for new tubing.

Halligan says it's probably true that academic labs have more accidents than industrial labs, but they tend to be smaller scale. Academic labs seldom work with the quantity of materials or scale of processes that are common in industrial lab work. And below a certain magnitude, accidents at academic labs do not have to

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be reported to state or federal agencies.

General security of laboratory buildings is a big topic right now, he continues, especially since the terrorist attacks of Sept. 11, 2001. He can give few details—another security precaution—but he says at the University of Utah and many other institutions security is often about controlling access. Key card locks for laboratories are becoming commonplace, he says, and they have the added benefit of documenting who is entering and exiting university buildings.

OSU officials estimate that 90% of their labs are in compliance with OSHA regulations. What's more, OSU graduate students are required to take a course in lab safety. In fact, Coleman and others say it is that training that helped prevent serious injury in the April 8 incident.

Still, OSU officials concede that greater vigilance, including more routine inspections of labs and lab equipment, might have prevented the incident altogether.

The OSU students recount what happened on April 8. Both students agreed to speak with C&EN on the condition that they remain anonymous.

"I was loading solvent bottles to the top shelf" of a solvent storage cabinet, the first student explains. "I loaded 12 bottles, and as I put the 12th bottle up, the shelf collapsed. There were large amounts of hexane on the floor, and my jeans were soaked.

COURTESY OF OSU

UNDER INVESTIGATION A collapsed shelf in a solvent storage cabinet is implicated in the fire incident.

"This has happened before," he continues, "and it's not something where you get too alarmed. I was more concerned about breathing the vapors, and I noticed I had a small cut on my arm. Within five minutes, the explosion occurred."

"We were unpacking shipments from Fisher [Scientific]," says another student, telling the story from her perspective. "There were 10 to 12 bottles of hexane.

"We were getting ready to leave and [the first student] offered to help unload the shipment," she continues. "When I came back with a cart, the shelf had broken and his arm was cut. I said, 'Why don't we all go down to the group room?' "

And with that, the 11 students left the lab—especially, they say, as the fumes from the hexane were becoming overpowering.

As she was going to call Coleman, the second student says, "I saw [the first student] run out of the lab yelling fire. I saw flames lick out from under the door. I could hear it as each bottle started exploding."

"We had put out a number of other fires in the lab," the first student says. "This was such a large explosion that we didn't even bother to go back to the lab."

THE STUDENTS used their cell phones to dial 911 and Coleman. He rushed to the lab from another part of the campus, making it in time to greet firefighters who were responding to the scene.

"We were met by people coming out of the building as well as by Dr. Coleman," says CDF Battalion Chief Kevin M. O'Connor, one of the first responders on the scene. "Coleman advised us as to what was in the lab—40-plus liters of hexane."

Everyone who was there says it was a chaotic scene of some 20 fire trucks and equipment. With Coleman's information about all of the chemicals that were in the lab, firefighters switched from the water they were initially using, to dry powder extinguisher, and finally to chemical foam, which eventually put out the blaze.

Total damage estimates range from $200,000 to $300,000.

"This was a big deal," O'Connor says. "We had approximately 84 firefighting personnel at the fire, and that's probably a low number. A lot of people did the right thing, especially immediate evacuation of the lab."

In addition to the student who cut his arm, several firefighters required treatment, for inhalation of smoke and/or chemical fumes from the fire. Both OSU and CDF officials say all injuries were minor.

COURTESY OF OSU

Coleman

COURTESY OF OSU

Herrington

COURTESY OF LABORATORY SAFETY INSTITUTE

Kaufman

The explosion could have been triggered by any number of ignition sources, Coleman says, including static electricity or a spark from a motor or switch. One preventive solution, he adds, might be to outfit the labs with an emergency power-off switch so that all electricity can be killed in a lab whenever there is a solvent or other flammable liquids spill.

The solvent storage cabinet is another focus of attention. Coleman says that, although it was properly vented, it was close to a freezer and probably should not have been.

More troubling is the fact that "somebody put the wrong shelves in the cabinet," says John W. Herrington, OSU chemistry department coordinator of chemical safety. The cabinet was by manufacturer Eagle, he explains, but the shelves had been replaced with those made by Justrite.

"The products we make are really only made for our cabinets," says Joe Eddy, a marketing manager for Eagle. "There are differences."

Coleman and Herrington agree that with routine inspections somebody might have spotted the unstable shelves.

Halligan says its common in academic labs for graduate students and others to just try to make things work. "We call them 'the weekend carpenters,' " he says.

For now, "we were tremendously lucky that Dr. Coleman was on the scene," O'Connor says, crediting the professor for his knowledge of what was in the lab so that firefighters knew they could safely go into the building and extinguish the blaze. Otherwise, he says, "we would have left the fire to burn." ■