UNDERSTANDING THE BUNSEN BURNER

SUMMARY:

Proper lighting of the Bunsen Burner is demonstrated. By placing of cardboard, a match assembly and wire in the flame, regions of combustion and variations in temperature are noted.

MATERIALS:

Bunsen burner
Matches
Pins
Thin piece of copper or platinum wire
Cardboard
Tongs

PROCEDURE:

1. Connect a bunsen burner to the gas outlet, turn on the gas and bring a lit match directly into the area at the top of the barrel. (With good gas pressure, the match is blown out.)

2. Take a 2nd match and bring it slowly over the edge of the barrel from the side (lighting occurs).

3. With burner lit, turn flange at base of burner so air supply is closed off. (Often one can improve result by using your hand to close off air more efficiently.)

4. With the burner lit, use tongs to hold a piece of cardboard vertically in the flame. As charring occurs, remove cardboard (blow out any fire that has started) and show to students.

5. With the burner lit, use tongs to hold a piece of cardboard horizontally in the flame. As charring occurs, remove cardboard and show to students.

6. Take a thin piece of copper or platinum and slowly move it up and down in the flame.

7. Take a match and place a pin through the stem directly below the head of the match. Place the match assembly into the barrel of an unlit burner so that the head barely shows above the barrel. Turn on the gas and light the burner. If match does not light turn the flame down until it does.

8. Take a wire screen and hold it about 3 cm above the burner. Turn on the gas and light above the screen. Move screen up and down.

HAZARDS:

Don't burn yourself.
Do not leave gas on without lighting burner quite quickly.

DISCUSSION:

1. What is needed for burning to occur?
2. What is the meaning of the yellow flame versus the blue flame?
3. Why does the pattern of charring occur as it does?
4. Where is the burning occurring?
5. Where is the flame the hottest?
6. Where is the flame the coolest?
7. How can the match remain unlit in the middle of the flame?
8. (If wire melts) Can we tell anything about the actual temperature of the flame?
9. What color flame is the hottest?
10. Explain the observations of the burner and the screen.
11. How is the burner and screen related to "mine" safety?

ADDITIONAL INFORMATION:

The Bunsen Burner is named after the 19th century German chemist, Robert Wilhelm Bunsen

When the burner is operated with a 3:1 gas mixture the flame consists of two regions; the inner region, known as the reducing zone, consists of partially burned gases, while the outer cone (oxidizing zone) has nearly complete combustion. Depending of the efficiency of the burner, temperatures from 900°C (1600°F) to 1850°C (3360°F) can be obtained.

Draw and label the parts of this flame!

THE BACK BURNER

Robert Bunsen . . . more than a burner design

by *Derek Davenport*

Some men are fated to be remembered for a single achievement—and not always their most glorious. Who recalls Custer's *first* stand? In chemistry, Erlenmeyer lives on as a flask, Claisen as a condenser, Gooch as a crucible and, above all, Bunsen as a burner. In remembering him thus, we do scant justice to Robert Bunsen, one of the greatest and most influential of 19th-century chemists. Besides, the design of the famous burner was not entirely new and Bunsen's instrument maker played as large a part as he in its perfection.

Robert Bunsen (1811–1899) was born in Gottingen, Germany, the son of the chief librarian and professor of modern languages at the university. A precocious student, he received his doctorate degree at the age of 19. For the next three years he traveled and studied in Germany, France, and England before embarking on his long and illustrious academic career.

His first major research was on *cacodyls*, compounds containing carbon, hydrogen, and arsenic. The most important of these proved to possess the molecular formula, $C_4H_{12}As_2$. These compounds were all highly poisonous, often spontaneously flammable, and were possessed of smells to make a billy goat blush. Bunsen described one of these compounds thus: "The smell of this body produces instantaneous tingling of the hands and feet, and even giddiness and insensibility. . . It is remarkable that when one is exposed to the smell of these compounds the tongue becomes covered with a black coating, even when no further evil effects are noticeable."

From such unlovable compounds Bunsen was able to establish one of the most important principles of organic chemistry—that in some chemical reaction sequences a particular group of atoms (in this case a CH_3- or methyl group) may survive totally untouched. This principle was one of the keys to the developing science of organic chemistry, which was shortly to enter upon its golden age. But when an explosion of cacodyl cyanide caused loss of sight in his right eye, Bunsen decided, golden age or not, to swear off organic chemistry for life. His remaining labors were, in the broadest possible sense, concerned with chemical analysis.

An expert glass blower, Bunsen perfected methods for manipulating and analyzing gases in a quantitative way. He then applied these methods to the improvement of blast furnaces, to the analysis of gases from Icelandic volcanoes, and to the photochemical and combustion behavior of mixtures of gases. A minor by-product of this research was the perfection of the immortal burner. He never patented his invention and indeed mentioned it only in passing in some of his papers.

In 1855, the city of Heidelberg was first illuminated by coal gas. Bunsen was in the process of designing his new laboratory (much of his previous work had been done in an abandoned monastery), and he was eager to employ the gas, not so much to illuminate the laboratory, but to replace the old, inconvenient, and sooty furnaces then in use for heating reaction vessels. He drew on earlier work by Humphry Davy and Michael Faraday in England and on designs by Aimé Argand and others in France, all of whom had tried to perfect a hot and smokeless gas flame. Working with his instrument maker, Peter Degasa, Bunsen devised the burner we know today in which the essential premixing of air and gas is controlled by a rotating sleeve. The trick was to premix the gases in such a way that the flame did not "strike back" even in the absence of the wire gauze used in the Davy–Faraday miner's safety lamp. Bunsen and Degasa succeeded admirably.

Bunsen was the first to use carbon (graphite) cathodes and zinc anodes in a battery, with chromic acid serving as electrolyte and depolarizer. With a bank of these batteries, he purified many of the known metals in bulk—chromium, magnesium, barium, strontium, cerium, and lanthanum. And in the early 1860s he discovered the remaining alkali metals, cesium and rubidium, in certain mineral waters.