Review of

The Chemistry of Fireworks

Michael S. Russell
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Michael S. Russell's treatise on the chemistry involved in the composition of display fireworks is a welcome primer on the chemistry of pyrotechnics. While this book was written for the student with 'A' level qualification or equivalent, it has potential for use in a college level general chemistry course. (The British 'A' level equates to Advanced Placement (A.P.) coursework at the high school level in the United States.)

Russell's 12 chapters cover the basic devices used in fireworks and conclude with pyrotechnic safety, and British regulations and standards. Chapter 1 includes a seven-page glossary of pyrotechnic terms designed to help the person reading pyrotechnic literature for the first time. Some of the definitions are quite brief and do not completely explain some key terms. *Stars* are defined simply as "a compressed pellet of explosive composition designed to be projected as a pyrotechnic unit". This definition excludes two major forms of stars—rolled and cut. This reviewer found the glossary helpful in translating some of the British terms for fireworks; terminology is not always the same. For example, the U.S. pyrotechnician would know the *burster* as the burst charge or composition, the British term for lift charge is *propellant,* and U.S. terms Quick match and Black Match are called *piped match* and *quick match*, respectively in Britain.

Chapter 1—Historical Introduction is a nine-page condensation of the history of Black Powder. While this survey focuses on the development of Black Powder in Britain, Russell also covers key international history and gives

the reader a chronological time frame to see how this compound has progressed. Starting with the Chinese and Arabs as the discoverers of Black Powder he continues through Roger Bacon's work ending with modern day knowledge.

Chapter 2—The Characteristics of Black Powder gives the reader a very concise yet sufficient account for understanding some of the basic dynamics of Black Powder. Russell includes the influences of composition density, moisture and the stoichiometry. This chapter could be used in practical application for teaching such basic tenets of chemistry as: heat of reactions, enthalpy change, stoichiometry, and activation energy as applied to ignition temperature.

Chapter 3—Rockets invokes the science of physics and chemistry in describing the basics of rocketry. This ten-page chapter provides an introductory view of the key principles including propellants, ballistics (internal and external), and influences of rocket design.

Chapter 4—Mines and Shells deals with the two major devices used in modern display fireworks. Once again internal and external ballistics are discussed. Russell uses the European system to describe shell diameter in millimeters in contrast to the U.S. practice of describing shell and mortar dimensions in inches. He describes the current trend toward using plastic hemispheres to construct ball type shells. While plastic has grown in popularity, he refers to a type of plastic shell with lift included that is rather outdated and not currently seen in the U.S. The author introduces mines but gives little description of how they are constructed as compared to aerial shells.

Chapter 5—Fountains not only describes how fountains are constructed, but also introduces the reader to atomic and quantum theory. This information prerequisites a cursory understanding of how different colors are produced in fountains and other fireworks. His descriptions are adequate for this level of book, but he fails to complete the discussion in this chapter.

He writes about **Sparklers** in **Chapter 6** and **Bangers** in **Chapter 7**. Then in **Chapter 8—Roman Candles** he finishes explaining how the main colors of fireworks are produced. As an introductory text this separation does not help the newcomer to pyrotechnics to apply the theory with current applications. I would recommend this subject be discussed consecutively rather than dispersed among different chapters. These chapters, however, do provide the novice a clear initiation point as to how these items perform.

He divides the discussion of color by giving the standard information for green and red stars in Chapter 8; blue stars are completely omitted. Blue producing compositions are the most challenging to understand and consistently make, and they are not discussed until two chapters later in **Chapter 10—Special Effects,** which describes how different color lance materials, including blue, are formulated. The author does an ample job of handling the current understanding of how blue flames are produced during the combustion of the pyrotechnic material. Unfortunately, this discussion occurs some five chapters after this subject was introduced. Consolidating the discussion of color would have strengthen this text and afforded a more systematic and cohesive understanding of this key topic. **Chapter 9—Gerbs and Wheels** provides a good description of these interesting and entertaining historic fireworks devices.

Chapter 11—Fireworks Safety and **Chapter 12—Fireworks Legislation** help the reader to begin to grasp how important safety and following the regulations are to properly and legally displaying fireworks.

This book would make good reading material as a supplemental text to a high school A. P. Chemistry or General Chemistry college course. Fundamental principles of chemistry can be illustrated through their applied uses in pyrotechnics, and this text provides some of that correlation. The author has some errors such as in Chapter 2 equations 2.9 and 2.10, where k, the rate constant for a reaction, is equal to t the time to ignition. The rate constant (k) will increase with a temperature increase, whereas the time to ignition (t) must decrease. Perhaps this was a transposed equation that could be easily corrected in a second printing of this text. While this volume can be improved, it does offer a starting point for the beginning student of pyrotechnics and chemistry.