Fire Works

Rendezvous at sea

28th Oct 1792

Meal Powder	M
Corn'd Powder	☽
Saltpetre	⊖
Brimstone	Z
Crude Sulphur	C Z
Charcoal	C +
Sea Coal	C. S
Saw dust, raspings of Beech	B. K
Steel or iron filings	S. +
Brass dust	B +
Glass dust	G +
Tanners dust or bark	T +
Cast iron	C. I.
Crude Antimony	C. A.
Camphor	✱
Yellow Amber	A. Y.
Lapis Calaminaris	L. S
Gum (Arabic Supposed)	Ĝ
Lamp black	B. L
Ising glass	G. I
Spirit of wine	W
Spirits of Turpentine	S. T
Oil of Spike	A. O.

Compositions

Sky Rockets

Four Ounces —	1 Lb 4 oz —	4 oz —	2 oz
8 Oz —	1 " —	4 —	1 ½ "
0 —	2 —	1 ½ —	4 ½ —
1 Lib —	20 oz —	8 oz —	4 oz — 2 oz — 1 ½

Sky Rockets in general

1.	4 Lib —	1 Lb —	1 ½ Lib
2.	4 Lib —	1 ½ Lib —	1 Lib 12 oz — 20 oz

Large Sky Rockets

4 Lib — 1 Lb — 1 Lib

Rockets of a middle Size

1.	8 Lb —	3 Lib —	3 Lb M. —
2.	3 Lb —	2 Lb —	1 Lb M — 1 Lb

Rocket Stars

White

M — ⊖ — Z [illegible] — P.O. — ✗

4 oz — 12 oz — 6 oz — 2 oz — ~~8~~ oz 5

Blue

M — ~~⊖~~ — Z — ~~✗~~ w — P.O.

8 oz — 4 oz — 2 oz — 2 oz — 2 oz

Variegated

M — Rock petre — Z.V. — ✗

8 ~~drams~~ — 4 oz — 2 oz 2 oz

Brilliant

⊖ — Z — M.

$3\frac{1}{2}$ oz — $1\frac{1}{2}$ oz — 3/4 oz — worked up with } 1 [illegible] of wine only

Common Stars

⊖ — Z — C.A. — G.J. — ✗ — w

1 lb — 4 oz — 4 3/4 oz — 1/2 oz — 1/2 oz — 3/4 oz

Tailed Stars

M — Z — ⊖ — C+

3 oz — 2 oz — 1 oz — 3/4 oz this last [illegible] [illegible]

Drove Stars

⊖ — Z — B+ — C.A.

1. 3 lb — 1 lb — 12 oz — 3 oz
2. 1 lb — ~~8~~ oz — ——— 4 oz

Fine [illegible] Stars

⊖ — Z — C.A.

$\frac{1}{2}$ oz — ~~8~~ 2 oz — 1 oz 10 drams

Fine Coloured Stars

⊖ — M — Z — ✗ — S. [illegible]

1 oz — 1 oz — 1 oz — 4 dr — 4 dr

Golden Rain for Sky Rockets

⊖ — M — Z — B+ — B.R. — G+

1. 1 lb — 4 oz — 4 oz — 1 oz — $2\frac{1}{4}$ oz — 6 dr

M — ~~⊖~~ — C+

2. 12 oz — 2 oz — 4 oz

⊖ — Z — G+ — C.A. — B+ — B Rop.

3. 8 oz — 2 oz — 1 oz — 3/4 oz — 1/4 oz — 12 dr

Golden rain

⊖ — M — Z — C.A.

1. 4 oz — 2 oz — 2 oz — 2 oz — 1/2 oz Sal [illegible]

⊖ — Z — C+ | 3 ⊖ — Z — C.A.

2. 1/2 lb — 2 oz — 4 oz | 3. 1 lb — 1/4 lb — 6 oz

⊖ — Z — 3 — S+

4. 4 oz — 1 oz — 2 oz — 3/4 oz

Water Buckets

	M	O	Z	C+
1.	6 Lb	– 4 Lb	– 3 Lb	– 5 Lb
2.	——	1 Lb – 4 Oz	– 6 Oz	–
3.	——	1 Lb – 4 Oz	– 12 Oz	–
4.	——	4 Lb – 1 Lb 0 Oz	1 Lb 12 Oz	—
5.	4 Lb	– 4 Lb	– 2 Lb	
6.	4 Oz	– 1 Lb – 8½ Oz	– 2½ Oz	
7.	1 Lb	– 3 Lb – 1 Lb	– 1 Oz – 8½ Oz	– ¾ Oz – ½ Oz

C.S. C+ B.R. S+

and ¼ Oz Coarse Charcoal

	M	C+	B.R.
8.	1 Lb 12 Oz	– 3 Lb	– 1 Lb 0 Oz – 12 Oz – 2 Oz

Sinking Charge for W. Buckets

M	C+
8 Oz	– ¾ Oz

Wheat Cases from 2 Oz to 4 Lb

	M	O	S+	Z	C+
1.	2 Lb	– 4 Oz	– 7 Oz		—
2.	2 Lb	– 12 Oz	– 3 Oz	– 4 Oz	– 4½
3.	4 Lb	– 1 Lb	–	– 8 Oz	–

B.R.

4. 8 Oz – 4 Oz – 1½ – ¾ Oz Cereal –

G+

5. 1 Lb 4 Oz – 8 Oz – 2½ Oz – 4 Oz 10 Gr –

Wheat cases continued —

	M	C+	B.R.
6.	12 Oz	– 10 Oz	– ½ Oz –

	O	Z	C+	
7.	1 Lb 9 Oz	– 4 Oz	– 4½ Oz	C.S.

	O	M	Z	
8.	1 Lb	– 2 Lb	– ½ Lb	– 2 Oz

	M	O	S+	
10.	1 Lb	– 2 Oz	– 3½ Oz	

~~9. M O S+ M. G+~~

	O	M	S+	
9.	2 Lb	– 1 Lb	– 4 Lb	– 4 Oz

	M.	S+		
11.	2 Lb	– 2½ Oz	– 2½ Oz	Fine Dust of coal ash

	O	Z	C+	
12.	11 Lb 13 Oz	– 8 Oz	– 6 Oz	—

Blow pipe for Shells

	O	Z	M	
1.	4 Oz	– 2 Oz	– 1½ Oz	C.A.
2.	4 Oz	– 1 Oz	– 10 Oz 6 Dr	
3.	4½	– 1 Oz	– 1½ Oz	M.

Dead pin for Shells

O	Z	L.S.	C.A
1¼ Oz	– ¼ Oz	– ¼ Oz	– 2 Dr

Standing or Fixed cases

	M	⊖	Z	C+	S+
1.	4 lib	2 lib	1 lib	1 lib	8 oz
2.	2 lib	1 lib	—	C+ 4 oz	—
3.	1 lib 4 oz	—	—	—	4 oz
4.	1 lib	—	Z 4 oz	—	6 oz C.S
5.	2 lib ½	—	—	C+ 5 oz	B.R. 1½ oz
6.	3 lib	—	—		

Drum Cases

	M	⊖	S+	Z
1.	8½ lib	1 lib 2 oz	2 lib 10 oz	4 oz

	M	⊖	Z S+
2.	3 lib	6 oz	7½ oz —

Brilliant Fire

M	⊖	Z	S+
12 lib	1 lib	4 oz	1½ lib

Gerbes

M	lib oz
6 lib	2, 1½ beat iron

Chinese Fire

⊖	M	Z	C.I.
12 oz	2 lib	1 lb 2 oz	12 oz

Tourbillons

	M	C+
4 ounce	2 lb 4 oz	4½ oz
8	2 lib	4¾ oz

Large Tourbillons

M	⊖	Z	C.I.
2 lib	1 lib	8 oz	8 oz

Tourbillons may be made very large and of different coloured fires, but the larger they are, the weaker must be the composition —

Water Balloons

⊖	Z	M.	C.A.	B.R	G+
4 lib	2 lib	2 lib	4 oz	4 oz	1¼ oz
9 lib	3 lib	6 lib	8 oz	12 oz of rosin	

Water Squibs

	M.	C+		M	C+
1	1 lib	1 lib	2	1 lib	9 oz

Mine-ports or Serpents

M C+ | ⊖ M C+

1 1 lib – 1 oz | 2 – 9 oz – 1 oz

Port fire for firing Rockets

⊖ Z M

1. 12 oz – 4 oz – 2 oz
2. 8 oz – 4 oz – 2 oz } finished out
3. 1 lib 2 oz – 10 oz – 1½ lib moisten with 1 gill of
4. 2 lib 2 oz – 10 oz – 6 oz – B–R.
5. 1 lib 4 oz – 5 oz – 4 oz – 8 oz
6. 8 oz – 2 oz – 2 oz

Port fires for Illuminations

⊖ Z M

1 lib – 8 oz – 6 oz

Cones or Sheet Wheels

⊖ Z M G+

1½ lib – 6 oz – 14 oz – 14 oz

Crowns or Globes

⊖ Z C.A ℞

6 oz – 2 lib – 4 oz – 2 oz

Air Balloon Fuzes

⊖ Z M

1 lib 10 oz – 8 oz – 1 lib 6 oz

1½ lib – 8 oz – 1 lib 8 oz

Serpents for Pots des Brins

M ⊖ C+

4 lib 8 oz – 12 oz – 2 oz

Fire Pumps

⊖ Z M G+

5 lib – 1 lib – 1½ – 1 lib

5 lib 8 oz – 1 lib – 1 lib 8 oz – 1, 8 oz

Slow white Flame

⊖ Z C.A. M – G+ B+

2 lib – 3 lib – 1 lib   1 lib – 4 oz – 1 oz

3½ lib – 2½ lib – ½ lib –

These compositions drove one inch and a quarter in one ounce case will burn one minute which is longer than any other yet known

Amber Lights

M

9 oz – 3 oz Amber, may be drove in small cases for illuminations —

Another Light

⊖	Z	M	C+	
3 lib	1 Lib	1 Lib	10½ oz	} The oil of Spike mixed with

Red fire

M	C+	Bk.
3 lib	12 oz	8 oz

Common fire

⊖	C+	Z
3 lib	10 oz	2 oz

Spur fire

⊖	Z	B.L
4 lib 8 oz	2 lib	1 lib 8 oz — or
1 lib	½ lib	4 quarts of Lamp black

This composition difficult to mix — First sift together the Salt petre and Sulphur which put into a marble mortar with the lamp black, work down by degrees with a wooden pestle till the composi- tion appear of an uniform colour which will be greyish near to black, drive a little into a case for trial, if the sparks come out in clusters and afterwards spread well the composition is good, if drossy sparks and the stars not full, it has not been saturated enough — If the sparks are small and soon break it is too much rubbed — This is the most curious of all fires, was invented in China, but is now made in great perfection in Europe — The lamp black must be dry and not clodded — the other ingredients perfectly pure — May be ram'd into one or two ~~inch~~ ounce cases part- [?] & inches long but not drove very hard concave stroke [?] should be very smooth, the choak or vent something less than the usual proportion — Is better when kept a few months than when new rammed — If kept dry will not spoil in many years — But fired near and in a dark room round a transparent paper pyramid — will not burn a silk handkerchief held in the middle —

feels cold to the hand — when strongly rubbed with wet flannel from the case may be held in the hand with as much safety as a candle

Artificial Earthquakes

Equal parts of Benzoin and iron filings wrought into a paste with water — bury it under ground the quantity should not be less than 10 Lbs but the more the better

No 2

Fireworks

Kedleston 29th Octr 1792

Colours produced by Simple Ingredients

– Sulphuret blue — Camphor a pale white — Salt petre a bright white — Yellow Amber a yellowish white — Sal ammoniac a green — Antimony reddish — Rosin Copper a blue — Greek pitch a orange or brass Col:

White Flame

Salt pr. Sulphur Meal powder & Camphor — The Salt pr. predominant

Blue Flame

Meal Powder, Salt pr. and Sulphur Varnish — The Sulphur the chief part

Flame reddish

Salt pr. Sulphur — Antimony and Greek pitch — Salt pr. predom: —

Ingredients which shew themselves
in Sparks when rammed into choaked
cases

Black — Meal powder and Charcoal
White — Saltp: — Sulph: and Charcoal.
Grey — M + θ + Z + C
Red — M + C + Br —

Brilliant fire

M + θ + Z + St or 2 M + St —

Quick match

Cotton	lib oz 1, 12	θ 1 lib	— 2 quarts W — Water

three quarts — Sping Glass 3 Gills
and meal powder 10 lib —

N.b. To dissolve four ounces of Sping Glass
it will require three pints of water

Quick match is generally made
of such cotton as is used for candlewicks
of different sizes from one to six threads
according to the size of the pipes it
is intended for — The pipes must be of

such a size as to allow the match
to be pushed in easily without breaking.
Lay the cotton in loose coils on the
flat bottom of a copper or earthen pan
put in the Saltp: and Liquor, and let
them boil about 20 minutes — after
which coil it into another pan and
on it what liquor remains, put in
some meal powder pressing it down with
the hands till quite wet — wind it on
a flat frame or reel letting the cotton
pass lightly through the hands full
of wet powder, if the powder be too wet
to stick to the cotton, put more in
the pan — the match may be wound
as close on the frame as can be
but so as not to stick together
— Sift some dry mealed powder on it
till it appear quite dry — In winter
the match will be a fortnight before
it is fit for use — When thoroughly dry
cut it along the out side of one of the sides
of the frame, and tie it up in skeins for

Gun Powder

	⊖	Z	C+
1	100 —	25 —	25
2.	100 —	18 —	25
3	100 —	12 —	15
4	100 —	20 —	24
5	100 —	15 —	18
6.	100 —	10 —	8

Melidor

30 ⊖
5 Z
5 C+

English Mills

$76\frac{1}{2}$ ⊖
$12\frac{1}{2}$ Z
$12\frac{1}{2}$ C+ } $1\frac{1}{2}$ lb in water [illegible]

Pulvis fulminans

⊖	S. Tar.	Z
3 —	2 —	1

This composition makes the greatest noise when not confined

Aurum fulminans.

Disolve pure Gold in Aqua regia then precipitate it with Sal amm.c The precipitate is of a brown yellowish colour, it detonates with a moderate heat — Great care necessary to avoid the danger of fulminating Powder — Phials stopped with common corks — dried in the Sun at a distance from the fire — If the aquaregia is formed by pure nitre and Muriatic acid the precipitate will be one fourth more in quantity than when formed of the nitrous and marine acid — The Dephlogisticated marine acid disolves gold as readily as any aquaregia

Argentum Fulminans

Dissolve pure Silver in the Nitrous
acid precipitate with lime water
digest the black powder in ~~sal am~~
caustic vol. alk.
Decant the alkali and evaporate
to dryness – This powder fulmi-
nates with a heat little greater than
that of boiling water it also ful-
minates by ~~the~~ a slight friction
against any body

– The materials must all be ex-
tremely pure for this experiment

– The caustic alk. decanted from
the above powder deposits ~~slowly~~
by slow evaporation small bright
laminated Chrystals which fulmi-
nate under water by simple friction

Stars

M ⊖ Z 5+
1 4 oz – 2 oz – 2 oz – 1½ oz – camphor, white
amber and mercury sublimate of each
half an ounce

2 Saltpetre 10 oz + Z + ⊖ + CA + M+x
of each 3/4 oz – These compositions
are worked to a paste with aquavitae
in which some Gum Tragacanth has
been dissolved – make a hole thro'
each and string them on a quick
match, leaving them about two inches
asunder

⊖ Z yel: Antib CA Powder
3 8 oz – 2 oz 1 oz – 1 oz – 3 oz

Z ⊖ Franklin in dispr mastic and
4 2½ oz 6 oz – 4 oz
mercury sublimate of each four oz
M
5 oz – white Amber, yellow Amber and
Camphor of each 1 oz. Antimony and
Orpiment of each half an ounce

Cr Z M

5. 1 Lb – ½ Lb – 8 oz – Incorporated with Colcothar out —

6. Powder ½ Lb – Z 4 oz – 4 oz

7. 4 oz – 2 oz – 1 oz —

Stars with tails of Sparks

Z Cr Prussian

1. 6 oz – 4 oz – 2 oz – 4 oz — or

2. Salt P. rosin and Charcoal of each 2 oz – 1 oz — These ingredients are sometimes melted in an earthen pan and mixed with chopped cotton match before they are rolled into Stars but as well to wet and work them up in the usual manner

Other Stars which yield Sparks

1. 2 oz – 1 oz – 1 oz | 2 1 oz – ½ – 2 oz – omitted

wet with Gum water or Spirit of wine in which G. Arabic Trag.th has been Dissolved to the consistence of a pretty thick liquid to this one oz of Lead in the Composition – 2 oz of Nitre for Stars —

Stars of a yellowish colour

4 oz of G. Arabic Trag.th pounded and sifted thro a fine sieve – 2 oz Camphor Dissolved in Brandy – 1 Lb – ½ Lb – 4 oz – ½ oz white Amber – 2 oz of pounded and Incorporate well the materials and form them into Stars in the usual way

Stars of another sort

1 Lb melted in 1 pint over a slow fire and 4 Lb of Gum Arabic which has been Dissolved in Nitre Vinegar mix

1 Lb – 6 oz – 5 oz Stir them well and work it into Stars proportionable to the Size of the rockets —

Table of dimensions of Rocket moulds in which the Rockets are rammed solid —

weight	Lenth of the moulds without the nipple	Interior Diameter	Height of the Nipple
lib. oz	Inches	Inches	Inches
6 —	34.7	3.5	1.5
4 —	20.6	2.9	1.4
2 —	13.35	2.1	1.0
1 —	12.25	1.7	0.85
0. 8	10.125	1.33	0.6
0. 4	7.75	1.125	0. 5
0. 2	6.2	0.9	0. 45
0. 1	4.9	0.7	0. 35
0 [illegible]	3.9	0.55	0. 25
6 [illegible]	3.5	0.5	0. 225
4 dra[illegible]	2.2	0.3	0. 2 —

The diameter of the nipple must always be equal to that of the former
The thickness of the mould is of no consequence provided it be sufficiently strong —

Dry rocket cases should be 6½ exterior diameters (or interior of the mould) in length, made of the strong cartridge paper — The vessel of paste board — thick 1 Diam. & one third — Nipple half a Diam. high and $\frac{2}{3}$ thick — Piercer is in height 3½ Diam. ~~and~~ $\frac{1}{3}$ Diam. thick at the bottom and $\frac{1}{6}$ at the top — Rowler is in length from the handle 7½ Diam. and its Diam. $\frac{2}{3}$ of the bore of the mould End of the Former is of the same thickness and ~~the small part~~ 1$\frac{2}{3}$ Diam. long, the small part which fits into the hole when the case is a finishing is one death and a half of the moulds diam. thick — There are three Drifts or rammers — 1st. 6 Diameters from the handle — a very little thinner than the Former to prevent the sticking of the paper in drawing, and hollow to go over the piercer, 2^{3} Rammer 4 D. from the handle hollow like the 1st but proportionally shorter the hole for the piercer being 1½ D. long — 3^{3} The solid Drift to finish the case

All the rammers must have a collar of brass to keep the wood from splitting The same proportions are given to all mortars from 2 oz to C Lit-

— The above dimensions respect the mortar not the case — The interior Diam: of the mould is supposed to be divided into 6 equall parts ——

— The mealing board is best made of ~~ein~~ Elm with a com. bleding piece at one end — The Muller also of Elm but harder wood is necessary for pulverising Salt Petre and Brimstone

— Balloon cases or paper Shells are made by pasting paper on an oval solid wooden Form in the same manner as Globes — when the two parts are cut asunder leave about an inch uncut by this they will be more easily joined — make the end which goes in- to the mortar a little thicker than the rest of the Shell to resist the blast of powder in firing — Burn a hole at top for the fuse — If the shells exceed eight inches in Dr. the joint shell should be turned of Elm instead of being made of paper —

Dimensions

Mortar Inches	Forms	Thickness Shell
4.4 —	3 1/8 by 5 1/2 —	1/2 Inch
5.5 —	4 by 8 —	5/8 Inch
8 —	5 15/16 by 11 7/8 —	7/8 Inch
10 —	7 3/16 by 14 1/4 —	1 1/8 Inch —

Diam: of the fuse holes

Mort.	
4.4 —	7/8 Inch
5.5 —	1 1/8
8 —	1 3/8
10 —	1 5/8

4 Sorts of Balloons

1. Illuminated Ball —
2. Serpent Balloons
3. for Rockets, marrons and crackers
4. Compound Balloon

1 Serge illuminated — Cochorn

Meal Pr. — $1\frac{1}{2}$ oz

Corn Pr. — $\frac{1}{2}$ oz

Powder for the Mort: 2 oz

Length of the fuse com position $\frac{3}{4}$ Inch

Drove or rolled stars of 1 oz each, as many as will nicely fill the shell

---

1 Serge Ballon of Serpents — Cochorn

Meal Pr. — $1\frac{1}{4}$ oz

Corn powder — 1 oz

Powder for Mort: $2\frac{1}{4}$ oz

Length of the fuse Comp: $\frac{13}{16}$ Inch

Half ounce cases drove three drams and bounced three drams; and half oz cases drove two Drs and bounced four of each an equal quantity and as many as will fit in easily, placed head to tail

---

Fire works — No 3

1 Sery. Balloon of Crackers and upon

Meal P. 1 1/4 oz
Corn P. — 3/4 oz
P. for Mal. 2 oz —

{ Fuze const. — 3/4 Inch
Pressed of four and
Crackers of six inches —
as many as will fill y. Ball

1 Sery Composition — Crackers

Meal P. 1 4 Dr (oz)
C. P. — 0. 12 Dr
Mal. 2. 4 Dr

{ Fuze — 13/16 Inch
Mal. oz. cases drove 3 1/2
Ditto burned 2, 16
Mal. oz. Cases drove 4 } 10
and not burned }

Blue Stirring Stars — — — — — 10

Rolled Stars as many as will fill the balloon

2 Size Balloon Stars Royal
Fuse $\frac{15}{16}$ Inch

	or	Drm
Meal P.	1 :	8
Corn P.	0 ·	12
For Mort:	3 ·	00

2 oz Stars Stars — 34
Rolled Stars to fill the Ball
allowing room for the fuse —

Royal Balloon of Serpents
or Dr Fuse 1 Inch one

Mealed P.	1	0
Corned P.	1 ·	8
Mortar	3	8

ounce cases drove $3\frac{1}{2}$ and 4 Drs and bounced 2 Drs of each an equal quantity
sufficient to load the Shell

2 Size — Ball: of Crackers and Marrons Royal

	or	Dr
Meal P.	1	8
C. P.	1	4
Mortar	3	0

Fuse $\frac{14}{16}$ Inch
Reports — 12
Crackers of 8 Bounces to fill the Ball

2 Size Compound — Royal
or 5 Fuse 1 Inch

Meal P.	1	5
C. P.	1 :	6
Mortar	3 ·	12

Half ounce cases drove and boun.d 2 Drs — 8
Two oz C.s filled $\frac{3}{8}$ Inch with Star Compo.n and boun.d 2 Dram — 8

Silver Rains — 10
Two ounce Tailed Stars — 16
Rolled brilliant Stars — 30
If there shall be room compleat with Gold rain falls

3 Size Balloon Stars — 8 Inch
or Dr Fuse $1\frac{3}{16}$ Inch

M. P.	2	0
C. P.	2	0
Mort. —	9	0

two ounce cases drove one Dram and a half, and bounced two, and one ounce cases drove two dram and bound $2\frac{1}{2}$, of each an equal quantity, sufficient to fill the Shell

Dimensions for Balloons may be made either of paper or bees with a cap like those of Howitzers or the Artillery — The Diam[r] of the Former for paper of the 5" Size must be 1/2 Inch 2 Size 5/8, 3 3/4 Inch: 4 h 7/8 Inch

Composition for fine sheets

N O Z

8 Oz — 2 Oz — 1 among these may be mixed a little Salt Petre should be very dry and not too fine — The papers may be made of two or three rounds of Elephant paper — The Formers are from 1 1/2 to 4 inches Diam[r]

Blue or White lights

Nitre 28 Lib } Fire about half a lib
Sulphur 7 — } at once in an earthen
Orpiment 2 — } pan or iron Laddle

on the lee side of the ship, the former being noxious —

Philosophical Fire works

1 Greenish white fire, common in-flamm. air and pour iron and vit: acid

2. Greenish, the above with the Marine acid —

3. Blue — Ethereal air — produced in the process of making Ether or more readily by blowing com-mon air thro' a sponge moistened with Ether —

4. Yellow Nitrous Ether — air

5. Green $\frac{1}{3}$ Nitrous and $\frac{2}{3}$ inflam^m.

6. White — Dephlogisticated air — Pit coal — Bennet coal

7. Fine yellow inflam^d. air passing through } vitriolous } Ether!!!
perhaps } nitrous } Ether —

8. Blue air in one tube and Dephlo-
gisticated in another blown into each
other produces a brilliant greenish a
— Instead of Dephlogisticated take
Nitrous air [illegible] dephlogisticated

9. Blue a powder — Steel filings
Verdigrease and Zink reduced to
a fine powder and blown with
blue air produces a ~~the~~ greenish
blue and very Brilliant flame

10. The following substances were
put into the bole of a tobacco
pipe and exposed to a red heat
— Nitre a very bright white and in
great quantity —
— Strontian a white and in con
siderable quantity — took long time
— Mary Gold seed a fine white

— Lemon peel a blue bead with
white in the middle
— Camomile flower a white incli-
ning to red
— Rape and Canary seed — white

11. Sedative Salt dissolved in Ether
green — It is probable that all
the colours may be produced by
dissolving different Salts Gums &c
in Ether

12. Into a bladder not quite full
of pure air pour a small quan-
tity of Ether the bladder will soon
be filled soap bubbles with that
air give a violent explosion
— This air tried with respect to
its colour

13. Pure air for fire works or other
purposes may be produced from

Manganese — It is ~~too~~ purer than from red precipitate — In Manganese is exposed to heat without any acid of in the common air spirit, the flame of a candle will be sufficient —

14. Pure air from the Muriated alkali or Bertholets new salt the best by far the purest, but is very expensive —

15. Inflam.ble air made from iron turnings and the steam of boiling water the best — lightest, smell not so disagreeable — Cheapest —
— Patent lamp sufficient for boiling the water

16. Iron file dust mixed with Lycopodium and Charcoal blown out with — common air a powerful

17. Borax and Green Copperas calcined together and reduced to a fine powder, blown with com.n inflam.t air produces a fine yellow — should be mixed with an equal part of Lamp black —
— Cast iron file dust the best —

18. If Zink is heated nearly to its melting point, it may then be pounded in a mortar — It may also be pulverized by pouring it when in fusion into water, or into a box the inside of which is rubbed with chalk or Whiting agitate the box strongly till the Zink cool —

19. Infusions of Jesuits bark and many other vegetable matters in Ether or Spirit of wine or perhaps common spirits will in all probability give

a variety of colours usefull in Philos:
Fire works —

20. If a small quantity of Geneva or other Spirits be mixed or rather poured gently on the water and out of bott: during the extrication of the comm: inflam: air it will render it blue — In this way blue air may be had cheaper than from Ether —

21. If instead of a Pipe made use of in the Exp:t mentioned in Article 10 a cork nor Globe or other Vessel be used a variety of air may be produced from a great many substances, both solid and fluid — Such as wood — fruits — flour — oils — Spirits — Dye stuffs &c &c —

Fire works — names

1 Rockets - signal - Sky - honorary and caduceus - Table - Line - swarmers

2. Wheels - horizontal. Perpendicular plural - Spirale - Double Spirale Balloon - Friotoni Double cone -

3. Squibs - Serpents - Pin wheels - Single reports - Marrons - Crackers

4. Balloons - air - water - Illuminated Serpent - for reports; marrons and crackers - Compound —

5 Stars - Strung - tailed - Drove Rolled -

6. Rols de Brins - de Saucissons Des Aigrettes —

7. Tourbillons - Globes with horizontal wheel - Fire tree - yew tree Chinise fountains - Dodecahedron - Fixed Sun -

8. Regulated piece with nine mutations - Chandelier - Horizontal wheel to change to a vertical wheel with a sun in front - Moon and Star - Volute

Aquatic Works - water Rockets

9. Horizontal wheels - mines Fire Globes - Dispersers Balloons - Water Balloons - water Squibs - Sea fight - Neptune in his Chariot - Swans and Ducks - Fire fountains in the water

Fireworks No 4

Simple reports and Marrons are small quantities of Corned powder in paper cases tied firmly with pack thread — Marrons which are generally larger than reports are when finished somewhat of an oval form — Batteries of them are made by hanging a number on a rail by their leaders two of which are inserted into the same end of the marron them

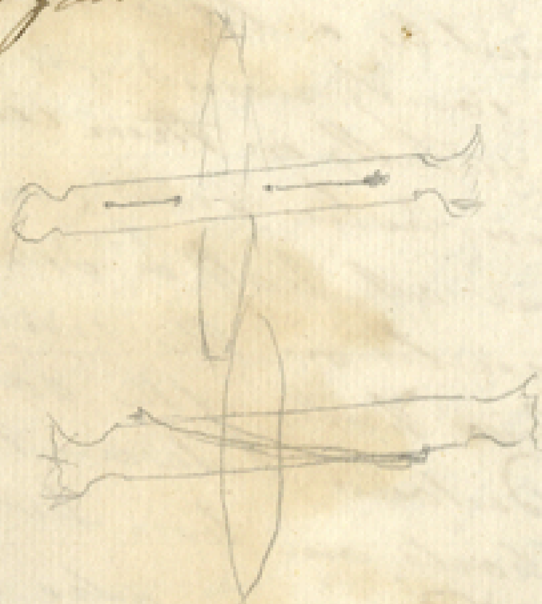
a piece of paper should be wrapt tightly round the marron and leaders — may be primed regularly — — Reports are fired nearly in the same way thro a hole either in the middle or end

Crackers — cut some cartridge paper into Slips of 3½ Inches broad and one foot long — Fold down lengthwise one edg of ~~them~~ each of these pieces about 3/4 In broad, then this double edge 1/4 Inch and turn the single edge back half over the double fold, then open it and lay all along the channel some meal powder, then fold it over and over till all the paper is doubled up, rubbing it down every turn, Bend it backwards and forwards about 2½ Inches each turn as often as the paper will allow — Hold the folds flat and close and pinch them in the middle tying hard with pack thread — prime one end when it was pinched and Cap it with touch paper — When fired they give a report ~~two~~ bounce at every turn of the paper —

~~Fire Pumps~~ Tourbillons

Cases — both ends have 1½ Drams of dry clay rammed hard, and the cases pinched close at the ends — bore a hole equal to ¼ of the neck of a common case, with a Gimlet ~~close~~ to the clay on opposite sides — find the center of Gravity of the case to which nail and tie a stick ½ Inch broad at the middle, and running somewhat narrower towards the ends, The sticks must be a little curved, so as to move easily round on a smooth table horizontally on their centers — Through these holes draw circles round the case, and at half a diameter from these circles on the under side bore other two holes of the same size Divide the distance between these into three equal parts, and bore two holes at the middle divisions also equal to the former — between each two holes lay a quick match covered with paper

also a leader between the holes in the sides — when it is to be played off apply the port fire to the last leader at its middle, the tourbillons with them horizontally on the table for 3 or 4 seconds and then rise — To tourbillons may be fixed reports — crackers — stars and other matters, but take care not to load them too much — N. B. The stick may be the length of the case which is fastened at right angles to it.



Fire pumps

— Cases for fire pumps made in the same manner as for Tourbillons only the former are pasted, whereas the latter are rolled dry — First put in a little mealed powder then a star, on which ram lightly a laddle full or two of composition then a little meal powder, star, composition meal powder &c till the case be filled — Stars should be either square or flat or circular, not globes — hole through each — Quantity of meal powder for throwing the star should increase towards the top, much at bottom would burst the case — Stars of different sizes 1st about 1/4 less than the bore of the case 2 a little larger &c till the last but one which together with the last should fill the bore tight — Cases for fire pumps should be strong, and rolled on four or eight oz formers, 10 or 12 Inches long —

Dimensions and Poise of Rocket-Sticks

Wt. of Rocket lib Oz	Length of the Stick Ft Inch	Thick: at top Inches	Breadth at top In	Square at bottom In	Poise from the point of the Cone Ft In
6 —	14 . 0	1.5	1.85	0.75	4 1.5
4 —	12 . 10	1.25	1.40	0.625	3,9
2 —	9 . 4	1.125	1. —	0.525	2,9
1 —	8 . 2	0.725	0.80	0.375	2,1
— 8	6 . 6	0.5	0.70	0.25	1,10.5
— 4	5 . 3	0.375	0.55	0.35	1,8.5
— 2	4 . 1	0.3	0.45	0.15	1,3
— 1	3 . 6	0.25	0.35	0.10	0.11
— 1/2	2 . 4	0.125	0.20	0.16	0.8
— 1/4	1 . 10½	0.1	0.15	0.05	0.5.05

The last col: expresses the distance from the top of the cone to the Center of Gravity
— Best wood is deal — make a small groove the length of the Rocket, let the upper end of the Stick touch the head of the Rocket a notch near the head another at the neck of the Rocket to hold the string which ties on the Rocket

In general the Sticks for Rockets from half an ounce to 1 lib, may be Diam: of the Rocket, and for Rockets above 1 lib 50 or 52 Diam:s

— Their thickness at top ½ Diam and their breadth a very little more their square at bottom is generally about half the thickness at top

The principal object to be attended to in the Sticks is the poise or balance —

— Honorary Rockets are the same as Sky rockets only they have no head nor report, but closed at the top — Tie a ~~do~~ two ounce case close to the top of the stick across, pinched at both ends with holes round as in tourbillons a leader from this to the top of the Rocket

— Ascends spinning round its axis —

+ Line Rockets — Screw to a round bit of wood with a hole for the line — Rockets fired with their ends alternately

Line Rockets may be ornamented with
Flying Dragons Mercuries, Ships &c
or to turn on the line like a wheel
in this manner, have a flat swivel
made very exact, and on it tie two rockets
obliquely on it one on each side these
will make it turn round all the way
it goes, and form a circle of fire, Charges
should be a little weaker than ordinary
— For two Dragons fighting two Pounds
made square on each tie three rockets
together on the ~~upper~~ under side, then have two
flying Dragons made of tin, and fix one
on the top of each swivel, so as to stand
upright, in the mouth of each dragon put
a small case of common fire and another
at the end of the tail, two or three feet far
of a strong charge on each side of their
bodies to shew them, then put them on
the line one at each end, a swivel in

the middle to prevent their striking
~~to burn~~ against each other — before the
rockets are fired light the cases on the
Dragons, and if they are both lighted
at the same time they will meet
in the middle and seem to fight, then
will then come back and return with
great violence which will have a
pleasing effect — The line ought to
be very strong, otherwise they will strike
too hard

— Caduceus Rockets — are two placed
obliquely on one stick —
In rising form two spiral
lines or Double worm —
— Ends crossed close without either
head or bouncer — Do not ascend
so high as single ones —

+ Chinese Flyers cases filled with like
Tourbillons and made to turn round
on an iron pick or axis —

Mortars for Aigrettes — Nest of Serpents
- made of strong paper — a number
of serpents with a fire pump in the
middle which when finished communi-
cates to the Mortar —

+ Pots des brins - Made of pasteboard
rolled thick and strong - about 2 inches d
and four D[rs]. long pinched with a neck
at one end like common cases — get
a board fix two rows of wooden pegs, cut
a groove the whole length under each row bore
a hole thro' the center of each peg down to
the groove; fix and glue on each peg a
pot, the mouth fitting tight to the peg
thro' all the holes run a quick match
one end of which must go into the pot, the
other into the groove in which is laid a
match from end to end and covered with paper
that it may light the whole instantaneously
Into all the pots put about an oz of corned
and mealed powder, then into some put stars

into others serpents, rains, crackers, rains
&c, when all loaded paste paper over
their mouths, two or three hundred
being fired together, make a fine show
by affording so great a variety of fires —

+ — Lump brimstone better for large works
than flowers ——

Chemical

No 1.

Fire-Works

1. To try inflam.ble air from Coal Rock Charcoal &c —
2. A Balloon air supports a candle for a short time, and just before it is extinguished, the flame is enlarged by the addition of another flame of a pale yellow colour, and sometimes a weak flame spreads itself over the whole of the Balloon air —
3. Heat will inflame Balloon air in the inflam.ble
4. Inflam.ble air from the marine acid and iron burns with a greenish flame — Zinc —

5. A candle is extinguished in Nitrous air just before it expires it is surrounded with a bluish flame about the edge

6. Dephlogisticated nitrous air is made by putting iron into Nitrous air, or more readily by dissolving iron filings or turnings in a diluted solution of copper in the nitrous acid, such as remains after the production of Nitrous air from copper with the Nitrous acid

7. The last mentioned air supports flame & try it with inflamm. fume Alkaline air &c —

8. Hepatic air is best produced by pouring Marine acid on Lepar. Sul. It is exhaled in great quantity Its smell is intollerable affects silver and other metals rendering them black — burns with a light blue flame — Unites readily with water — forms sympathetic Ink — Mix this with Ethereal air, Nitrous &c —

9. Vit. acid air from oil of Vitt. and any inflamm. substance such as oil of ~~Olives~~ olives in the :: of 3 or 4 Vit. to 1

10. Nit. acid air from the Nitrous acid alone by heat

11. Marine Acid air from Marine Acid alone by heat —

11. Fluor acid air — Fluor Spar and Vitt: acid — heat taper

12. Alkaline air Vol: Spi: of Sal. Am: — heat — taper

Coloured air

1. Common inflamm^ble air — from iron with Vitt acid — a greenish tinge

— with the marine acid — somewhat greenish —

2. If any kind of Spirits is added in the process of making com-mon inflamm^ble air — bluish

— Clearer than Ether —

3. Ethereal air a fine Blue

4. Yellow Nitrous Ether

5. Green $\frac{1}{3}$ Nitrous and $\frac{2}{3}$ Inflam^e

6. A fine yellow by inflam^ble air passing through ~~Nitrous~~ acetous Ether

7. Dephlogisticated air — Bilious Honnel wat—

8. Sedative Salt dissolved in Ether a green

9. Blue air in one tube and De-
phlogisticated in another, blown
together a very brilliant greenish
white — This seen by means
of Tubes and other airs —

10. Pure air may be produced in
great quantities and in great
purity from Manganese —

11. Inflamm.le air from Steam and
red hot iron best for fire works
it is lightest — smell not so of-
fensive —

12. Borax and Copperas calcined
together and blown with
common inflamm.le air produce
a fine yellow — may be mixed
with an equal quantity of lamp
black —

13. Infusion of Jesuits bark and
probably many other vegetable
matters will be useful in fire
works —

14. Iron file dust with Charcoal
and Lycopodeum blown with
common inflamm.le air a pur-
ple — This Experiment done
— Flour — Starch — Powder &
other matter blown out with
Inf. Ethereal and other airs —

15. The purest Vital air yet known
is produced from Berthollet's
oxygenated Salt — but it is very
expensive —

16. The following Substances were
put into the bole of a Tobacco
pipe and exposed to a red heat
in a common fire —
— Nuts a very bright white and
in great quantity

— mustard a white and vi con-
siderable quantity — took long time —
— Many Gold-seed — gave a pale
— Lemon flust a blue border th
white in the middle
— Commonest flowers a white
inclining to red —
— Poppie and Canary seed — white

17 Jar a bladder about ½ filled
with pure air from about a
large tea spoon full of Ether
— The bladder with soon be filled
with air which explodes
most violently — (dangerous —
— soap bubbles, when ascending
if over taken with a red hot
iron give a considerable explo-
sion — several curious Expe-
riments with this air —

18. Phosphoric air made with
Phosphorus Ethereal and other
airs —

19. A hard coal probably the same
as our Kennel coal in England
is said to abound in China — This
will probably produce very white
air —

20. Corroded copper with the Butters acid and Spirit of wine makes a beautiful green

21. Zinck with the Vit: acid and Spirit of wine a blue with Sp: of Nitre

22. Bismuth a vast quantity of flame metering to Lay Lick—

23. Solution of blue Vit: in with filings of Zinck a green bordering on blue—

China

Fire works — No. 2

Experiments. —

1. Point — carried by persons —
2. Single — seven rays — Do. Reform
3. Single one — with one bladder —
4. Double star — two bladders —
5. Seven and circle of stars — twelve
6. Double star — two colours —
7. Spiral machine — Do. Colours —
8. ~~Single~~ Double saxon —
9. Six suns. with star in center
10. Double saxon — large bladders
11. Geometry —
12. Egyptian Illumination —
13. Chandelier —
14. Several of the above Experiments — mixed with rain fire —

Apparatus

1. An iron Vessel shaped like a florence flask — body about 6 or 8 Inches in Diameter — the copper tube may do —

2. Apparatus for filling Bladders constructed — Cisterns —

3. New [illegible] in form of a [illegible] with a [illegible] in center and a [illegible] for [illegible] air on the top —
The triangle Equilateral —
Side inches with a [illegible] on the top for colour [illegible]

4. Two tubes in length for Jupiter's [illegible] —

5.