

Review of *Fireworks Principles and Practice*

Ronald Lancaster

3rd ed., Chemical Publishing, New York, 1998
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It is unlikely that many readers of these pages have not yet bought a copy of the third edition of the Reverend Ronald Lancaster's *Fireworks Principles and Practice* (Chemical Publishing, New York, 1998). Those who have ignored this edition, because they already own first or second editions, should think again. If you enjoyed the previous editions, you will find still more to enjoy in this latest one.

Comparison of the Tables of Contents of the Three Editions.

First edition (1972)	Second edition (1992)	Third edition (1998)
The History of Fireworks ^[a]	The History of Fireworks ^[a]	The History of Fireworks ^[a]
Firework Materials	Firework Materials	Firework Displays ^[b]
		Gunpowder
		Firework Materials
General Pyrotechnic Principles	General Pyrotechnic Principles	General Pyrotechnic Principles
		Chemistry of Firework Composition ^[c]
		Legislation ^[d]
Mixing and Charging	Mixing and Charging	Mixing and Charging
Containers	Containers	Containers
Stars	Stars	Stars
Coloured Fires, Bengals, Lances, Portfires, Torches	Coloured Fires, Bengals, Lances, Portfires, Torches	Coloured Fires, Bengals, Lances, Portfires
Roman Candles, Comets, Mines	Roman Candles, Comets, Mines	Roman Candles, Comets, Mines
Noisemakers	Noisemakers	Noisemakers
Rockets ^[e]	Rockets	Rockets
Drivers, Saxons, Tourbillions	Drivers, Saxons, Tourbillions	Drivers, Saxons, Tourbillions

Comparison of the Tables of Contents of the Three Editions. (Continued)

First edition (1972)	Second edition (1992)	Third edition (1998)
Shells	Shells	Shells
Gerbs, Fountains, Rains, Squibs, Cones	Gerbs, Fountains, Rains, Squibs, Cones	Gerbs, Fountains, Rains, Squibs, Cones
Pinwheels and Crackers	Pinwheels and Crackers	Pinwheels and Crackers
Indoor Fireworks	Indoor Fireworks	Indoor Fireworks
Fuses, Quickmatch	Fuses, Quickmatch	Fuses, Quickmatch
Smoke	Smoke	Smoke
Exhibition Fireworks	Exhibition Fireworks	Exhibition Fireworks
The Manufacturing Processes for Fireworks Composition ^[c]	The Manufacturing Processes for Fireworks Composition ^[c]	The Manufacturing Processes for Fireworks Compositions. Japanese Fireworks ^[c]
		Glossary
		References
		Index
19 Chapters with 274 Pages	19 Chapters with 318 Pages	24 Chapters with 448 Pages

[a] Written by Roy E.A. Butler; [b] Written by J. Mark Lancaster; [c] Written by Takeo Shimizu; [d] Written by Thomas A.K. Smith; [e] Written by Ronald G. Hall.

When the first edition appeared in 1972, it was the first new book in English to deal with the technical details of firework making since the publication of the revised and enlarged second edition of George Washington Weingart's *Pyrotechnics* in 1947. The reprinting of Weingart's book in 1968 provided the stimulus for Lancaster's first book. Previously, Lancaster had contributed a chapter on fireworks to Dr. Herbert Ellern's *Military and Civilian Pyrotechnics*. At the time the first edition of *Fireworks Principles and Practice* was published, Lancaster was chaplain of Kimbolton School and a firework consultant to Pains-Wessex Ltd. He is now the Managing Director of Kimbolton Fireworks Ltd., by far the largest of the very few remaining firework manufacturing operations in Britain. Lancaster is a Fellow of the Royal Society of Chemistry and has been made a Member of the Most Excellent Order of the British Empire in recognition of his achievements. It is only to be expected that the writings of such a distinguished fireworker would be eagerly sought by anyone interested in pyrotechny.

The first two editions are so similar in size and appearance that it is difficult to tell them apart on the bookshelf. The third edition is a larger book, and, unlike the previous editions, is

provided with a dust jacket. A very appealing feature is a large range of black and white photographs, including many from the archives of Brock's Fireworks. The reproduction of these photographs does not always do them justice. It is disappointing to find poorly reproduced pictures in an expensive reference book, especially when cheap magazines and advertising brochures routinely contain pictures reproduced to a far higher standard. The book is also illustrated with many line drawings. The standard of these drawings varies considerably; some are first rate, while a few are oversimplified to the point of being of little or no value. The few bad ones, which have survived all three editions, are out of place in an otherwise excellent book.

The first edition of this book introduced many to the work of Dr. Takeo Shimizu, the great Japanese pyrotechnist. Dr. Shimizu has contributed a whole new chapter to the third edition. This chapter, entitled "The Chemistry of Firework Composition", is not a general treatment of that subject but a selection of concise, informative comments on specific effects, including firefly, micro-stars, glitter and strobe.

The three other new chapters include a comprehensive discussion of gunpowder by Lancas-

ter, and one by Dr. Thomas Smith on legislation for the control of fireworks. This latter subject is obviously of vital interest to anyone contemplating an involvement with fireworks. A prospective pyrotechnist might well conclude that the effort and cost of compliance with the ever-increasing legislative controls would far outweigh any pleasure or profit that might have come from working with fireworks. It is better to find this out at the start, and abandon one's pyrotechnic ambitions, than to discover it later. Such is the pace of regulation that any summary will soon be out of date. The subject certainly cannot be ignored and deserves its place in the book.

Lancaster's son Mark has contributed a most interesting chapter on firework displays, with discussion of the different display styles typical of Spain, Mexico, Malta and Japan. A useful glossary of over three hundred terms related to fireworks has also been included in this edition.

The first chapter in the book, R.E.A. Butler's *The History of Fireworks*, has been extensively revised and provides a fascinating, detailed treatment of the subject. A tremendous amount of research must have been carried out in the preparation of this chapter. As would be expected, there is much information on the British firework industry. That story is rather depressing. In the first half of this century British firms were world leaders in fireworks. In more recent years the once renowned companies have evidently fallen victim to businessmen bent on rationalization. After a series of mergers, acquisitions and takeovers, the old firms have variously abandoned fireworks in favor of military pyrotechnics and signals, given up manufacture of fireworks to become importers and display operators, or in some instances have disappeared completely. One can only wonder just how much knowledge and accumulated experience in all aspects of firework making has been lost. We are fortunate that Ronald Lancaster has provided a permanent record of some of the insights he has gained in over 35 years in the industry.

As evident from the Table of Contents, Lancaster's own chapters cover a great deal of material. In general, these chapters document how things were (and are) done in the British firework industry and are not a compendium of

specific, detailed instructions on how to build fireworks. Readers seeking such information will find it in publications such as *Pyrotechnica*, the *Bulletin of the Pyrotechnics Guild International*, and the wide range of material offered by American Fireworks News. They would be well advised first to read Lancaster for essential background information. Lancaster presents a large number of formulae; he also outlines the procedures and techniques involved in making fireworks. He emphasizes that there are all sorts of subtle factors that can make the difference between success and failure, particularly when one needs to produce consistently well-performing products on a commercial scale.

If one had to make any criticism of the content of the book, it would be that some of the chemicals discussed, while of historical interest, really ought not to be used in modern practice. Examples include the arsenic sulfides (realgar and orpiment) and copper acetoarsenite (Paris green). In these days of concern about health and safety, the toxicity of the products of combustion of arsenic compounds should rule out their use in pyrotechny. In his chapter on firework materials, Lancaster writes (p 96): "Arsenic is safe to handle, of course, provided that precautions are taken to keep it out of the nose and mouth. ...it should be remembered that soluble barium, for example, is equally toxic." That is not quite right. While soluble barium is undoubtedly toxic, no proven long-term effects are known.^[1] Ingestion of arsenic is known to be associated with serious long-term effects including certain types of cancer.^[2] To equate the toxicity of arsenic and soluble barium is to underestimate that of arsenic and to overstate that of barium. It would be most unfortunate if zealous regulators were to use Lancaster's remarks to justify prohibition of barium salts in fireworks. Pyrotechny can well do without arsenic but would be much the worse if deprived of barium.

Since the publication of the first edition of this book, there has been discussion of the dangers of mixing aluminium, nitrates and chlorates. There is concern that the metal might react with the nitrate and form ammonia, which might then react with the chlorate to form the spontaneously explosive ammonium chlorate.^[3] An example of such a mixture, a green/silver pillbox star, ap-

peared on page 92 of the first edition. It is surprising to find the same composition appearing again, without comment, in this edition (p 213).

These criticisms aside, this book is the latest and best version of a classic work by one of the leading figures in the firework industry. It should be read, and re-read, by anyone who is involved with that industry or who has more than a passing interest in fireworks. Readers of this Journal will want to own a copy, especially if they already have an earlier edition.

References

- 1) W. Zschiesche, K. H. Schaller, "Biological indicators for the assessment of human exposure to industrial chemicals. Soluble barium compounds". Comm. Eur. Communities, [Rep.] EUR 1994, (EUR 14815) pp 1,3,5-21; *Chem. Abstr.* **121** :294472J.
- 2) N. Irving Sax and Richard J. Lewis, Sr., *Dangerous Properties of Industrial Materials*, 7th ed., Van Nostrand Reinhold, New York, 1989.
- 3) See, for example, *The Best of AFN*, American Fireworks News, Dingmans Ferry, PA, 1985, pp 45–47.

