Western Pyrotechnic Association Newsletter

November 2013, Vol 24-2

FLYING PHOENIX FIREWORKS

P.O. Box 31
Riverton, WY 82501
307-856-0778
flyingphoenix@tcinc.net

COWBOY BRAND

#92 CíHair Lane
Arapahoe, WY 82510
307-856-3336 FAX
Mon.-Thurs 7am -5:30pm

Exclusive Items

1.3G

300sh Red/Green/Blue Moving Star
100sh Coconut Pistil w/Red Tadpole
100sh Blue Tail to Brocade Crown Crossette
110sh Fan shaped - Silver/crackling/blue/ red/green glitter mines to blue tail to chrys willow
100sh Fan shaped - Three stage massive crackling mine
88sh Fan shaped - Flying Gold Eagle
80sh Fan shaped - Ice on the Cake (brocade crown w/blue and crackling mine)
48sh Fan shaped - Silver Waterfall
48sh Fan shaped - White Strobe Waterfall
300sh iZi shaped - Colorful Whistling
5i - 10i Red, Silver or Blue Ghost Shells

1.4G

Cowboy Brand
Midnight Cowboy
Cowboy Copperheads
Night Rider
Eureka!
Mountain Meadows
All the Stars in the Sky
Lightning Crackers
Nite Lights Artillery
Jumbo Gold Crackers
Cowboy Couple
The Outlaw
Sky Plazma Artillery
The Mother Lode
Weeping Willow
Gone Fishin!
Cowboy Up!

More Brands in Stock

Brothers	Lightning Bolt	Beihei
Shogun	Black Cat	Wizard
Winda	Flower King	Huisky
Cannon	Flying Dragon	Lidu
Golden Bear	HopKee	Yung Feng

To receive a catalog or request information, please call or email. Ask for Jim or Becky on 1.4G and or Glen for 1.3G.

WPA Newsletter, Volume 24, Issue 2

Table of Contents

The BFR rocket crew: From left to right, Bob Myers, Andy Munoz, Al Stahler. Front: Dave Ferguson (seated).

Elected Officers of the WPA

President: Lynden King.
VP: Greg Dandurand
VP publications: Pete Hand
Treasurer: Ann Hill
Secretary: Kathy Bauer

IMPORTANT NOTICE

WPA CORPORATE MEMBERS

Combined Specialities

Novato, CA

Extreme Pyro

Mansfield, TX

Flying Phoenix

Riverton, WY

Holatron Systems LLC

Honolulu, HI

Pyro Novelties

Lenexa, KS

Pyro Spectaculars

Rialto, CA

Friends of the Fair

Lake Havasu City, AZ

We would like to take this space to express our thanks to our corporate members. These are folks who recognize that the health and longevity of pyrotechnic clubs and organizations is responsible in part of the continued success of fireworks in America. In these economic times, their support can be especially hard on them. It goes above and beyond the standard.

The WPA relies on our corporate members' continued support for the health of our club.

Do us ALL a favor and be sure to use their services.

What's Happening?

By LYNDEN KING, WPA President 2013

Your WPA board has been busy. There is a new web site that will bring us up to date with a new layout, a way to sign on, and sign up for events, and it will be more informative. You can now sign up on line and have your own account. We have changed the way the yearly membership is set up. Your membership will now start on the day you sign up; it will expire on that date one year later. I would like to take a minute here and personally thank Don Oesterle and John Noonan for their time and efforts to create a newly updated website.

Once again, we will be having WinterBlast under the sunny skies of Lake Havasu City, AZ, February 12th through 16th 2014 This is our 25th anniversary year! It seems not so long ago, that I attended my first WWB (1997) but still, I can't help feel the excitement and anticipation building as if it were my first Winter Blast!

Want to start the party early? Come out to Sara Park on Tuesday morning (9:00 AM). We start set up then and can use all the help we can get. The sooner we get set up, the sooner we can open manufacturing that afternoon. Then come join us early birds for food and beverages on Tuesday night at the city Aquatic Center for our pre glow party! It is $15 dollars for all you can eat and drink, beer and soft drinks. It's a great time to catch up with acquaintances that you haven't seen since the last WWB, so come join us and enjoy!

This years WinterBlast 25 will be one day longer, starting on Wednesday. We have a great lineup of displays and demo presenters this year. We are having an extra Public display on Friday night by AM Pyro. The Saturday night public display will be put together by Sam Bruggema and Pyro Spectaculars. Kief Adler has been working hard on getting more demos and shows, too. As of right now we have a show by Homeland Fireworks, another by Jakes Fireworks, Great Walls of Fire and more to be announced. Sunday – Member built shells, the Jackalopes and a tribute show for big John Lathrop by Pyro Productions. Wednesday is for open shooting only. We'll be moving up the start time to 7:30 for our shows, so there should be plenty of time for members to shoot manufactured items, class C and class B to their hearts content.

In addition to our nightly demo's and displays, Steve Wilson is putting together an assortment of seminars including shell building, PGI Shooter Certification, various AV presentations and more – too numerous to list all here. You will be able to get a full listing of all the various seminars on the new web site in January, and in your event program.

During the day, you can spend time at the WPA Trade Show, which once again, will be held on site across from the BIG Class C tent. Many vendors will be in attendance with most anything your pyrotechnic heart could want or desire. A great place to get a WWB XXV theme t-shirt or many other items for that Valentines Day gift you promised your loved one in return for being able to attend the event! Firing systems, videos and DVD's, Industry Insurance Specialists, collectibles, and all sorts of pyro-phenalia that you might miss out on otherwise. In the trade show tent we will have a memorabilia area for the swag collectors to show there collection of WPA collectibles, old pictures, past years art work and anything else you can find of the past. Check it out!

The one thing that has been neglected for the past few years is the young people that come to the event. For years we had a class for the pyros in training (PIT). We are looking for some one to take the lead on this. The shell shack, where you could go and contribute $5.00 to build a shell, has been missing the last couple of years. Now is the year to step up and help your fellow pyros, volunteer to help out with something at this years WinterBlast.

Don't forget the WPA Auction! It's held at the afterglow on Saturday night. This is a great opportunity to get rid of items that you can't remember where they came from or what the heck they are! Need a safe and convenient way to get rid of those unwanted chem's or an old blasting box? It's a great fundraising event for the club and a lot of fun to boot. For more information on the auction, please contact Randy Baranek at rbhooked@hotmail.com and he'll be happy to answer your questions.

If you want to manufacture, please contact Bill Ryan at pyrobill@comcast.net, and Bill can get you the information and forms needed. Spaces are limited so don't wait. For BP sales, please contact Craig with Bear River Powders. You can reach Craig at bearriverpowder@allwest.net and he can fill those orders. If you currently hold a BATFE license, please use yours to order. Otherwise, a license has been provided for those that don't. Please respect this opportunity as the license holder assumes responsibility and liability for the powder bought under the license.

FIREWORKS!!! What a concept! Visit the Class C tent (a supermarket of pyro pleasures!) If you can't find a fireworks item that will dazzle the senses, then you're not looking! Then walk out of the tent and head for the Class C shooting area to enjoy the wonderment of your purchases! It's what brings out the "kid" in all of us and helps us stay young (at heart). It also helps the vendors who travel long distances to provide us with our wishes. In the class "C" tint this year we are trying to put together a firecracker collectors area. Bring your collection, or start one at this years WWB. We will have more information about this on the new web site.

For those wanting a bigger bang for their buck, you can preorder Class B fireworks from Flying Phoenix Fireworks or Extreme Pyrotechnics. Their contact information can be found on the WPA website http://www.westernpyro.org. Catalogs of available product can be found there as well. As is true with all of our vendors, they depend on your support - just as we depend on theirs' so dust off the credit card. For those who manufacture, you can pre-order, or purchase on site, your ingredients to produce those amazing member made shells.

We are offering the "Bring a guest" program again this year to help boost the membership. Bring one guest that has never been to WWB, have him or her sign up under your member number. It will reduce the cost for the guest. Also, at the Business meeting, held on Sunday morning at 10:00 at the Lake Havasu Aquatics Center, we will be holding elections for the Board positions of President, Treasure and VP of Publications. These are two-year terms . If you have the desire and time to undertake any position, now's your chance to get more involved in the everyday workings of the WPA. Also up for grabs are the positions of all Area VP's. Only members who currently reside in these geographic areas can vote for the candidate running for that position.

We will be presenting this year a Life Member award to an individual for their contributions and dedication over the years to the WPA. I consider the club to be extremely fortunate to have these individuals, past and present, which have either received a life member award or are about to. Their dedication and involvement behind the scenes is what allows the club to function. Please join us to honor and express our thanks to this individual for their efforts.

VOLUNTEER!!!!! The Club is always in need of volunteers during the event. A 1-2 hr. shift on Security, Safety, Registration, and show setup, etc. makes it so much easier for all and allows everyone to enjoy the event. It's a great way to meet people and get involved, so please give as much time as you can.

CLEAN-UP - On Monday, we have cleanup. The more people who show up to help in this process makes it get done and over much sooner. So PLEASE! If you can come out on Monday morning (9:00AM) and give 3-4 hrs of your time, it will be appreciated. Plus, those who do stay until the end of cleanup get to split a percentage of the cleanup pot and have pizza.

In closing, I hope that those of you reading this, share my enthusiasm for our upcoming event and if you haven't already, I hope you will decide to join us for fun, friendship and fireworks.

Lynden

From the Desk of the Secretary

As this membership year is closing a lot of new things are in the works for the following year. There is a wonderful new web-site with easy access for you to register for events and renew membership. Watch for it soon. Great plans are coming together for our 25th anniversary Winter Blast, with an extra day and an extra public display. I'm looking forward to seeing you all there.

We finish this year with 531 members. As always we are hoping the membership continues to grow. Sponsoring a friend to Winter Blast will help show what a wonderful club the WPA is.

Enjoy the upcoming holiday season and remember a great gift might be a membership to the WPA or paying for someone to attend Winter Blast XXV, "Silver Salute to the WPA".

Kathy Bauer

From the Treasurer

Hello All,

Hope all of you have had a chance to look over our new web site. My thanks to all of those who have been involved in this creation. It sure is going to make life easier for all.

Time to start marking your calendars as our 25th Anniversary is only months away. From what I have heard is this is one you will not want to miss. Online forms and mail in forms should be up soon. Remember our early bird specials and save money.

Many thanks to all those board members, staff and members who made Do It and Pyro Playa a great success this year.

Looking forward to seeing ALL of you at Winter Blast. A extra day has been added to celebrate our SILVER YEAR. Let's all Shine Bright.

Ann Hill

From The Editor

Greetings, everyone. Another bumper issue full of news and pictures to enjoy and share with your friends and colleagues who might not, you know, completely *understand* what we get up to and how much fun we have in the WPA.

Do It is the main news this time round, with an article by Dave Ferguson about his amazing rocket, and a round-up of what other people were doing in the Maker area. It's too bad that the Newsletter can't contain videos as well as text and pictures, as the Member Showcase had some quite spectacular items, including a fine girandola. A still photo doesn't do it justice. We also have the fourth and final part of Peter Schoewe's article on the Firework Factories of India.

This issue includes a couple of short "how to" articles. I'd like to see more items of his kind in future, since although lighting commercial Class B is fun, the real future of pyro (and our club) lies in keeping alive the art and science of making our own fireworks. It's not that hard.

It's been an interesting couple of years for me as your Publications VP. I was quite surprised to be nominated for the position and not at all sure I had the skill or the time for it, but I've learned a lot along the way. My time is up, and the position is open for others to step up at Winter Blast if anyone so desires, though I will of course serve another term if the membership desires.

Putting the Newsletter together is not difficult. However, *writing things to put in it* is another thing entirely. The editor can't do it alone, and largely depends on you - the members - to contribute news and articles for publication. Thank you to everyone who helped me out with this and previous issues, but - let's not always see the same hands, ok? I know many more of you have something to give us. Don't be shy.

Pete Hand

John Lathrop, 1958 - 2013

John Lathrop, a loved and valued member of the pyrotechnic industry, passed away unexpectedly at age 55 on October 5th after having suffered a massive heart attack at his home in California. Most recently employed the last six years at Ultratec Special Effects as Sales Manager, John had worked in the past with among others, Pyro Spectacular, Disney, Zenith, Pyro Productions, touring with the world's top bands doing proximate pyro, wrestling events, football games, and also designing and carrying out large aerial fireworks shows. He was quite versed in his art form and loved every part of it.

A jovial, kind person who was always willing to share his knowledge and experience with others, "Big John" was also quite active on the APA Proximate Pyrotechnic Committee, sharing his expertise as the committee completes the Proximate Training Program they have been working on for several years.

Heartfelt sympathy goes out to his wife Toni, and the family.

DO IT - IN THE SNOW?

Putting up the Afterglow canopies, Wednesday afternoon

Seriously, we wondered if that's how this year's Do It would be remembered. As we approached within sixty miles of Hawthorne on Wednesday, the warm sunny weather gave way to low, thick cloud and the temperature dropped 40 degrees. At the site, there was snow on the mountains down to about 1000 feet above the valley floor, and a stiff cold wind threatened more.

On Thursday the clouds lifted and it didn't snow, but the icy wind made Manufacturing difficult and uncomfortable. However, as the week continued the wind dropped and the sun came out, and by the weekend we enjoyed perfect weather, warm and windless - it was even fairly warm at night for the Afterglows.

Speaking of which, we were well supplied with tasty food - barbecue chicken by Victor and Gina Papini, pulled pork by Dave Ferguson and the gang, and pizza by our generous sponsor Flying Phoenix. Beer flowed thanks to your Afterglow donations, and the organization was expertly handled by Spike and her crew. Nobody went to bed hungry.

The manufacturing area filled up on Thursday, with around a hundred members making shells, rockets, mortars, crossettes and stars as well as more elaborate items.

Friday night's Armageddon, a mixture of member and commercial product, included a few unique items such as Karl Amo's Roman Candle battery and a fine set piece by Victor and Gina.

Jim Olsen organized and conducted a member showcase event on Saturday night, all product made on site by members. There were shells from 3 inch up to 12 inch and numerous rockets, many of which actually left the ground.

Mike Garrett made a couple of fine girandolas. Unfortunately the first one was launched upside down, but the second rose straight and true. The much anticipated highlight was the launch of the "BFR" with its 12 inch shell header. It took off with a noise like a flight of F-15s and filled the sky with stars.

Ryan Parks arranged special Do It event t-shirts, and generously donated the profits to the club. Thanks, Ryan!

Many thanks also to Joe W and Daniel Dutra for organizing the event, and to everyone who helped out with safety, magazine duty and other essential services.

“We’re grateful to all who contributed to our first “Do It” experience. Your showing us the ropes, answering our questions and telling us your stories made all the difference.” - Mike & Donna Eyring

Home made star rolling machines

“Minors in Manufacturing” area

Todd couldn’t male it this year, but Richard (and friend) covered for him

Karl Amo's roman candle battery
The tubes are 36 inches long

Gina making mines

Pumped stars on drying rack

Shells, ready for lift and leader

"Armageddon" set piece under construction

Above: Pasting crossettes

Above, sawdust and lacquer lampare fuel

Below left, small shells ready to go

Below right, two rockets

Here's something you don't see very often - in fact, I have *never* seen it before. Member Peter Brown set out to reinvent the strike-anywhere match.

Working from old 19th Century books and publications, Peter retraced the steps of the original inventors, using potassium chlorate, sulfur and exotic chemicals (phosphorous sesquisulfide, anyone?) to make these foot-long matches. Your editor was provided with a few samples and is pleased to report that they do, indeed, strike anywhere.

These days it's not as easy to make them as you might think. Joe Victorian could send his valet to the neighborhood drug store for a penn'orth of phosphorous, no questions asked. Today, even looking it up on line is liable to attract the wrong kind of attention from agencies like the DEA, who think the only reason anyone could want it is to make meth.

Meanwhile, these crazy rocket guys set out to make rockets like they used to make them in Weingart's day, that is, with proper pointed noses. Unfortunately I had the same problems as Peter Brown, being unable to get my hands on the white phosphorous I needed to make Weingart's "Liquid Fire" heading.

Mike Garrett's second girandola ascending

(Below) Frankie's 4 inch shell

Pasting comets requires concentration

Steve Humphrey's mine
Photo by Peter Brown

Here’s something we’ve not had at Do It recently, if ever - a seminar. Jackalope Billy took on the task of seminar chair. We were expecting more than one seminar, but circumstances prevented our other presenters from attending the event at the last minute.

This one was conducted by Kevin Mather and covered the practical side of making whistle rockets. It was pretty popular, with about half the manufacturers taking time off to sit in.

Here’s something else we’ve not had at Do It before - the caterers!

Local party caterer **Maxine’s Place** brought us hot food - brisket and pulled pork sandwiches - for lunch Saturday. Unfortunately, they underestimated the demand. They sold out while the line was still half way around the Afterglow area, leaving a lot of hungry folk with well-stimulated appetites.

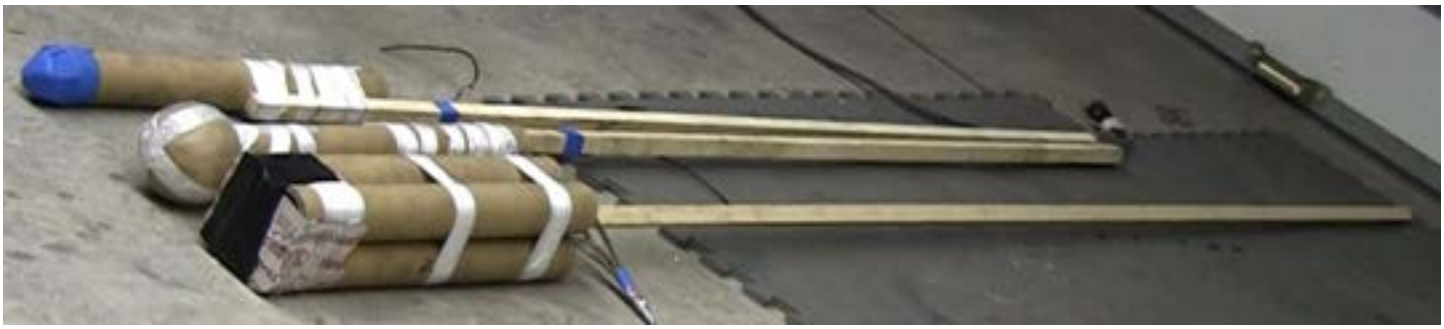
They returned later in the afternoon with fresh supplies, and sold out again.

Come again next year, guys!

The Big Fun Rocket progression Sequence

By Dave Ferguson

The story of the BFR rocket has been a constant slow progression over two years. The first BFR rockets were just standard six pound rockets that we felt qualified to be BFRs. The next step was four six pound rockets on one stick. The challenge was to get them to light exactly at the same time. This was accomplished by using the fastest fuse we could find, and cutting the lengths to be exactly the same. Below is our first BFR on it's stick alongside some six pound rockets.



The first launch of a BFR was a huge success; Andy cooked up some extra caustic version of flash, so we could estimate the elevation of the launch. As you can see, the length of the stick made it a bit of a challenge to keep our launch stand from tipping over. We had to put rocks on the bottom to stabilize things. We estimated the height to be over 1,000 feet. This launch gave us some encouragement to continue the progression.

The obvious next step was to mount four additional motors in the depressions between the existing four motors, and have an eight motor BFR. As the weight of the motors became heavier, the length of the stick needed to be increased. At this point we had reached the point

of NO RETURN! Notice that the paper caps have the ignition fuse entering the side of the venturi, we later learned that when the fuse goes exactly up the center, things get roaring better. This rocket was constructed January 8, 2013. Western Winter Blast was right around the corner!

Our plan was to launch a ten inch shell on an 8 motor BFR at WWB-24, but when I picked up the ten inch shell it seemed a little too heavy to lift with our standard 8 motor BFR. So we shot the ten inch shell out of a mortar tube, and launched an eight inch shell on our BFR rocket. The stick was about 12 feet long, and pretty heavy! It was a standard wooden closet rod about 12 feet long. Now the cost of sticks became another factor to consider - the closet rod was about $20.00.

Our BFR rocket barely fit in the B-rocket magazine, and did not fit in the ready box at all, but Bill managed to let us launch! I know he was a bit nervous about it, but we told him all this had been done many times before at my ‘personal rocket test range’. The test range is a place where the Navy used to test rockets on the back side of Walker Lake. The foundation of an observation shack is still intact, and even has the bolt circle for the spotting transit.

At WWB-24, Pete Hand chronographed one of our six pound motors. This gave us a platform to work with that was solid! No more guessing about lift capability, elevation, etc. We had just over 90 pounds peak thrust from each rocket, and his simulation did a very good estimation of altitude, and speed.

We made three or four other BFRs for WWB-24, and had a great time! Someone pointed out that the rocket sticks were more like lumber instead of sticks, and they got us to thinking about to make a lighter rocket without sticks. It would be a lot safer in the fallout area, and weigh less so we could get higher.

When we all got home, and back to 'normal ???? ', the thought process of building a bigger and better BFR rocket started again. You-Tube had a video of some kids putting a rocket inside a carpet tube, mounting fins on the bottom. Their rocket only went about 15 feet high, but it got me to thinking! I had used sono tubes for stuff other than concrete pilings, it is strong enough to pour cement inside so, it just might be strong enough for a rocket tube!

I should mention that I had purchased Amateur Rocket Motor Construction by David Sleeter. (*Note: this book sells for more than $200 on Amazon - Ed*). The most important thing I learned from reading this book from cover to cover was you can pretty much scale things to any size you can move around, and they will all work about the same. A one pound rocket length is 10x the size of the inner diameter plus or minus a bit, the core has a 15 degree taper, the nozzle hole is ½ the inside diameter, the length of the core is the same ratio, etc. Most if not all of the Sleeter rockets did not use a stick, every fin was scaled to the same ratio as the first tiny rocket in his book. One more thing: enough thrust can lift anything if you have some stabilization attached to the end, and the balance is reasonable. Center of Gravity and Center of Pressure need to be figured into the whole thing. Basically center of Gravity is the spot where the rocket balances on a rod, center of pressure is the spot where the pressure during flight is balanced front to back. Typically they are never equal, and the center of pressure should be about the length of one body diameter behind the center of gravity. If the Center of Pressure is too far back, then the rocket will weather cock and immediately head into the wind at launch time. Weather cocking just means your rocket will fly into the wind. Most all rockets do this, but if you reduce the size of the fins you can get a better flight pattern.

With all this information rattling around in my head I drove to Reno and purchased an eight foot length of ten inch Sono Tube. The ratio is actually 8.3, or more for a proper finned rocket, but who cares if it is four inches too short? I also bought a sixteen inch long piece of tube to figure the motor placement in the bottom. Nineteen motors packed into the short piece, if you properly place them to clear the bolts that attach the fins.

The fins on the first Sono tube rocket were scaled exactly from Sleeter's book. We found out that those fins were actually a bit too large. When the wind was calm, these rockets flew fantastic! When the wind was blowing, they headed into the wind too early. We ended up cutting 100 square inches off of the fins for the 37 motor BFR to get better stability. We used a piece of ¾ inch plywood at the very top of the motors to allow the lift to be transferred to the tube. We also put an additional piece of plywood about 16 inches from the top of the rocket tube. This was to hold a six inch shell including the lift charge. A large coffee can was screwed to the plywood to contain the pressure of the lift charge, and a 10 inch beach ball was pressed into the opening in the top of the tube.

Al and Andy drove to Hawthorne for this launch. You can view it here:
http://www.youtube.com/watch?v=CxUR2syRMDI
Listen especially to the child's statement at 22 seconds in. He is saying 'and that is how magic is done people ….that is a home constructed rocket' if you listen between home, and constructed, you can hear the rocket striking the ground some 450 yards away. The two people sitting almost in the flames of the rocket are myself on the right, and a retired Marine Corps Gunny Sergeant that helped me with most of the tube construction, and fins. We were sitting WAY too close! It was very warm where we were sitting.

We built another 19 motor rocket for Fourth of July, and put a mortar tube and an eight inch shell down inside the tube. Construction was pretty much the same as the original nineteen motor BFR with the exception of the mortar tube and shell down inside.

We learned on this rocket that putting a home fabricated mortar tube in is a bad idea. Our intention was to launch a shell out of the rocket during flight, but the lift charge collapsed the base of the shell, fire made to the inside of the shell, and this caused the rocket to self destruct five seconds after liftoff. You can view it here: http://www.youtube.com/watch?v=HcpSC3Tf0r0

The Final BFR!

Now what is the next logical step? I drew a 14 inch circle and placed 39 six pound motors within the circle. It was more than twice as large the nineteen motor BFR. We had made templates for the fin manufacture, and attachment. This time I removed about 100 square inches from each fin. We would have 3,500 pounds of thrust on the big BFR for do it - the thought was, will it fly straight? The fins are bolted to the rocket frame with eight bolts, four on each side. Each fin has two 1x1 strips attached to the fin with screws. This whole project was a scaled version of the nineteen motor rockets, just bigger in every direction.

We could not get thirty-nine motors into the rocket tube because we made a slight alignment error when we put the three motors that had the fire pass through for the twelve inch shell. The motors should start right between the two fin bolts, not on the left side.

You can view this launch here:

http://www.youtube.com/watch?v=kG1hVvhGEI0

http://www.youtube.com/watch?v=vwK2VTmOK4g

The interesting thing to us was that the twelve inch shell disintegrated the rocket into many pieces, of which none weighed more than 15 ounces! The heaviest pieces were the empty motors, each was separated from the others making the fall out no more dangerous than a six pound rocket. Actually each piece does not have the stick on the end that guides the spent motor in a vertical fashion. This means the terminal velocity of a falling motor is slower than one on a stick.

I hope the powers that be will allow us to build another one for WWB-25, our silver anniversary. The plan is to have one of our best shell builders make the shell, so the whole thing will be manufactured by WPA members!

ROMAN CANDLE COMPOSITION

By Karl Amo

In 2008, I attended Do It as my first-ever WPA event. I made Roman candles, for the first time since the 1980s. In the 1980s and at Do It 2008, I used the candle delay composition [candle comp] given in The Chemistry of Powder & Explosives by Tenney L. Davis, with the charcoal meshes sizes consisting of 20, 40, and 80. The difference between my candles in the 1980s and 2008 is that I rammed the candle composition damp in the 1980s; ramming it damp caused it to consolidate well. I didn't have time at Do It to wait for my candles to dry. Therefore I rammed the candle dry, and the result was that the delay between shots varied significantly. The shortest delay was half a second. The problem was that the candle composition did not consolidate well; it did not form a reliable plug between shots.

In 2009, Do It was canceled for me due to the financial crises. At about the time that Do It would have been held, I had an idea for candle comp that consolidates well but that does not need to dry after it is loaded into the candle. That way, a candle can be fired the same day that it is made, and the time between shots is consistent. I had read in Davis that some organic compounds gelantinize nitrocellulose. The idea was to mix gelatinized nitrocellulose and a black-powder spark composition, to make an easily consolidated candle comp. I wanted a gelantizing agent that was benign to health. I found triacetin; I purchased it and nitrocellulose from Firefox.

Both nitrocellulose and triacetin are soluble in acetone. I found that when the acetone evaporated from a 60:40 mixture of triacetin and nitrocellulose, a soft, transparent gum-like material was left behind. An important attribute is that if a piece of the material is torn in two, the two pieces can be rejoined. I figured that this attribute would make a candle comp consolidate well, if potassium nitrate, charcoal, and sulfur were coated with this material.

I decided to use Chrysanthemum 6 as the basis for the candle comp. I wanted it to produce many short-duration sparks. I decided that the composition would consist of 90% charcoal-spark composition and 10% triacetin-nitrocellulose. I then used the thermodynamic propellant evaluation program ProPEP to produce a formula that replicates Chrysanthemum 6 as close as possible, in terms of the amount of gas, solid carbon, and liquid potassium sulfide produced in burning. According to Takeo Shimizu in Fireworks - The Science, Art, and Technique, these parameters are important in determining spark duration. Through many simulations, I obtained the following formula:

Potassium nitrate: 52 %

Charcoal, air float: 31 %

Sulfur: 7 %

Triacetin: 6 %

Nitrocellulose, Firefox: 4 %.

I tried the formula at the next Do It, in 2010. I dissolved the triacetin and nitrocellulose in acetone, and mixed the liquid mixture with the potassium nitrate, charcoal, and sulfur. The composition formed a powder when it dried, but it consolidated easily, and clumped when I pinched some between a forefinger and thumb. It also had the nice attribute of being resistant to wind. It did not easily blow away. In burn rate tests, I found that a rammed 0.7-inch length in a 3/4-inch ID casinng burned for 4 seconds. That was the right amount of delay for Roman candles. The composition also burned cleanly in the casing, and it made good amount of sparks.

I made a seven-shot candle with the new candle composition, using two teaspoons for each shot. The time between shots ranged between 3.69 s and 4.03 s. That was a great improvement over 2008. I have used the same formula at each Do It that I have attended since. The candle comp formed a nice foundation for future improvements to my candles.

Editor's note: Karl's spectacular seven tube candle battery was fired in the Do It member showcase. It can be seen on page 11 of this newsletter.

WEINGART'S WILLIE PETES

Hard as it may be for our younger members to believe, there used to be a time when Americans were not terrified of leaving their homes; when States didn't yet know that everything gives you cancer; when children were allowed to play in the street and walk home from school alone; and when the Government minded its own damn business.

In those halcyon days of yore, people were responsible for their own actions. You could buy dynamite at the hardware store, and morphine at the drugstore. Apparently, nobody was thinking of the children! It's a miracle the human race survived.

George Washington Weingart's famous "Dictionary and Manual of Pyrotechny, covering the authors work and experiments from 1890 to 1935" was published in 1937. The excerpt below tells you all you need to know about the spirit of the age.

LIQUID FIRE ROCKETS.

These are one of the most beautiful pyrotechnical effects known to the art. Take a 3 lb. rocket and fill the space above the clay with grain powder. Cover this with a circular piece of perforated paper secured by a strip of tissue paper. Roll on a head of about three turns of strong manilla paper, only pasted on the edge, about 6" long. Now procure some sticks of phosphorus and cut them under water with a chisel into pieces about ¾" long. Get some ¼ lb. tin cans, punch a number of holes in the bottoms of them and fill with the pieces of phosphorus, conducting the entire operation under water. When ready to fire the rockets remove one of the cans from the water, allow to drain for a few seconds, empty contents into one of the rocket heads tuck in and fire at once. Great caution must be observed owing to the dangerous nature of the phosphorus.

The Firework Factories of India

By Peter Schoewe

This four part article covers the 12+ Fireworks
and Chemical Factories I toured in Sivakasi India.
Part Four

Asok Sparkler Factories, Arasan Aluminum Atomizing Plant, We Two Fireworks Factory and Delhi's Fireworks Market

Generally in northern India the festival of lights holiday is called Dewali, but in the south it's called Deepavali. It happens in September/October and lasts five days. Children will light off firecrackers during this time. Dewali is also becoming more popular to celebrate with Indians living around the world.

From 'History of the Fireworks Industry in India' by A. Chelladhurai, the late General Director of Standard Fireworks in Sivakasi, India, who died in 2001:
"Accident rates in other industries are higher than in fireworks. It is much below 1% while in all other industries, the accident rate was from 5-47%. Actually, there are more casualties resulting from auto, liquor, swimming pools and others events in one day than are found in fireworks in five years throughout the world. Indian house fires (not related to fireworks) claim 15,000 lives every year and 40,000 deaths occur on the road by car. Thus the fireworks industry, prone to fire and explosion, has a better safety record."

Asok Sparkler Factories

Mr. Asok, owner of the Asok Sparkler company, and his driver took me to his sparkler factories. We both sat in the back of his SUV. His factories were modern, clean and in the middle of farmland. Seventy people worked at the first factory and forty-five at the next. Both factories looked to be about five hectares (12acres). He owned some of the land around the factories where he grew corn and other crops.

DRIPPING SPARKLERS

DUNKING SPARKLERS

There was a devil painted on the cement posts at the gate. This is typical at other factories, it is to warn bad people to keep out.

Women dropped metal rods into a wood box, then bolted together nineteen wood slats inside to hold together the metal rods for dipping into composition. From there, the sparklers were dipped into comp and then slid down a wood chute to let some of the composition drip off for reuse. After they were dry, some factories would dip the sparklers in a clear coat. He wouldn't tell me what it was made of, but its used for protection against humidity and for better adhesion. Some rods had copper coated wire to keep certain chemicals from oxidizing the rod. Otherwise the sparkler would fall off over time. After the sparklers are dry they are put into colorful packages then into shipping boxes.

His next sparkler factory was ten minutes down the road. Thankfully this road was straight and without pot holes. Remember to always build your factory along a straight and well maintained road! It makes life so much easier.

This was the fifth sparkler factory I'd toured in Sivakasi that week. There was something different at these two factories. All the roofs were flat with a bit of a slant to let rain water run down a PVC pipe, for collection. The pipes ran underground beneath the largest assembly building where there was a cement water tank. The tank was about ten meters wide by twenty-five meters long by three meters deep.

This was enough to supply the factory with a year's worth of water. It would fill up with

Sparklers ready for shipment

400,000 liters in just two days of rain. Excess water was diverted to the well which got used for watering plants on the property and to irrigate his farm next door. Water at the factory is used for washing hands and equipment and mixing chemicals. They use no city water at all and are completely self reliant. He does this at both factories and as far as he knows he's the first and only one.

The Arasan Aluminum Group and the We Two Fireworks Factory

A day later I was ten minutes north of my hotel at the office of the We Two Fireworks Company and the Arasan Aluminum Group. These are both owned by two brothers. Thirty desks with people behind each one. There were two offices eight meters square with the bosses' private office in the middle separating the office rooms. In the owners office I asked about salutes.

Some salutes were sold to the United Kingdom as bird bombs hung in fruit trees to scare away birds. They would go off every thirty minutes. This was done with a rope used as a time fuse. One of his workers brought in a cardboard box filled with them. The new box was cut open and the worker took out a string of five-gram salutes. The fuse from each salute was stuck into the rope spaced seven centimeters apart from each other.

TIMED BIRD BOMBS FOR THE UK

ARASAN ALUMINUM PLANT ENTRANCE

The brothers uncle had started the company, but he died four years ago. Then the older of the two nephews, aged twenty-six, became the boss. He has run this company for the last six years. The younger brother is twenty.

The younger owner and I drove out to the aluminum atomizing plant. There was a 3m high cement wall around the factory with a large steel gate. He talked non stop. He said only this morning did his older brother tell him someone was coming for a tour. If he had been told a few days earlier he could have made a demonstration of them loading ingots of aluminum into the furnace, so I could watch the process from beginning to end. But now that part of the plant was not running until all the aluminum was atomized and put into drums. It was their monthly clean-up for a new batch.

For this reason much of the process was skipped. We didn't see the stabilizing area or post milling screening room. It was disappointing. At least at this plant, most of the ball mills were turning and loud.

They started making aluminum twenty-eight years ago. A lot of large metal parts and tanks were rusting far off to one side, with tall weeds growing around them as if this company had been there a while. Arasan Aluminum atomizes 3,000 metric tones a year. 1,800 MT, over half was used for fireworks!

ALUMINUM INGOTS

MILLS FOR PASTE MAKING WITH MINERAL OIL

My guide said he gives around forty tours a year, mostly to Indians. His cell phone rang every minute.

This plant has five ball mills for pyro aluminum making. The smallest is 500 Kilograms and the largest is 2 metric tons. There are also four ball mills of one MT each for paste making. It takes them five to eight hours to make aluminum paste, depending, on which size they made.

NITROGEN, OXYGEN and SUCTION TANK ROOM

BARRELS OF ALUMINUM

Paste making mills don't need water for cooling. However water is poured all along the top of each dry ball mill to keep it cool. The water runs down the outside and into a large steel tray around the bottom half. From there the water is pumped outside to one of five cooling towers. The towers stood seven meters high by 3m square. The water went up the middle of each tower by pipe and then sprayed out onto baffles that made up the four walls. As the water worked its way down, air helped cool it.

6-7mm sized stainless steel balls are used to powder the pyro grade aluminum. Operators will fill the ball mill 20-25% full of these steel balls and 40% full of powdered Aluminum for a total of a 65% filled mill. When they make coarse grade Aluminum they fill the ball mills with up to 50% full of Aluminum plus 20-25% steel balls.

The aluminum used for making fountains does not need to be stabilized in nitrogen because it's course enough to be stable and goes straight into packing to be shipped.

Arasan does three quality tests for all their Al. and four tests for pyro grade Al.
1) There's the bulk density test, for specific gravity using the atomic absorption spectrophotometer. 2) The moast test for particle size. 3) The sieve test, for percent of mesh size. And 4) the cache test for burn speed.

The company owns the farm land next door, but they don't farm it. It's covered in tall dry grass.

In their catalogue they have listed course, fine, super fine and dust aluminum. Coarse gets used for brake linings, Thermite, explosion welding, sintering applications, chemical reactions, diamond resin wheel production, tails and comets. Under 'Fine Aluminum' it's 45% forty-five microns, 45% seventy-five microns and 10% 150microns. This aluminum is used in oxidizers, slurry explosives, exothermic mixtures in steel plants, brick making,

missile fuels, metallurgy and in aluminum paste. Silver shine, non leafing Aluminum paste is for the automotive paint industry for decorative sparkling finishes. Under 'Super Fine' they call 'Pyro-technic Powder', 'Special Grade' aluminum or 'TTT 170 RS' aluminum its forty-five microns and is also used for slurry explosives, defense applications, cold soldering, Titanium dioxide aluminum compounds, rocket propellant, light sound crackers and other fireworks. It has a density of 0.25 to 0.35. Their 'Dust Aluminum' also called their 'Dark Pyro' is the heaviest product they sell with a density of 0.6 to 0.7. Its 1% coated with Steric Acid and is used for heavy sound crackers. They add the acid just before it goes into the ball mill. They will add 2.5% acid when it will be used with Ammonium nitrate, to give it a slower reaction time so everything will catch fire first before it explodes.

They sell their Aluminum to the military, to paint makers, and a lot to the Middle East to make cinder blocks. Without aluminum the blocks would be too weak. 60-90% of the Aluminum for light weight concrete will pass through a 325 mesh screen.

WATER COOLING TOWER

At that time Sri Kaliswari sold one kilo of their pyro grade aluminum for $3.30 while at the Arasan Aluminum Group it was $2.20 a kilo. 99% of Arasans' Al. would pass through 325 mesh, they called dark pyro. While at Sri Kaliswari only 85% passed through 325 mesh. This and the price seemed to be the only difference.

There is an excise duty added to your order of 8%, an education duty of 2%, a higher education duty of 1% and a Vat charge of 3%. You'll get a 2.5Rs (Five US cents.) per Kilogram discount for 100% advance payment.

All grades can be supplied in solvents like Naphtha, Xylene and Toluene and shipped in twenty-five or fifty Kilo steel drums. If you buy aluminum from them and get your own transportation the company charges you state taxes, because they have to assume it is not leaving the country and will be used locally. If you let Arasan bring it all the way to the shipping port, then there is no tax.

Arasan used to make atomized copper and zinc, but the prices were so volatile that by the time they bought it, received it and turned it into powder, the price would be different.

To make powdered zinc or copper, instead of spraying the molten metal sideways as with aluminum, they sprayed it straight down to atomize it, because it's heavier. This copper and zinc was never flattened in a ball mill because they would have to buy one mill for each metal and the demand wasn't that great.

I was given four 100 gram samples of aluminum.

The We Two Fireworks Factory

It was a thirty minute drive down a road filled with too many holes! The drive was not more then twenty kilometers per hour. Taking photos at the factory was mostly not allowed.

A lady in her own shed made five gram salutes. She took a thin cardboard box about 2.5cm high by 2cm square, and scooped it into an aluminum bowl, filling the box to the top with flash powder. She closed the lid and rolled up the box in thin paper torn out of a book; then glued it shut. She wrapped the box tightly in all directions with a green, heavy twine 3/16th inch thick. Then she used an ice pick to make a hole into the small box filled with flash power, twisted in a fuse, and then added glue. Once the dark green twine was wrapped around, the salutes ended up looking like little hand grenades. These are sold in India and South Africa.

MANUFACTURING SHED

Just outside her building were around 100 kilo's of black powder drying in the sun on twenty burlap bags. The black powder on these bags were up to 5cm thick.

One room had eight men sitting in it. One man scooped up a small amount of black powder and dropped it down a three inch mortar. There was a half inch thick cardboard disk at the bottom with a 1.5" hole to hold in the black powder. He put in a shell and passed the mortar on to the next man. With a wood dowel that man put in another cardboard disk, then wrapped the mortar with packaging paper. Another man took an ice pick and made a hole at the bottom into the black powder then twisted in a fuse.

In China there were rubber mats on the floor of the work rooms, which were hosed off 3-times a day. But in Sivakasi only a few factories had rubber mats on the floors and they were covered with flammable chemicals.

We came to a stop in front of a manufacturing shed when my guide called over a factory manager who walked by at the time in slacks and a dress shirt, unlike the other men who wore a sarong. We gave him our cell phones. There was a 4m high Cinder block wall with an opening in the front and back. Then a 3m cement square room inside with steel doors. We walked into a cone fountain making shed. A woman sat on the floor. In front of her were three, fifteen-liter sized Aluminum bowls half full of composition. She picked up an empty cardboard cone about 12cm high and scooped up chemicals some from each bowl as this was a 3 color fountain. She then put in a cardboard disk and set the cone in a round aluminum tray with a small 2cm lip. Once this tray was full, she got up and walked to the other part of the room, then sat back on the floor. That day she made two different sized cone fountains. She would alter between the two she made. She put one cone in a thick wood block with a cone shaped hole in the middle. This held the cone in place, but upside down. Only the bottom half of the cone was in the block. She put in a second cardboard disk. Then put in a thick wood dowel, with a round end the same diameter as the cone, she took a wood hammer and whacked it just twice barely compressing the powder. That is why these fountains only last two seconds. The fountains get put aside and later get taken to another building to be fused, wrapped and boxed.

There were about eighty manufacturing sheds at this factory. Each was 3m square with over 100 workers, mostly women.

I noticed during firecracker making, the fuse was not dipped into black powder before getting put into the firecrackers as at other factories. I didn't see what they did to keep the fuse in.

As in China powder mixing started at 7am and stopped by 9am because of the heat and fire potential.

As we drove off, I asked if we could see the factory that blew up. He made a call as the last manager did. After a minute he got off the phone and said. "No." I asked what about just going to the outer streets so I could see from far away. He said "no, because the whole area is blocked off. There is a heavy investigation going on and no one is even allowed down that street unless you're a police officer."

Meanwhile, our driver was negotiating slowly through a heard of goats. That was only the tenth time this week there were goats blocking the road.

RUSH HOUR IN RURAL INDIA

We saw more women walking barefoot on the hot black asphalt country road, ten miles from the nearest town, with heavy buckets of water and baskets of washed clothes on their heads.

I called Mr. Paneer of Sri Kaliswari. We talked the day before about getting a ride to the next city. After some confusion about my check out time, I was driven forty-five minutes to Madurai. His company had called a five star hotel there to give me a 15% discount, so I only paid $75 for that night.

As I walked into the Royal Court Hotel the front desk man called me, “Mr. Peter.” They’ve done this in all ten Asian countries I’ve been to. I forget to write my last name first over there. Other times ‘Mr.’ will be added to your first name anyway to show respect even if they know it’s your first name. So it gets confusing.

In the US I had met a twenty-six year old man from India. By e mail I found out he was back in India, but could not meet me in Madurai as we had planned. He had a life threatening virus. He couldn’t move out of bed more than fifteen minutes a day. All his muscles were too weak and he had to go to the hospital everyday for injections or the virus would have killed him by the time I was in India. The injections were holding off the virus, but not killing it. The doctor said his lungs and liver were half destroyed.

So that night I walked alone to see the Meenankshi Amman Temple with its four large towers, and six smaller ones inside. The oldest was built in the year 1216. Along the way beggars from five-year old boys on up to eighty-five year old women asked for money. Shop keepers stood in front of their store hawking anyone to “come in just to look.” The main streets of Madurai were filled with 100s of people walking the sidewalks. Street sellers were everywhere. They will walk with you for half a block talking non-stop to get you to buy something out of their hand, blocking your efforts to take photos of other things.

Sleeping in a hotel within five blocks of a train station is not possible. The blast from the train horns and the announcements every four-five minutes are just too loud. I was lucky if I slept a total of three hours. By morning I was not in a good mood.

Wincraft's Fireworks

The next day, after a three hour flight, I arrived in Delhi at the Metropolitan Hotel, formally called the Nikko. From my room I called Wincraft fireworks. I had called them from the US. I spent ten minutes looking for the number and time was running out. It was getting close to 8pm, when businesses close. The first number I had didn't work, but I called his cell and reached him. He said in broken English, "I'm going to be out of town for a week, so I cannot meet with you Monday, go to MSN."

Just the previous week he told me by phone "Sure come on out." This is about 75Km East of Delhi. He just kept saying, "Go to MSN." I asked him if he could get someone else to give me a tour. But he wouldn't arrange it.

He doesn't do export or want to get into it. I assumed he was a small operator. If I had been from India, I may have been accommodated.

Pai Walan St Fireworks Market, Old Delhi

Monday night the 27th of July I went to see some Fireworks stores. It was dark and pouring rain. In a taxi ten kilometers from my hotel we would stop for eight minutes then drive again. The traffic lights would stop working in the rain. This was a common problem. Traffic was bad during rush hour anywhere in India, worse during heavy rains, worse during flooding, and really bad when the traffic signals failed (many were not water proofed.) We moved ahead five cars then wait for eight minutes, we moved ahead another five cars and stopped another eight minutes each time the drivers turned off their engines.

I'd never seen it that bad in any other of the twenty-two countries I've been. We weren't going anywhere. This was too much. After an hour I told him to turn back. I asked, "Is it because of rush hour?" "No, its because it's raining." At least the Gateway of Delhi had a nice yellow glow to it. Even the street in front of my hotel, had 15cm of water. Two and a half hours later I was back in my hotel.

The next day I tried again. Without the rain or traffic it was a twenty minute drive to a very narrow, two-lane street crowded with cars and people. Once we were on the street we would stop for five minutes, then drive a few car lengths. It was hard driving down that street. I got out in front of a fireworks store. There were eight stores in all with souvenirs shops in between. They let me take pictures and videos.

DELHI'S FIREWORKS MARKET

There were five gram boxed salutes, ten for 100Rs, $2.10. A brick of forty packs of firecrackers with twenty per pack went for $4.20. They had flower pot fountains in different sizes and many other products and brands I never saw at the factories. I asked if it was OK to light off fireworks. He said, "Sure you can light 'em off at your hotel property or public places."

But the next dealer said, "No, only during special occasions; weddings, ceremonies and the Deepavali holiday in November." They didn't know I had just spent the past ten days visiting many of these factories. Most shop keepers sat around writing on paper and

said nothing unless I asked. Each of them spoke about 60% English. I saw no buyers. I wondered how they made any money.

One dealer said, “We only sell wholesale.” I found out his idea of wholesale meant ten boxes of anything you want, nothing less. So, not just one box of ten salutes, but ten boxes of ten each, or 100 in all. This would be 500Rs or $10. $1 a box instead o $2.10 a box right next door.

It’s common to see images of westerners on boxes of cakes or mortars including, Lindsay Lohan, Jennifer Aniston and Milla Jovovich to name a few.

READY TO LIGHT

I stopped at seven of these stores, then walked to my taxi waiting at the end of the street. As soon as I walked down the street I was followed by ten kids asking for money. Then a thirty year old woman in traditional Indian attire with a baby in her arm hit my taxi window asking for money.

As we drove off, the boys ran up to us and started beating on the windows. One had a big smile on his face and pointed while yelling at his friends. This encouraged others to join in. More of them surrounded the back and sides of the taxi. All of them screamed and hitting the car windows as we drove 10km per hour. We stopped because there was a line of cars in front of us. It seemed like some kids may unknowingly have their feet under the tires. The driver turned his head back and yelled at them in Hindi. The kids backed off and we made our escape.

If you're ever in Delhi I recommend seeing the Red Fort, the Old fort, Qutub Minar, the zoo with big cats, the Lotus Temple, Akshardham temple and the Taj Mahal at least. And for gosh sakes watch out for those poisonous snakes! I almost stepped on a cobra while getting out of a taxi to see a temple. A boy was playing a flute sitting at the curb with a cobra sticking up from a basket. You may be wakened nightly up on the 10th floor by squealing pigs from the empty lot behind your hotel. And I've never seen so many birds in the air. Keep your gold at home. The newspaper said that "women were getting afraid to wear their gold jewelry for fear of thieves that would rip them off their necks and run or drive off in their scooters." "Large cracks were discovered in an over pass under construction in Delhi. The whole project may have to be redone."

If anyone asks for your passport, don't give it up. Ignore em and keep walking. Some will impersonate government officials. When they follow you tell em you'll call the police. Having a stern look on your face helps. Most real police carry rifles or guns. When one asked for mine at the main train station I kept walking and he followed talking non stop that I must show him my passport immediately and I can't go in until I do. What made it all the more convincing is that two police with rifles talking with each other were standing only 3m from him. At the top of the stairs I saw a policeman with rifle and asked him where to find the train I was looking for. The impersonator quickly went back downstairs. The real police will not be interested in you. Keep a photo copy of your passport with you with the last number blacked out with hotel business card. Keep your real one locked in your suit case or safe. Only buy train tickets at the windows of the train station, not at booths nearby, because those tickets are only good for half your destiny. If your lucky, you'll see tourist police in white SUVs carrying rifles for your protection.

The Taj Mahal is in the town of Agra forty-five miles west of Delhi. It's a five hour taxi ride one-way, because of traffic that costs $200 US round trip. Or $20 each way by train. The train takes four hours one-way, and you must buy your ticket four hours in advance or even the previous day, because everything gets booked up. However if you take the 6 or 7am non-stop express train from a smaller nearby station for the same $20, then it's only two hours one way. It's best to stay in a hotel in Agra for a night.

I saw very few travelers who were not there for business. Then there are even fewer who travel the world on their own dime just to see, write and make videos about fireworks!

The adventures continue.

HUMAYUN'S TOMB

THE GATEWAY OF DELHI

http://www.Arasanwetwo.com The Arasan Aluminum Group and WeTwo Fireworks Companies.

http://WWW.Sivakasionline.com/fireworks_list.php - a list of over 160 firework stores and factories. Asok sparklers in here is spelled Ashok.

http://www.en.wikipedia.org/wiki/_Meenakshi_Temple - in Madurai, Southern India. 800+years old temple.

The following is a list of a few attractions in Delhi and some of the places I visited. All are open to the public. Most of these occupy at least one square mile of land. These web sites include photos.

http://www.akshardham.com - a very large temple open for any tourist.
http://www.en.wikipedia.org/wiki/gurudwara_bangla_sahib - another interesting temple.
http://www.en.wikipedia.org/wiki/qutb_Minar - the 800 years old Qutib Minar, built to celebrate their victory battle.
http://www.en.wikipedia.org/wiki/Red_Fort - Lal Qila (Red Fort).
http://www.en.wikipedia.org/wiki/Purana_Qila_Delhi - Purana Qila (Old Fort) The first city of Delhi
http://www.bahaihouseofworship.in - built like a Giant Lotus.
http://www.en.wikipedia.org/wiki/Humayun's_Tomb - Humayun's tomb.
http://iwww.enwikipedia.org/wiki/ISKCON_Temple_Delhi - a temple open to the public.
http://www.en.wikipedia.org/wiki/Taj_Mahal - the Taj Mahal.