

Explosion Information: applying the information transfer process to the pyrotechnic arts community in the United States

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Introduction

Many people in the United States gather annually to watch beautiful Fourth of July firework shows, but only a few people are aware of the processes that help shape the fireworks they see. For professionals and hobbyists to shoot first rate displays, they require a complex information transfer process that must be actively maintained and advanced by the pyrotechnic arts community. According to Herbert Achleitner (2006), the information transfer process includes: knowledge creation, dissemination, organization and storage, diffusion, and, finally, preservation (np). This transmission of ideas and information occurs formally and informally within many disciplines and specialties. Pyrotechnic artists (often referred to as “pyros”) require a high degree of specialized knowledge, need complex social networks to facilitate the transfer of information, and face unique legal and practical challenges in the diffusion and preservation of their discipline’s knowledge. In the United States, firework enthusiasts have their own academic journal, periodical literature, guilds and associations, and even yearly conventions.

Fireworks need to be promoted through education and documentation because they literally blow themselves up, leaving little or no evidence of their construction or composition. In addition, because pyros practice an art that is potentially dangerous and heavily regulated, they must focus on disseminating and utilizing information through specific channels in approved settings, or risk suffering legal, social, and physical consequences. The ephemeral nature of their craft causes pyros to be especially aware that communicating their processes of creation and innovation is a serious responsibility, one that they inherit from earlier practitioners and owe to their successors. It is for this reason that pyrotechnic practitioners place a premium value on tacit knowledge, often giving long club tributes to deceased members and conferring high accolades and status to older and experienced members.

Information creation: how pyros produce innovation

Ask a typical pyro to name an authority in pyrotechnics and chances are that you will hear some very old names: Takeo Shimizu, author of *Fireworks: the art, science, and technique*, first published in 1912; George Weingart, author of *Pyrotechnics*, published in 1871; or perhaps Joseph McLain, author of *The Viewpoint of Solid State Chemistry*, published in 1916. The most recent name you may note might be John Conkling, author of *Chemistry of Pyrotechnics: Basic Principles and Theory*, published in 1985 (personal communication, Dustin and Mike Moore, June 23, 2006). Although the use of fireworks can actually be traced as far back as China's Han Dynasty (206 BC – AD 220), Shimizu, Weingart, McLain and Conkling are all considered by contemporary pyros to be fathers of pyrotechnics because they were among the first to apply modern physics and chemistry to the art of fireworks. This paradigm shift from mere alchemy to hard science made pyrotechnics into the legitimate discipline that it is today.

For a field to remain active and dynamic it needs more than just past authority, it also needs contemporary innovation. According to Evertt Rogers (2003) in "The Elements of Diffusion," "an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p.11). The impetus for a pyro to create innovation can come from a desire to compete with other pyros for status, the economic drive to sell new types of pyrotechnic products, or the need to deal with ever changing restrictions on fireworks. Pyros across the United States are still scrambling to create or discover adequate substitutes for ammonium perchlorate composite propellant, a main ingredient used by hobbyists in black powder rocket motors. Perchlorate was effectively prohibited for hobbyists in 2002 when the Safe Explosives Act, a smaller section of the larger Homeland Security Act that President George Bush signed into law, began requiring expensive permits to use or transport even trace amounts (<http://www.space-rockets.com/congress.html>).

In the American fireworks community, new information is typically added to the discipline when individuals perform personally funded experiments. In order to create the kind of experiment that leads to true innovation, a pyro usually needs to have a license or permit, a thorough understanding of either chemistry or ballistics (or both), and a place that will legally allow experimentation. Successful individuals, by and large, have years of experience in the hobby/industry and often have a high degree of technical knowledge or hold advanced degrees in chemistry (personal communication, Dustin Moore, June 23, 2006). Formal scientific research and experimentation in pyrotechnics is typically published by *The Journal of Pyrotechnics (JPyro)*, "a technical journal on pyrotechnics, including fireworks, pyrotechnic special effects, propellants & rocketry, and civilian pyrotechnics" (<http://www.jpYRO.com/>). According to *JPyro* editor Ken Kosanke, *The Journal of Pyrotechnics* is used by academic libraries, research facilities and laboratories, as well as by clubs and companies (personal email, June 26, 2006).

Dissemination: getting the information to the pyros

In our day to day lives, we are often on the receiving end of dissemination, the one-way transfer of information used for educational purposes (Achletiner 2006). Mainstream media, including newspapers, radio broadcasts and television shows, all shower us with

news, warnings and public awareness campaigns (for instance, promoting reading or increasing consciousness about the risks of smoking). However, dissemination does not need to take any of these popular forms in order to be effective. While pyros can receive information about their art from a variety of surprising sources, they often need to be proactive about locating and obtaining materials. In pyrotechnics, it is especially important for hobbyists to educate themselves about current safe and legal building techniques. It is also important for the pyrotechnic community to distribute scarce technical knowledge about pyrotechnics to as many interested parties as possible so that fireworks can remain a living art. Books and articles that may have previously been in danger of disappearing are now beginning to reappear in print thanks in part to the efforts of the Kosanke. On his *JPyro* website, Ken Kosanke writes:

In recent years, a larger number of research papers have been written on various aspects of pyrotechnics. However, these articles tend to only appear in specialized publications and symposia proceedings, which are generally not available, even in large libraries. In the Pyrotechnic Literature Series, collections of research and technical articles are being republished to give greater access to the information” (<http://www.jpyro.com/refseries/index.htm>).

In addition to reading republished books by accepted authorities such as Shimizu, Weingart, McLain and Conkling, pyros typically subscribe to newsletters and journals. *American Fireworks News*, for instance, is a popular provider of books, periodical newsletters and instructional videos. In addition to newsletters and journals, more unusual sources of published pyrotechnic information include government documents, club minutes and communication, and the free tips and articles, such as those given out by the company Skylighters, that are included as part of the commercial sale of certain pyrotechnic supplies and materials. The field of pyrotechnics is regulated enough and specialized enough that individuals with deep knowledge of the subject are rare and the potential extinction of their acquired learning and expertise is a constant threat. Because technical information about creating fireworks is not easily available from libraries and conventional bookstores, knowledgeable pyros often take the task of dissemination upon themselves by sharing field notes, distributing monographs, or self-publishing with spiral bindings and a photocopier (personal communication, Mike Moore, June 23, 2006).

The organization and storage of pyrotechnic information

If one is searching for pyrotechnic information in a public library, one should look for the Dewey classification number for fireworks: 662.1. In the Dewey Decimal System, 662.1 falls under the broader heading of chemical engineering. In an academic library, the Library of Congress subject heading is T for technology, subclass TP for chemical technology. The range for pyrotechnics is generally TP267.5-301.

It is useful to note, however, that public libraries carry a limited amount of material on pyrotechnics. Although some books on the topic are kept in public libraries, they are not formally preserved or widely available. In Oregon, for instance, Takeo Shimizu’s classic work *Fireworks: the art, science and technique* is only offered in a single branch location

of the Portland public library's Multnomah County system. A simple search for keywords "pyrotechnics," "fireworks," and even "chemical engineering" turns up little to nothing suitable for adults in Multnomah's neighboring counties Washington and Clackamas. Likewise, very few academic libraries carry books or videos about pyrotechnics. Some academic libraries do subscribe to the *Journal of Pyrotechnics* though, and if one is fortunate, one might be able to obtain a copy of *AFN* from one of the less than a dozen total government and private libraries that carry it (personal email, John Eric Drewes, June 27, 2006). The bulk of pyrotechnic information is not kept by large libraries or organized according to a library schematic. By and large, pyrotechnic information is stored in personal and club libraries and is either organized according to an obscure private system or not organized at all but simply kept in storage.

The challenges of information diffusion and utilization

For a pyro, turning information into utilization can be like spinning straw into gold. Diagrams and facts on paper are information; being familiar enough with the process of manufacturing to build and shoot your own shell is knowledge. Actually shooting the shell is utilization. Getting from information to utilization often requires more than information dissemination, it requires a multi-directional exchange and flow of knowledge. The major goal of pyrotechnic associations, clubs and internet groups is knowledge diffusion. "Diffusion" according to Rogers, "is the process by which an innovation is communicated through certain channels over time among members of a social system" (qtd. Achtleitner 2006).

Because much of fireworks learning occurs best when it is hands on, guilds and associations aim not only to inform members, but also to help them connect with one another through local clubs, conventions and workshops so that pyrotechnic knowledge can both increase and remain in circulation. According to their website:

The Pyrotechnics Guild International, Inc., founded in 1969, is an independent worldwide nonprofit organization of amateur and professional fireworks enthusiasts. Its educational and scientific purposes are to:

1. Promote the safe and responsible display and use of pyrotechnics and fireworks.
2. Encourage the display of public and private fireworks in conjunction with local and national holidays as well as patriotic and other events.
3. Promote the production and sale of high quality fireworks.
4. Channel the creative energies of talented people into the design, production and display of high quality fireworks by example of the membership and through the sharing of knowledge. (<http://www.pgi.org/>)

The Pyrotechnics Guild International (PGI), the largest non-industry specific pyrotechnic organization in North America, lists on their website 18 different independently operated regional clubs in the United States (<http://www.pgi.org/fireworks-clubs.aspx>). PGI members, however, are often involved in the pyrotechnic industry in some way and are

also frequently members of several of these other regional clubs at the same time. Because of this overlap, clubs typically cooperate with one another, creating a complex network of social systems where diffusion can rapidly take place.

Clubs and associations use many events to channel innovation and knowledge growth, including: conferences, workshops, and lectures. The Western Pyrotechnic Association, for instance, holds periodic events like the free shoot “Do It,” in addition to its annual conference, the “Western Winter Blast.” In order to participate in these types of knowledge exchanges, a person must first become a club member – a process that usually requires some combination of paid fee, proof of licensure, formal application, or sponsorship by existing club member. The reason for all these different requirements is the primary barrier diffusion faces in pyrotechnology: liability. Laws that restrict transportation of product, determine who can shoot product, who can buy product and where product has to be shot are not only difficult to understand, but can carry serious penalties if they are broken. Different government agencies even have conflicting rules of transport that sometimes are impossible to obey simultaneously. Club membership can provide a way of mitigating this risk in a controlled environment. However, because every new member is a potential risk, would-be members must demonstrate their eligibility and share in the overall expense. The PGI, for instance, must insure its yearly summer conference with the most expensive but only form of insurance available: Lloyd’s of London (personal communication, Dustin Moore, June 23, 2006). Associations such as the PGI are willing to sponsor and put on these costly events though because they know that the future of fireworks in America depends upon their ability to create opportunities for diffusion to occur. Conferences allow members to collaborate, forge informal apprenticeships and try out materials that might now otherwise be possible to try in everyday settings.

The listserv is a relatively new addition to pyrotechnic community’s support of knowledge diffusion. Although websites, podcasts, and blogs have not become popular online ways for serious pyros to communicate with one another, pyrotechnic listservs have flourished. PGI maintains a popular members-only listserv, “for discussion of PGI business. It is also the official method for the PGI board to disseminate time-sensitive news items and instruction” (<http://www.pgi.org/pgi-d.aspx>). Another high traffic mailing list is the PLM (Pyro Mailing List), which, although it is not associated with any one particular club, is promoted on PGI website as “focused on serious pyrotechnic discussion.” In addition, there is a myriad of other less professional listservs and USENET News based discussion groups that pyros use. The PGI website says the following, for example, about the Google Group rec.pyrotechnics: “some good info can be found using the search features and many knowledgeable pyrotechnicians partake in the discussion” (<http://www.pgi.org/pgi-d.aspx>).

The preservation and destruction of pyrotechnic knowledge

In order to actively preserve fireworks literature and information for future use, more than just storing documents and circulating books in public libraries is called for. Papers randomly stored in people’s homes in boxes can easily be lost or destroyed and public

libraries typically attempt to distribute information, not save it. True preservation of knowledge entails the regular organizing, archiving and maintaining of materials in the anticipation of future use.

Editors of pyrotechnic journals and periodicals often bear the brunt of the responsibility for not only disseminating their own publications, but also for preserving them. According to John Eric Drews, son of *AFN* editor Jack Drews, and himself webmaster for *American Pyrotechnic News*, “We reprint on demand making photocopies of the masters used in printing, if the newsletter is less than 5 years old. Older than that we photocopy the issue in archive . . . It has been my dream to archive digitally all of our back issues and videos. Never had the time or money. We archive everything with physical hard copies” (personal email, June 27, 2006). In contrast, Ken Kosanke does small press runs of *JPyro* and all back issues are archived both on electronic media (CDs and hard drives) and hard copy (personal email, June 29, 2006).

Books stored in personal or club libraries, however, are typically just placed on a shelf or are used quite heavily and are rarely kept in way that aids preservation long term. Even more worrisome is the state of self-published literature, copied field notes, monographs, and other rare material. While publications like *JPyro* and *AFN* may try their best to reprint the most influential of these sources, they cannot hope to capture and save them all. If a pyro dies and her children are not connected to the pyrotechnic community, often the great wealth of information that person has personally gathered and stored throughout her lifetime is sold off or recycled and lost forever (personal communication, Mike Moore, June 23, 2006). Documents are often destroyed when people die, can be destroyed simply because people lose things, and if laws prohibit certain types of knowledge, then writing about off-limits topics can and be discarded if readers see no reason to keep it anymore. Lack of time, manpower, and money, are the most commonly cited problems that prevent serious efforts at collection and archival.

Conclusion

It is because of the innovation, collaboration and maintenance of pyrotechnic knowledge by dedicated pyros that fireworks survive and flourish in the United States. Exploring the information transfer process within the pyrotechnic community reveals the creative strategies pyros use to keep their art alive, but also illuminates some possible areas for improvement. In fireworks, diffusion occurs much as it does in other hobbies and disciplines, but with several notable exceptions. The degree of danger is unusually high and restrictions on actually putting knowledge into practice limit the number of experienced practitioners. These limitations force most interactions into highly supervised environments only at predetermined times. While many pyros put tremendous time and personal effort into the creation and dissemination of knowledge, few take any active role in storing, organizing or preserving it. Some, like John Eric Drews, see digitizing as a possible democratic aid to the problems of preservation. Pyro Mike Moore, for instance, described his fantasy of scanning and posting his substantial library of independently published articles and loose papers online, but until he actually gets the

time he admits that it will remain just that: a fantasy (personal communication, June 23, 2006).

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