THE DOGS OF SCIENCE HALL

by Howard Veregin, PhD

As one of the earliest buildings on the UW-Madison campus, Science Hall has experienced many of the indignities that accompany old age. The building was completed in 1887 on the site of an earlier structure—also known as Science Hall—that had been destroyed by fire three years earlier. The 1887 building, constructed of red brick and rhyolite in the ponderous Romanesque Revival style reminiscent of medieval fortresses, has been home to many of the university's academic programs including Geology, Geography, Physics, Zoology, Limnology, Botany, Anatomy, Bacteriology and Medicine.[1] All of these programs adapted Science Hall's interior to accommodate their unique needs. Modifications include the partitioning of the building's open wings, the creation of mezzanine floors, and a multitude of classroom and lab reconfigurations. The scars are everywhere: Doorways that have been bricked in, stairways that seem to lead nowhere, brick columns that poke out of the plaster...If the walls could speak they would probably just scream in agony.

Some of the more significant changes to Science Hall are associated with the various departments of the Medical School, which occupied much of the building in the first decades of the 20th century.[2] To accommodate growing demand, the School opened up many previously underused areas of Science Hall.[3] In particular, the fourth and fifth floors, which had been considered attic space when the building was constructed, were reconfigured to house anatomy and dissection rooms.[4] Cadavers were delivered to a stairway in the rear of the north wing, which has since been reconfigured as a ground-floor window, and then moved to the cold-storage and embalming rooms in the basement. A winch in the north tower transported the cadavers to the upper floors of the building.[5]

Perhaps the most infamous corpse to make its way to Science Hall was that of Julian Carlton, who in 1914 murdered Mamah Borthwick, her two children, and four workmen at Taliesin, Frank Lloyd Wright's home and workshop in Spring Green, Wisconsin. Carlton set fire to Taliesin before consuming a large quantity of hydrochloric acid and hiding in a furnace. After his death several weeks later, authorities purportedly shipped his body to Science Hall and delivered it to Room 0 (perhaps the rear stairway) where it was divided into three sections for the purposes of dissection by medical faculty and students.[6] Once the dissection was complete, the pieces of the body were burned in Science Hall's human incinerator.[7] Grisly stories like this are central to the building's mythology. Students were apparently still finding human bones hiding in unused storage spaces well into the 1970s.[8]

In addition to anatomy, Medical School faculty worked in physiology, pathology, pharmacology and medical microbiology.[9] Teaching and research labs were scattered around the building. But as student demand increased, Science Hall became too small for the Medical School and expansion into a new building became necessary. This was solved when the Legislature approved funds for the Wisconsin General Hospital and Service Memorial Institutes, which opened in 1924 and 1928, respectively.[10] As the Medical School moved out of Science Hall, only the Anatomy Department stayed on, occupying rooms on the upper floors until it too departed in 1957.[11]

The Fourth Floor Additions

Of all the alterations made to Science Hall over the decades, perhaps none is as puzzling as the addition of two rooms on the fourth floor sometime around 1917. The addition of these rooms actually altered the façade of the building. They can be seen from the rear parking lot today. The brick has a slightly different color than the rest of the building and the architecture is much less ornate. (Figure 1)[12] Today these rooms are used as faculty offices. There is one room on each side of the main staircase, each a mirror image of the other.

FIGURE 1. The dog rooms today (highlighted by the white dashed lines) from the rear parking lot of Science Hall. Source: Author.

It is certain that these rooms are not original to Science Hall. An early photograph ca. 1890-99 of the rear façade of the building confirms this. (Figure 2)[13] A later photograph—dating from the late 1920s to early 1930s—shows the two rooms after their construction. (Figure 3)[14] This evidence agrees with several building histories stating that the rooms were added sometime before 1924.[15] Additional evidence comes from a set of 1917 renovation plans, which depict these rooms as new additions and provide details about their construction. The plans—officially titled "Diagram for Remodelling of Science Hall, University of Wisconsin"—were produced by the Office of the State Architect in Madison in the summer of 1917.[16]

Figures 4 and 5 are portions of these plans for the fourth and fifth floors. In addition to a general plan view of the new rooms, there are elevation drawings showing their appearance from the outside of the building, two cross sections showing interior features, and details of the doors and windows.

These rooms have some curious features, to say the least. For a start, they were designed to hold dogs. In Figure 4, the plan view and cross section A-A show "dog cages" on a concrete and asphalt floor. The cages were evidently custom-made; the diagrams even specify the gauge and spacing of the longitudinal and vertical cage wires. The reference to "Clinton Electrically Welded Wires" may refer to a specific type of arc welding in use at this time. The plan view shows the room partitioned into four chambers, each with a door. There are two chambers for the dog cages, an antechamber (with a drain and sink) leading to the building corridor, and a chamber leading up the stairs to the second level.

This points to a second oddity: The fact that the rooms have two levels. The upper level can be seen in plan view on Figure 5. There are six chambers shown, the largest of which extends over the building corridor and contains a drain. The smallest of the chambers—there are three of these—are only about three feet wide. All of the chambers have doors. In contrast to the lower level, which has three small windows, the upper level is completely windowless. A large glass skylight and two galvanized iron ventilators, shown on the roof plan, provided light and ventilation. The skylights and ventilators can be seen in the photograph in Figure 3. The two levels are connected with a metal stair with a balustrade constructed of wire netting (see cross-section A-A).

A final oddity of these rooms is that they were designed to be soundproof. The plans provide drawings of soundproofing in the windows, walls and doors. The double-hung windows on the lower level are "to be made sound proof." The "detail of sound proof wall and door" shows insulation in wall and door cavities.

FIGURE 2. Rear view of Science Hall from the 1890s, with no dog room present at the north location (highlighted with white dashed line). The south dog room location is not visible. Source: University of Wisconsin-Madison Libraries, digital.library.wisc.edu/1711.dl/NS5ZOMXNWY4AC8Y

What does all of this signify? To try to answer that question we need to consider three sets of facts we have on hand. First, there are the rooms themselves, with their dog cages, windowless chambers, ceiling ventilation, and soundproof construction. Second, we know that medical research was being conducted in the building at this time and that Medical School labs were close by on the fourth floor. Third, there is the historical context to consider. In April of 1917, a few months before these renovation plans were drafted, the United States had declared war on Germany and entered the First World War. An immediate concern was poison gas, which Britain, France and Germany were all using as a chemical weapon. By mid-1917, the federal government and the War Department had launched a war gas research program that eventually enrolled hundreds of scientists from universities and private labs across the country. From the very beginning, researchers employed animals, especially dogs, as experimental subjects.

U.S. Chemical Warfare Research during the First World War

The first use of poisonous gas in the First World War was a German chlorine gas attack against British troops in April of 1915. The British, initially outraged, soon decided to fight fire with fire and an arms race escalated quickly.[17] When the U.S. entered the war two years later, the chemical arsenal of the combatants had grown to include asphyxiants like phosgene, lung irritants like chloropicrin (also spelled chlorpicrin), various compounds of arsenic and cyanide, and blistering agents (vesicants) like mustard gas.

Like Britain and France, the United States adopted a bellicose stance upon entering the

FIGURE 3. Rear view of Science Hall sometime in the late 1920s to early 1930s. The dog rooms are highlighted with white dashed lines. Their skylights and ventilation units are visible. Source: University of Wisconsin-Madison Libraries, digital.library.wisc.edu/1711.dl/77KPDC4KYN5338N

war. An editorial in the December 1917 issue of the American magazine “Illustrated World” observed,

> chemical knowledge of destructive substances is not limited to the German mind or German textbooks. There are among us chemists who can meet them upon their own ground and go them one better in devilish inventiveness if it is so desired.[18]

After declaring war in April of 1917, the U.S. government quickly launched a program focused on large-scale gas production and the creation of new gasses and methods of delivery. By the end of the war in November of 1918, less than two years later, the U.S. was producing twice as much poison gas as Britain, France and Germany combined.[19] Gas production in the U.S. had grown to encompass at least 10 facilities. The Army’s main chemical warfare plant, Edgewood Arsenal in Maryland, had more than 10,000 workers at peak production.[20] Other plants included re-purposed commercial chemical factories in Ohio, New York, Michigan, and Connecticut. At full capacity, this network of plants was capable of producing over 4,000 tons of poison gas per month, including chlorine, phosgene, chloropicrin, mustard gas and lewisite, the latter being a U.S. innovation.[21]

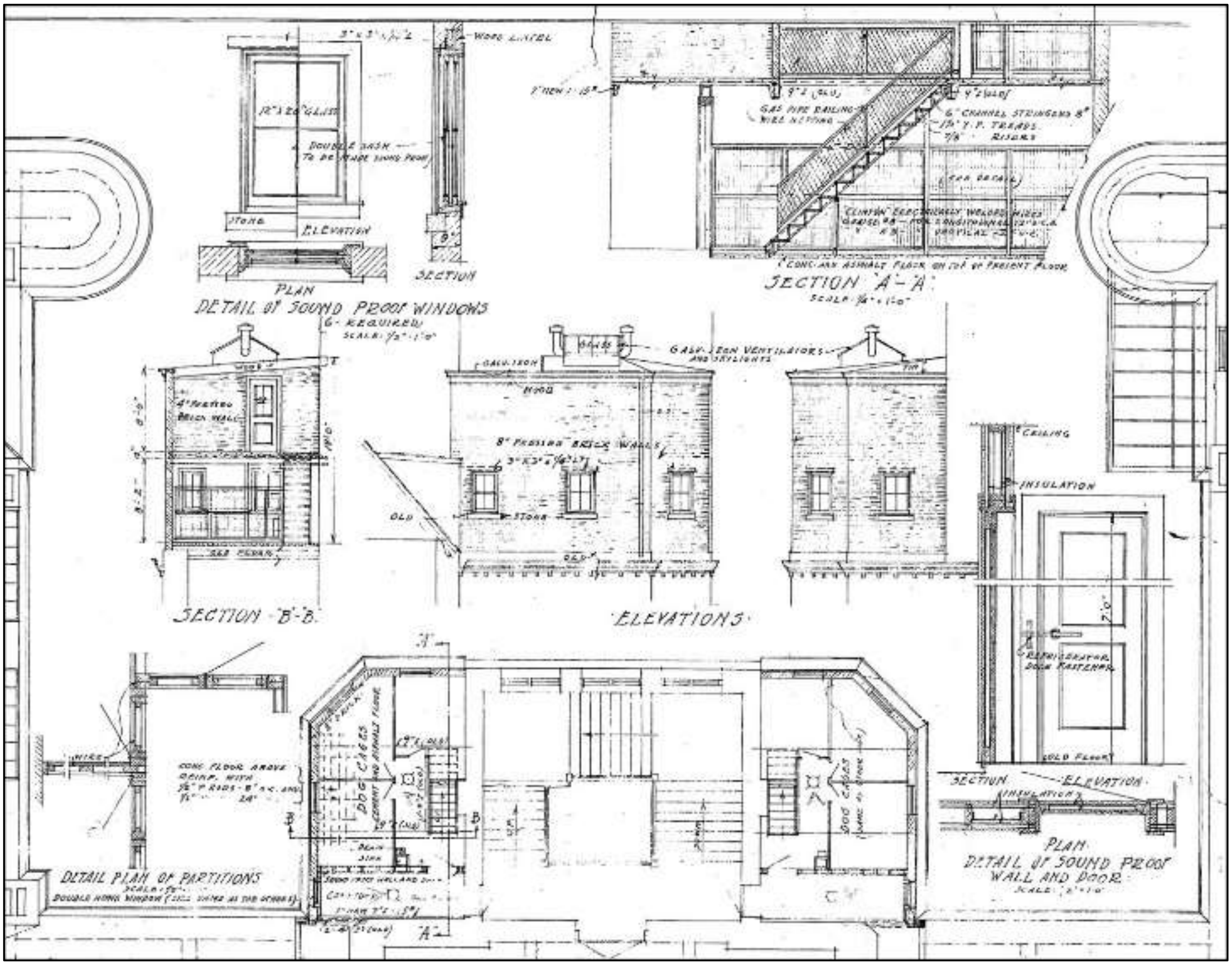

FIGURE 4. 1917 Science Hall renovation plans, fourth floor, showing construction details for the dog rooms. Source: University of Wisconsin-Madison Facilities Planning & Management.

When the war was over almost 11,000 tons of gas had been produced domestically.[22] The Army's First Gas Regiment reached the front lines in the spring of 1918 and deployed thousands of gas shells and canisters against the German Army.[23] But as this was already late in the war, gas use by U.S. forces never matched its domestic production levels, let alone its planned capacity. In fact, despite soaring domestic production levels, the U.S. Army did not employ any domestically produced gas in the war, relying instead on British and French weapons.[24] If the war had continued into 1919, the U.S. and its allies were prepared to use their stockpiles in massive gas attacks, including aerial bombardments, against Germany.[25] But at the end of the war, these plans were abandoned, and instead hundreds of tons of surplus gas in barrels and artillery shells were dumped into the ocean.[26]

The rapidity with which production facilities were established led to a problem: injuries to plant workers resulting from accidental exposure to toxic chemicals. At the Edgewood plant in Maryland there were 279 casualties in one month alone in 1918.[27] Much of the impetus behind the war gas research program was to protect the workers in gas production facilities, and this was a major focus of the research effort at the University of Wisconsin.[28]

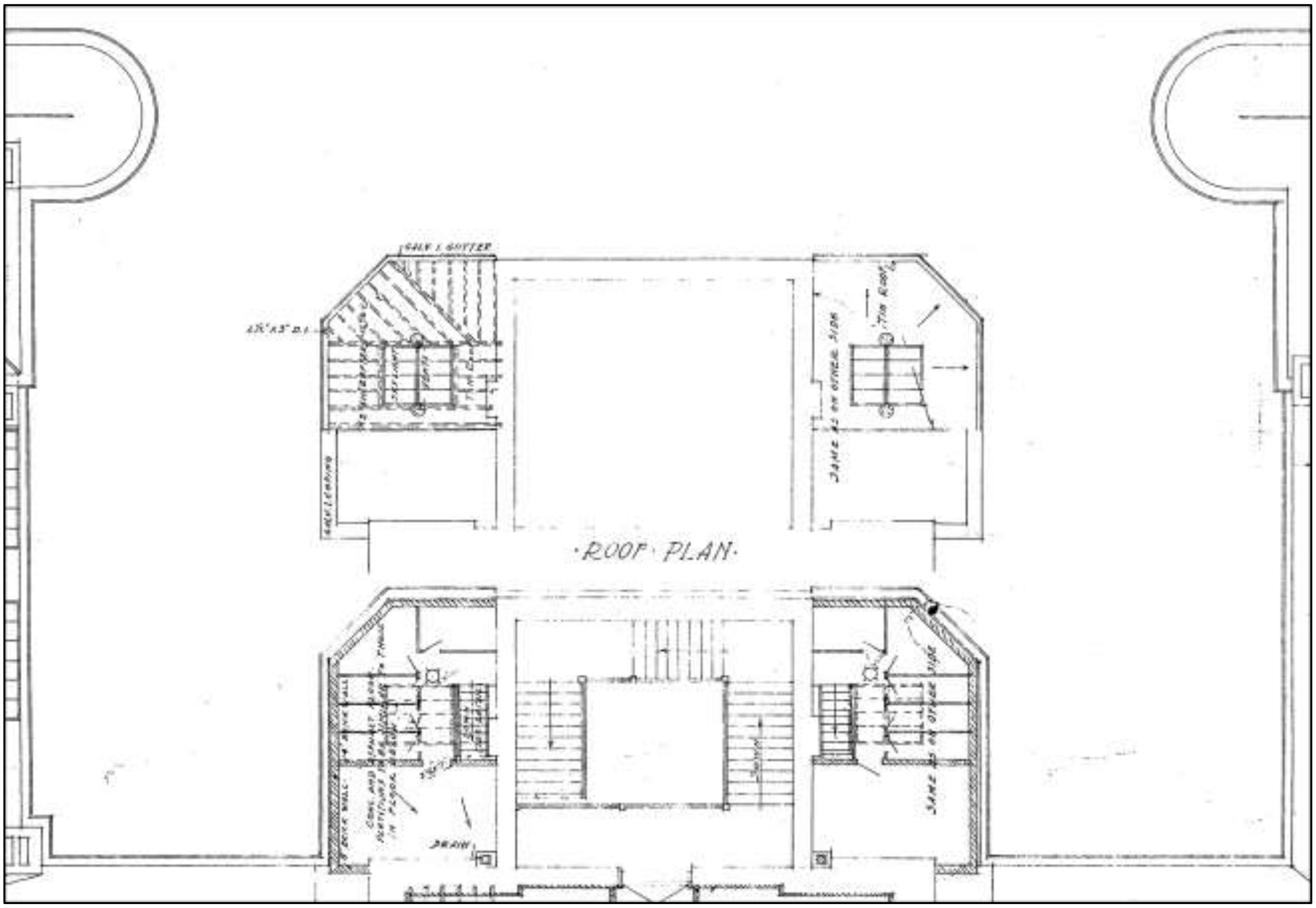

FIGURE 5. 1917 Science Hall renovation plans, fifth floor, showing construction details for the dog rooms. Source: University of Wisconsin-Madison Facilities Planning & Management.

Despite its obvious military applications, it was the Bureau of Mines in the Department of the Interior that initially coordinated chemical warfare research in the United States.[29] This made sense, because the Bureau was already involved in research on mine gasses and self-contained breathing devices.[30] In early 1917, the Director of the Bureau of Mines, Vannoy Manning, offered the Bureau's services to the War Department for chemical warfare research.[31] He made this offer through the National Research Council, which had been formed in 1916 under the National Academy of Sciences.[32] During the war the Council's Military Committee acted as an intermediary between the Army, which posed research problems, and scientists at universities, who carried out the work.[33]

In April of 1917, with a declaration of war imminent, the Council's Military Committee added a Subcommittee on Noxious Gases chaired by Manning.[34] The Subcommittee was charged with conducting research into the generation of toxic gasses and developing antidotes to them.[35] The Subcommittee's subsequent plan for research gave the Bureau of Mines its authority to conduct chemical warfare research.[36]

Staff of the research program initially included several engineers and chemists from the Bureau of Mines, as well as Dr. Yandell Henderson, Professor of Physiology at Yale University and a consultant with the Bureau of Mines.[37] Henderson was put in charge of medical research including

> physiological investigations of gas masks, pharmacological gassing experiments on men and on animals, pathological gross and microscopic study of gassed animals, and pathological chemistry of disorders of gassed animals.[38]

Henderson set up a makeshift lab under the bleachers on the baseball field at Yale to begin gas experiments on animals.[39] Apparently the demand for test animals was so great that even the dog pounds in New Haven could not keep up, and Henderson's team sent out requests to the mayors of cities up and down the east coast to round up stray animals.[40] Eventually Henderson became Director of the Toxicology, Therapeutic, Pathological and Physiological divisions at Yale, which accounted for over 40 military personnel and almost 20 civilian employees.[41] Like other universities, Yale was eager to contribute to the war effort by supplying lab space and releasing faculty from their teaching duties.[42]

With scientists and lab space in short supply, the Subcommittee on Noxious Gases was granted authority to accept offers of assistance from scientists in the private sector and universities. Manning probed for interest by conducting a nationwide census of chemists that eventually received over 22,000 responses.[43] The census was conducted with the assistance of the American Chemical Society,[44] a strong advocate for the involvement of chemists in the war effort and one of the groups that successfully lobbied the government to continue chemical warfare research after the war ended.[45]

By the end of 1917, the Bureau of Mines had obtained the aid of labs in three industrial companies, three government agencies, and 21 universities.[46] The list of universities eventually included Bryn Mawr, Catholic, Chicago, Clark, Columbia, Cornell, Harvard, Johns Hopkins, Michigan, MIT, Ohio State, Princeton, Wisconsin, and Yale.[47] This cooperation was possible, in part, because the field of chemistry in Europe and the U.S. was highly industrialized and marked by a well-developed academic-industrial network.[48] This in turn was the result of the academic-industrial symbiosis that evolved out of the chemical dye industry, which ironically even in the U.S. was dominated by German interests.[49]

An important partner for the Bureau of Mines was American University in Washington, D.C., which had offered its buildings and grounds for free to the Army for the duration of the war.[50] American became the main center of chemical warfare research in the United States.[51] By late 1917, research facilities had been constructed at American, including kennels to hold over 700 dogs. Researchers across the country, including Henderson at Yale, transferred their experimental equipment and animals to American University for the duration of the war.[52]

By September of 1917, students and professors at the University of Wisconsin had begun researching safety measures for workers at gas-production facilities.[53] The University's role in this area became more formalized in February of 1918, when the factory protection section of the Gas Defense Service was created to study the chronic effects of exposure to war gasses and test protective devices and therapeutic treatments.[54] (Figure 6)[55]

As the functions of the Gas Defense Service expanded, the Army created a new Chemical Warfare Service in the summer of 1918 to improve coordination.[56] Under a directive of President Woodrow Wilson, the new Service absorbed the civilian research organization of the Bureau of Mines and leading researchers were given Army commissions.[57] At this time there were almost 1,700 employees conducting chemical warfare research for the Bureau of Mines, including military and civilian personnel.[58] According to a report by the American Chemical Society, the workforce included not just chemists and other scientists but also a "clerical force, electricians, glass blowers, engineers, mechanics, photographers and laborers."[59] The University of Wisconsin continued to play a central role in factory protection research including chronic symptomology, pathology, X-Ray, therapy, and protective devices, with 21 military personnel on duty. (Figure 7)[60]

Faculty at War

Toxic gas was only one avenue of research conducted at the University of Wisconsin to support the war effort. In 1918 University of Wisconsin President Charles van Hise observed that 187 members of the faculty were on

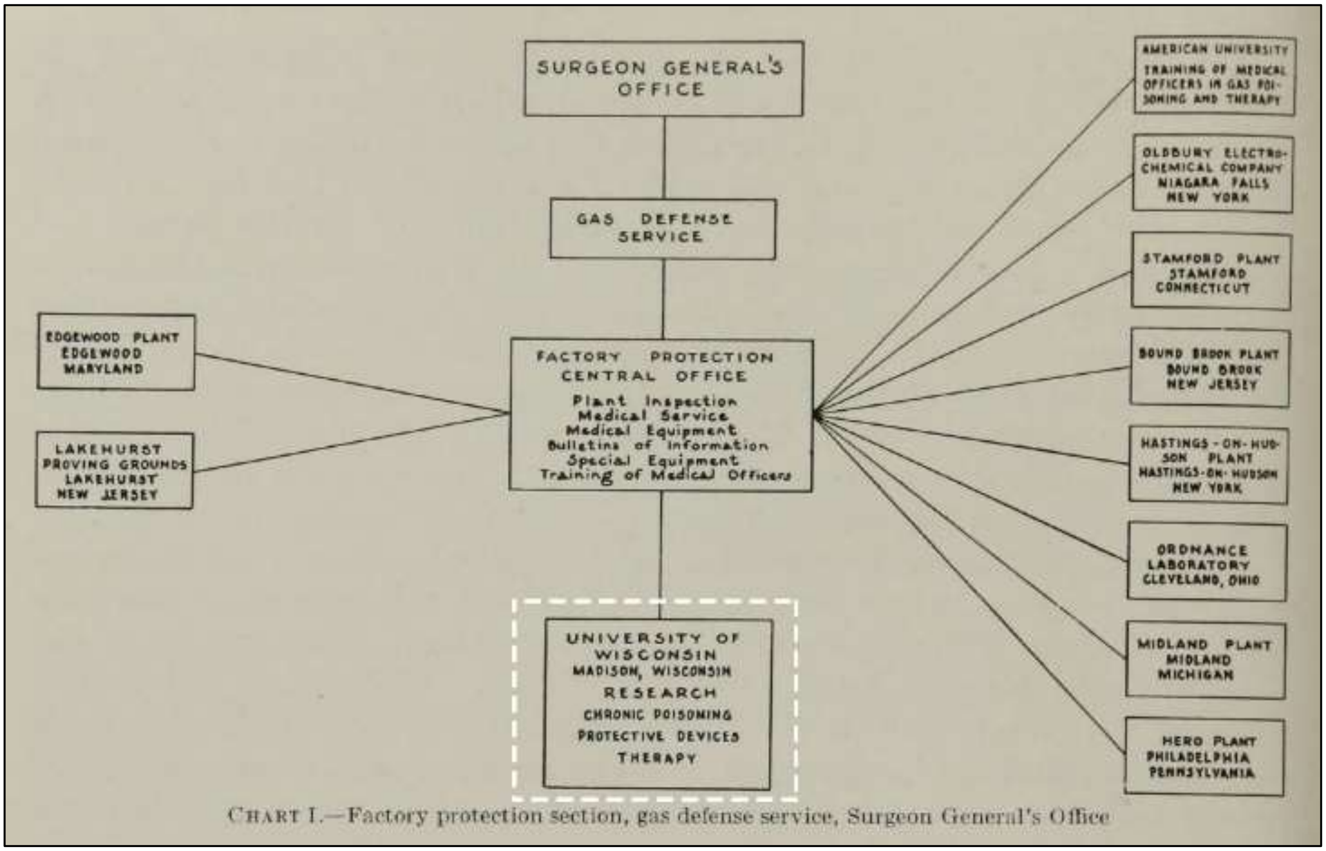

FIGURE 6. Organization of the Gas Defense Service in early 1918. Source: Wilder D. Bancroft et al., The Medical Department of the United States Army in the World War. Volume XIV: Medical Aspects of Gas Warfare. (Washington: Government Printing Office, 1926).
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leave conducting war work, while an even greater number were performing this work while also continuing their other responsibilities.[61] The university was eager to support the war effort, giving leaves of absence to faculty who requested them.[62] As van Hise noted, war research at Wisconsin touched on many fields, including "psychology, economics, history, industry, medicine, engineering, foods, gas, aerial work, and the submarine."[63] The submarine work is well-known: Max Mason, Professor of Physics, and seven of his colleagues developed a submarine detector that they tested in the waters of nearby Lake Mendota.[64] At the Forest Products Laboratory in Madison (technically a U.S. Department of Agriculture facility), researchers developed and tested new gas masks and wood products for the war.[65] From Wisconsin also came the unique idea of establishing "piggeries" at military camps to convert garbage into food.[66]

Toxic gas research at Wisconsin involved at least 15 members of the faculty studying gas manufacturing, physiological effects, remedies, and gas masks.[67] There were in addition 33 enlisted personnel and 19 civilian assistants.[68] Many graduate students were also involved.[69] Some faculty, such as Professor of Chemistry J. H. Mathews, served with the British Army abroad studying German war gasses.[70] On campus, factory safety research was primarily conducted by faculty in the Medical School under the direction of Dr. Harold C. Bradley, Professor of Physiological Chemistry.[71] In late 1917 Bradley began research on chronic gas poisoning aided by Dr. John A. E. Eyster and Dr. Walter J. Meek, both Professors of Physiology, and Dr. Arthur S. Loevenhart, Professor of

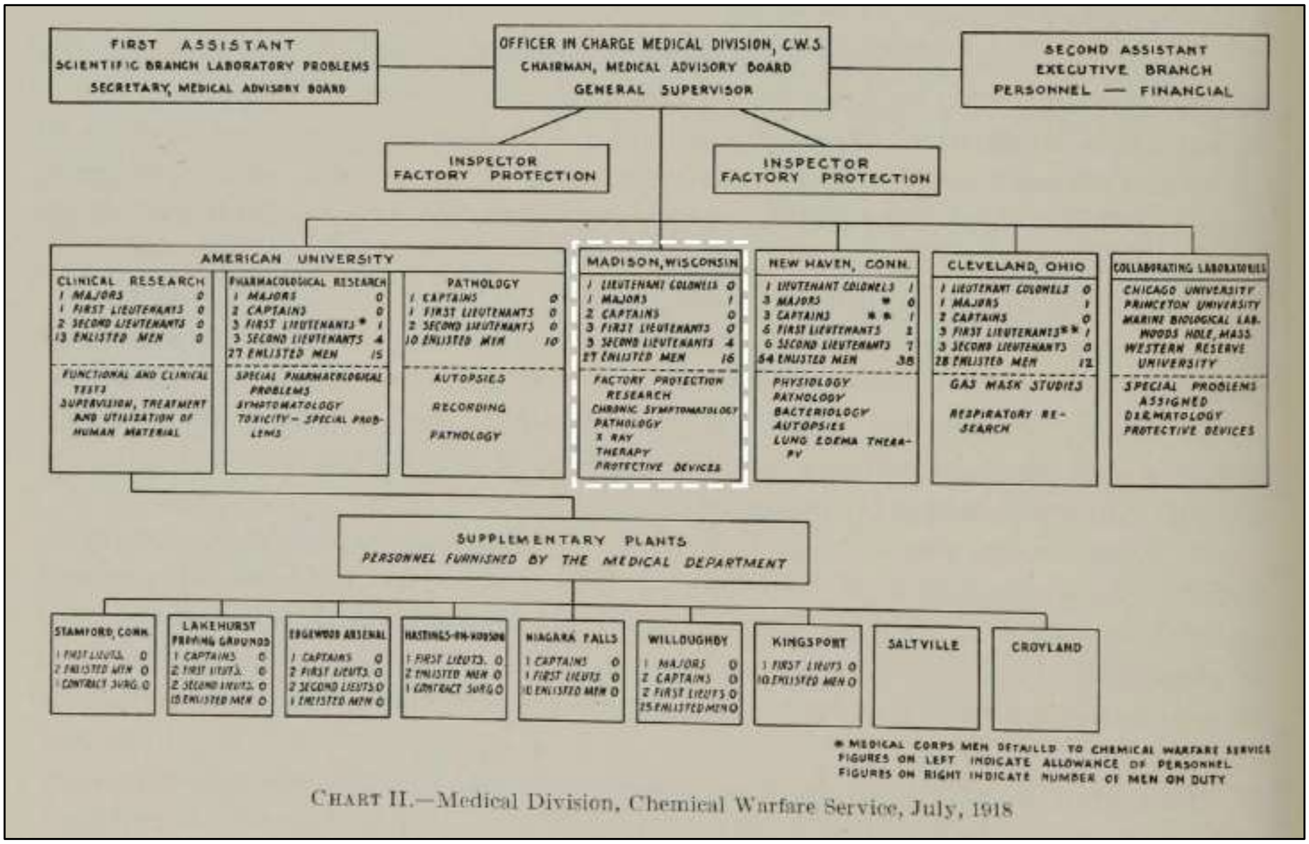


CHART II.—Medical Division, Chemical Warfare Service, July, 1918

FIGURE 7. Organization of the Chemical Warfare Service in 1918. Source: Wilder D. Bancroft et al., The Medical Department of the United States Army in the World War. Volume XIV: Medical Aspects of Gas Warfare. (Washington: Government Printing Office, 1926). collections.nlm.nih.gov/ext/kirtasbse/14120390RX15/PDF/14120390RX15.pdf

Pharmacology-Toxicology. The research program resulted in a large experimental laboratory at the University.[72]

Bradley came to Madison in 1906 from Yale, as a professor in Wisconsin's new Medical School.[73] Eyster received his M.D. from Johns Hopkins in 1905 and was appointed Professor of Physiology at Wisconsin in 1911. Meek obtained his Ph.D. in Physiology from Chicago in 1909 and then joined Wisconsin's Medical School. Eyster and Meek both served long terms as chair of the Physiology Department. Both men held wartime commissions as majors in the Army Medical Corps.[74] At the time, there was no easy way for the military to channel research funds to the universities, but one method that did work was to grant commissions to faculty members.[75]

Eyster and Meek were responsible for much of the work carried out in the university's chemical warfare unit from 1917 to 1919, including investigations into the biological effects of phosgene, mustard gas, and lewisite. Another of Meek's duties was procurement of dogs for research purposes.[76] According to Meek's biographer, this required him to appear regularly before the state Legislature to justify the use of animals against "the criticisms and actions of the antivivisectionists."[77]

Loevenhart came to Madison from Johns Hopkins and became the first chair of Wisconsin's Department of Pharmacology-Toxicology when it was established in 1908.[78] Loevenhart took on many tasks for the war effort, including testing of new offensive compounds, care and breeding of animals, and supervision of the toxicological aspects of large-scale field tests.[79] His work included experiments on dogs, rabbits, guinea pigs, mice, rats, monkeys, and even people.[80] Loevenhart was also a commissioned officer during the war.[81]

The offices and labs of Eyster, Meeks, and Loevenhart are identified on the 1917 renovation plans of Science Hall. Eyster's office and private lab were located on the first floor, where the Geography Department's main office sits today. Through his private lab he had access, down a short flight of stairs, to a physiology lab located next to a large lecture hall that is still in use today. Loevenhart had an office and private lab in the north wing of the first floor, adjacent to an even larger physiology lab. Meek had an office on the first floor and a private lab in the basement.

It has been reported that the basement of Science Hall was the center of gas research at the University at this time, and that gas chambers were constructed there.[82] This is possible but it does raise some questions about exactly where in the basement these gas chambers were located, as well as the likelihood that researchers would have been permitted to vent toxic gasses out of the building at pedestrian level. The 1917 renovation plans do show a "fume room" in the basement, but it is not clear that this room was used for toxic gas research. To add to the mystery, the northeast corner of the building has been torn off the university's copy of the basement diagram. (Figure 8)[83]

The Experiments

As noted earlier, the use of dogs in chemical warfare research during the First World War originated at Yale under Yandell Henderson's direction. Another Yale faculty member involved in this line of research was Frank Underhill, Professor of Experimental Medicine. Underhill received an Army commission in 1918 and became commanding officer of the Yale Station of the Chemical Warfare Service.[84] By the end of the war, Underhill supervised 38 staff members, both civilian and military, including seven staff responsible for gassing of animals.[85] Underhill focused on therapeutic work involving the examination of gassed animals and the treatment of gas poisoning.[86]

At over 300 pages, Underhill's 1920 book, *The Lethal War Gases*, describes the Yale gas experiments in excruciating detail.[87] The 1926 compendium by Bancroft and others entitled, *Medical Aspects of Gas Warfare*, with almost 900 pages, offers even more details on the experiments done at Yale, American, Wisconsin, and elsewhere.[88] It is difficult to say how many dogs (and other animals) were killed, but given the statistics shown in tables and appendixes, the number must have been in the thousands.

The research program was exhaustive. Scientists at universities across the country studied most of the major war gasses, focusing the most attention on chlorine, phosgene, chloropicrin, and mustard gas. They examined the effects of these gasses on seemingly every body part: Heart atria, lung tissue, bronchial tubes, capillaries and blood vessels, kidneys, intestines, and even the skin and eyes. They examined the effects on respiration, pulse, body temperature, metabolism, blood concentration, blood oxygen levels, and hemoglobin. They looked for signs of burns, pneumonia, bronchiolitis, emphysema, pulmonary edema, pleurisy, leukocytosis, heart dilation, acidosis, and decline in kidney function.

To obtain consistent results, researchers followed a standard "experimental method of gassing" consisting of passing a mixture of gas and air through an air-tight chamber containing the dog for a definite period at a determined rate.[89] Dogs were always gassed singly rather than in groups.[90] Dogs of both sexes and various breeds, ages, and states of nutrition were selected.[91] Depending on the gas administered, symptoms could include restlessness, barking, urination, defecation, blinking, dizziness, sneezing, coughing, nasal secretion, salivation, retching, vomiting, dyspnea, cyanosis, and convulsions.[92] Underhill's book contains a drawing of the animal gas chamber, reproduced below in Figure 9.[93] Henderson designed the original apparatus but Underhill and others apparently improved upon it.[94]

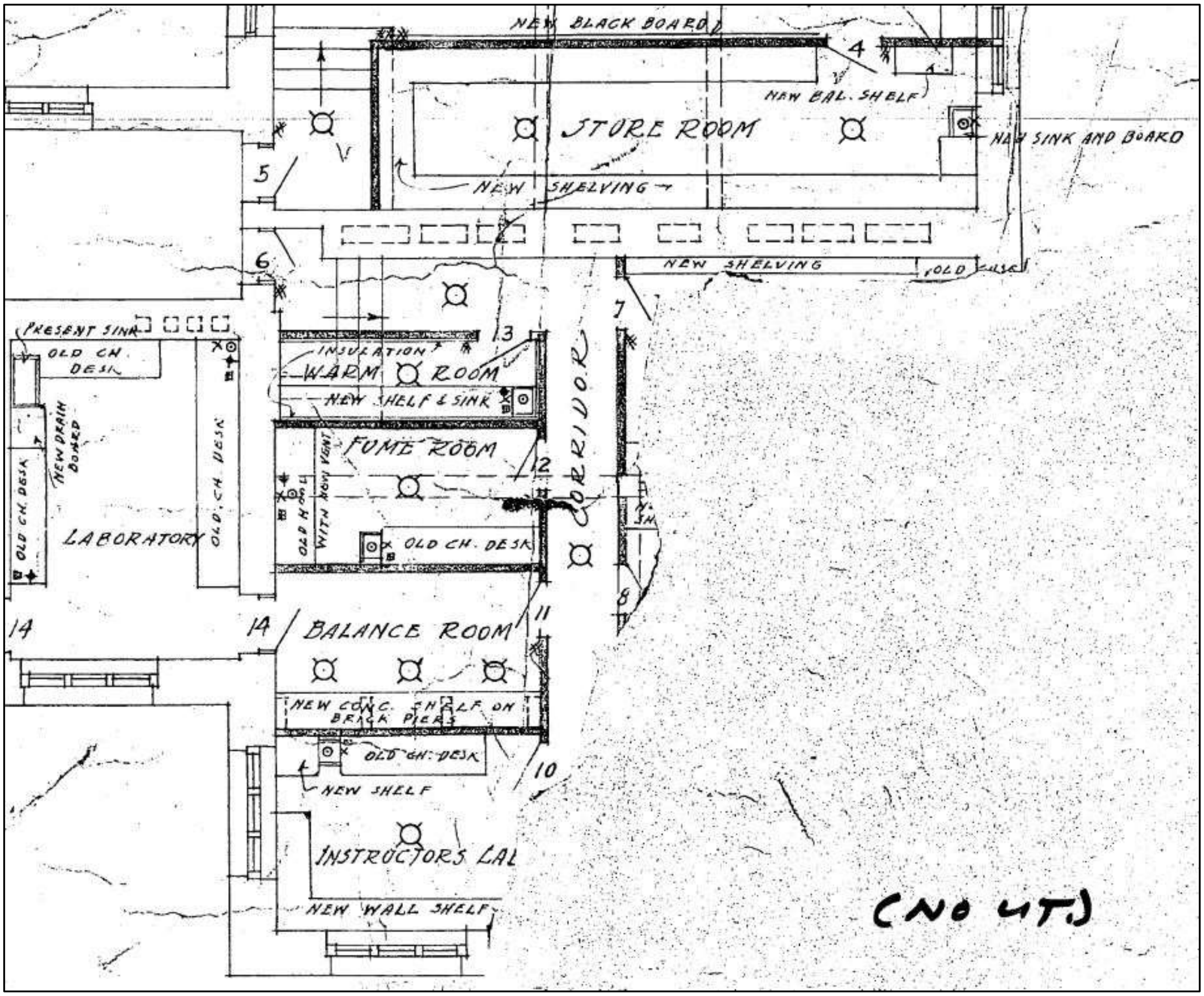
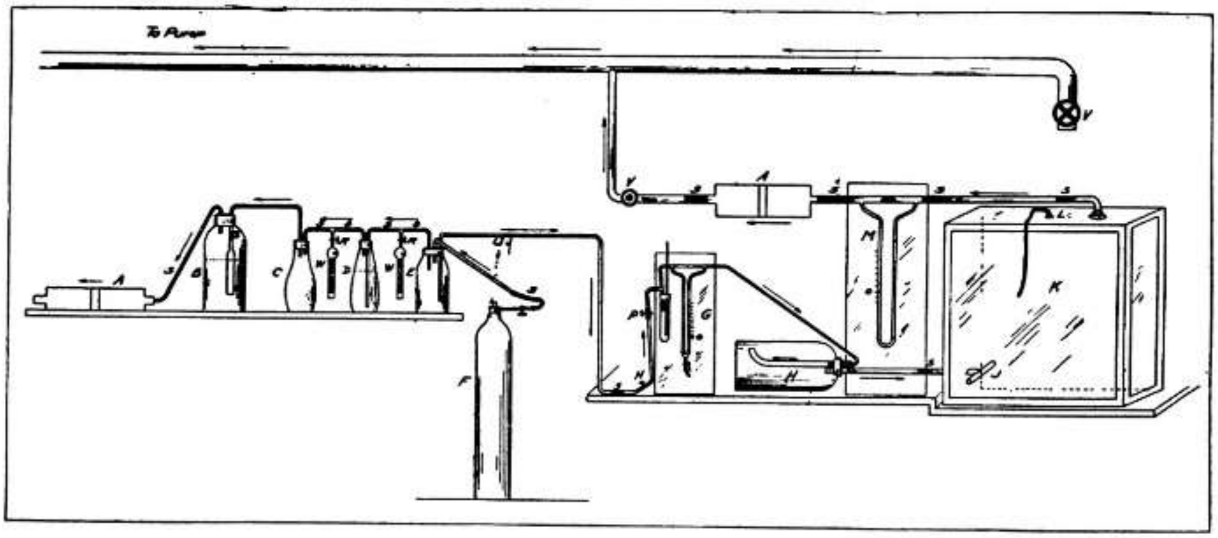


FIGURE 8. 1917 Science Hall renovation plans, basement, showing the missing portion of the plan for the northeast corner. Source: University of Wisconsin-Madison Facilities Planning & Management.

Considering just one of the gasses studied, phosgene, researchers found that dogs generally died from three to 12 hours after gassing, although this depended on the concentration of phosgene administered. Dogs gassed at low concentrations often lived for weeks or recovered completely.[95] However, dogs that recovered were not necessarily safe, as researchers sometimes gassed them a second time to determine if they were more susceptible due to repeated exposure.[96] Researchers also deliberately killed some dogs that survived gas poisoning—for example, by strychnine injection—so that they could take tissue samples.[97] Some dogs were starved before being gassed to obtain a clearer picture of metabolic changes expressed in urine samples, and some were "water starved" to explore toxicity rates at different levels of hydration.[98]

Ultimately researchers were not able to determine definitively whether poison gasses caused death as a result of pulmonary edema or a change in blood concentration.[99] Several antidotes were tested, including venesection (blood letting), infusion (injection of a salt solution or other chemicals, including morphine), and administration of water and oxygen. Typical of the results is the recommended treatment for chlorine poisoning: Venesection of 1%



Description of Chlorine and Phosgene Gassing Apparatus (Fig. 55).

Gas passes from gas cylinder (F) to bottle (E), where a certain pressure is always maintained by means of concentrated H_2SO_4 in (D). The excess of gas passes through (C) into (B), where most of it is absorbed. Any unabsorbed gas passes into the metal absorber (A), where it is completely taken up. The safety valves (R) are closed during all gassings. They are opened when the apparatus is not in use to prevent the liquids in (D) and (B) from being siphoned to the right.

From the bottle (E) the gas passes by means of a delivery tube to the gas flowmeter (G) which measures the rate of flow of the gas. The gas flow is controlled by the glass stopcock (N) and pinchcock (P). From here the gas passes into the glass mixer (H). Air is also drawn into the mixer (H) by means of a suction pump, and the rate of flow of air is measured by the flowmeter (M) which is controlled by the valve (V). The mixture of air and gas then passes through the T-tube (J) into the gassing chamber (K).* It leaves the chamber from the top, passing through the air flowmeter (M), then into the metal absorber (A), where most of the gas is taken up, and then passes out through the suction pump and up through the flue.

Samples of the mixture of gas and air are taken at three-minute intervals from the top of the gassing chamber (K) by means of the outlet tube (L).

Fig. 55. Gassing Apparatus.

A — Absorption cans containing soda-lime and charcoal.
B — Absorption bottle containing a saturated solution of caustic soda.
C — Safety bottle.
D — Bottle containing concentrated H_2SO_4.
E — Empty bottle (gas supply).
F — Gas cylinder.
G — Gas flowmeter.
H — Mixer (for gas and air).
J — Metal T-tube.
K — Gassing chamber.

*A standard rate of flow through the chamber of 250 liters per minute was adopted. With this rate, a desired concentration can be attained in from 2 to 4 minutes.

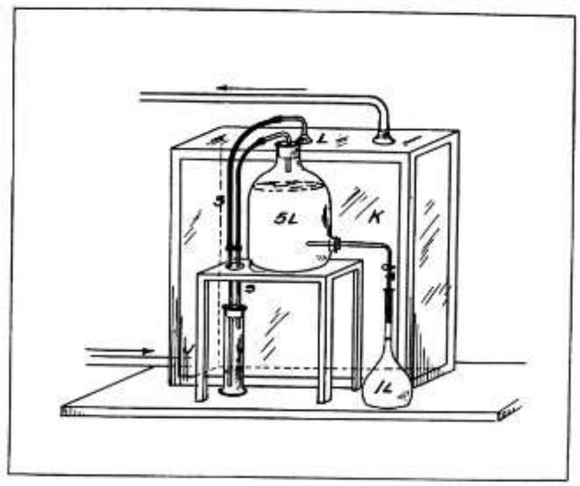


Fig. 55.

FIGURE 9. Underhill's dog gassing apparatus. Source: Frank P. Underhill, The Lethal War Gases: Physiology and Experimental Treatment. (New Haven: Yale University Press, 1920). hdl.handle.net/2027/uc1.31378008169438

of body weight in blood, intravenous infusion of warm sterile isotonic solution, and administration of sodium bicarbonate orally, to be carried out one to two hours after gas exposure.[100]

Tests on humans were initially improvised but later became more systematic. One experiment in mid-1917 involved Henderson entering a gas chamber to test the effectiveness of a new gas mask on chlorine. He remained in the chamber for 15 minutes. The gas bleached his socks and hair, and dissolved his shirt.[101] Another researcher stayed with a dog in a gas chamber filled with hydrocyanic acid until the dog had been killed, proving that humans are less sensitive to this gas than dogs.[102] A man-test section was eventually established at American University, where various experiments were performed. Subjects were exposed to tear gasses to assess their lachrymatory effect. They were sprayed with mustard gas to determine the lowest level that would incapacitate the subject, leading in some cases to temporary blindness. They were daubed with blistering agents that caused pustules to form.[103] It seems every possible contingency was explored.

The Wisconsin Experiments

The experiments conducted at the University of Wisconsin are documented in a study by Meek and Eyster, published in 1920 in the *American Journal Of Physiology*[104] and—in slightly modified form—in a chapter of the compendium by Bancroft et al.[105] The study pays particular attention to the physiological reactions associated with fatal phosgene poisoning, including

> arterial blood pressure, venous blood pressure, pulse rate, hemoglobin determinations, blood volume, red blood cell counts, histological examination of the lungs, x-ray studies of heart and lungs, alkaline reserve, respiratory rate and volume of respiratory ventilation.[106]

Meek and Eyster used dogs as subjects throughout the experiments. They gassed the animals for 30 minutes with phosgene at a concentration sufficient to cause death within 24 hours, with death occurring at 16 hours on average. The method of gassing was similar to that described by Underhill:

> placing the dogs in a one-hundred-liter air-tight glass box through which air was drawn at the rate of one hundred liters per minute. The phosgene cylinder was connected to the air inlet tube, the gas outflow being regulated by a needle valve and the rate roughly determined by a flowmeter.[107]

One hundred liters is approximately 3.5 cubic feet—or a cube with sides just a little over 1.5 feet long—which suggests that the dogs were not very large. All dogs were tied to operating boards by their limbs to facilitate rapid and frequent observations. According to the authors, the animals "lay quietly and comfortably until the usual asphyxia stimulations occurred shortly before death."[108]

Like their counterparts at other universities, the Wisconsin gas testers probed the dogs in various ways following gassing, and sometimes killed them to take tissue samples. Dr. W. S. Miller of the Anatomy Department conducted histological examinations of lung tissue, using special methods of his own development.[109] X-rays of the thorax were made at regular intervals after gassing to measure changes in the lungs and heart.[110] The 1917 renovation plan shows an X-ray room in the basement, suggesting that dogs may have been lowered there after gassing, perhaps via the cadaver lift while strapped to their operating boards.

Meek and Eyster, like Underhill, concluded that death by phosgene poisoning was attributable to some combination of pulmonary edema and a change in blood concentration.[111] In an effort to identify remedies, the Wisconsin researchers were able to keep some gassed dogs alive up to 72 hours by placing them in oxygen-rich chambers. Unfortunately the effects were not restorative, and if released from the chambers the dogs typically fell into "asphyxia convulsion which quickly terminated in death."[112] Concluding that the administration of oxygen was essentially just a palliative, the authors did not speculate further on any treatments for phosgene poisoning.[113]

The Dog Rooms Today

Meek and Eyster continued using dogs for research purposes into the 1920s, although these later research efforts probably did not involve toxic gasses. The pair published several articles on research involving dogs while still working in Science Hall.[114] According to Harland W. Mossman, Professor of Anatomy in Science Hall from 1924 to 1957, at least one of the rooms still held dogs for the Physiology Department in 1924.[115] Mossman recalled that the room (or rooms) needed a thorough cleaning after Physiology moved to the Service Memorial Institutes in 1928.[116] William B. Youmans, a student of Meek's in the 1930s, recalled being responsible for dogs in the Service Memorial Institutes.[117] Youmans prepared them for experiments, which included eliciting the assistance of the lab handyman to administer an anesthetic. And of course, dogs and other animals continue to be used in medical research through the present day, albeit under heightened professional standards.

We do not have any direct eyewitnesses to what happened in Science Hall's dog rooms 100 years ago, but the circumstantial evidence points strongly to the conclusion that they were used for poison gas research involving dogs. The rooms were self-contained and isolated from the rest of the building, permitting work to be carried out in some secrecy. The stairs with their protective wire netting balustrade would have provided a safe and convenient way to move dogs to the upper level. The various chambers on the upper level could have been used for a variety of purposes, including preparation of the dogs for gassing. The large room over the corridor may have been used to hold dogs if recovery or delayed death was anticipated; the drain in this room would have been useful for disposing of waste.

The fact that there are no windows on the upper level of the dog rooms suggests a desire for privacy, while the soundproof construction would have inhibited noises such as barking—one of the symptoms of gassing—from annoying or alerting other tenants of the building. The cadaver winch on the north wing would also have been convenient to move dogs to the basement for X-rays or to be disposed of after death. It also seems plausible that the large roof vents in the dog rooms were designed to vent gas through the flue in Underhill's gassing apparatus. If the rooms appear too small and cramped for such work, recall that the gas chamber Meek and Eyster used was only 100 liters in volume. Perhaps only small dogs were used in the experiments due to the limited space available in the building.

Would researchers have been allowed to store and release poison gas in Science Hall at this time? If so, did other building tenants know this was going on? Our ancestors seem to have had a more accepting attitude toward such dangers. For example, at this time poison gasses were sometimes mailed from one research lab to another, and would occasionally arrive at their destination in damaged or leaking condition.[118] Likewise there are many documented accidents at the American University labs, including accidental gas releases, explosions, and exposures to deadly chemicals leading to death.[119] Perhaps the ceiling vents in Science Hall's dog rooms were enough to mitigate concerns about gas escaping into the building. It is noteworthy that Science Hall has only one group of windows on the fourth floor in the rear of the building (the pair of arched windows visible in Figures 1, 2, and 3). Therefore there was little chance of vented gas wafting into other parts of the building. In any case, there were probably many other dangerous chemicals being used in Science Hall at the time, including ether, formaldehyde, and gaseous fuels. And one floor below the dog rooms was a large bacteriology lab. In those days Science Hall was a dangerous place.

After the dogs were moved out, the dog rooms were converted to more conventional uses. The 1929 renovation plan for Science Hall called for new tile and furring, plaster on the walls and ceiling, and a new cement floor.[120] The plan also gave directions for the removal of the partitions on both levels. Today the rooms seem unusual but innocuous. The upper level is a curiosity, suitable for storing old books and maps. It has lost its skylight and ventilators. With its low ceiling and lack of windows it feels claustrophobic, but not ominous. The sink and drain on the lower level have been removed, as evinced by a patch on the wood floor. The original stairs with their metal netting balusters are still in existence, and the massive soundproof doors—which must be three inches thick—still hang on oversized hinges. But these are the exceptions, and for the most part the rooms feel quite ordinary. It takes some effort to imagine how they would have looked at the end of the First World War, with the dogs in their kennels and strange medical equipment lying about.

History is so easily forgotten, especially when the spaces where history happened are covered in layers of plaster and paint. It's hard to see the history that unfolds from everyday events in everyday spaces. In the meantime, rooms are clumsily altered for new uses, walls are erected or removed, doorways and windows are closed off, and the historic fabric is torn to pieces. History, of course, is irreversible. Philosopher Walter Benjamin, reflecting on Paul Klee's painting "Angelus Novus," saw human progress as a storm piling up the wreckage of the past at the feet of the angel of history, who is unable to go back and repair the damage.[121] Science Hall is like that. Its interior has been so utterly transformed over the decades that it is almost impossible to mentally reconstruct the original floor plan, let alone imagine what it was like to work there. The Science Hall that Meeks and Eyster knew is gone forever. We will never be able to fully understand how the dog rooms were used, experience their sounds and smells, or grapple with questions about the morality of our actions in those spaces at that time. Even with the scraps of the historical record that have survived, we need to lean heavily on our imaginations. The building will not give up its darkest secrets without a struggle.

Madison, Wis., 2021-22

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