Members Talks on 13th December 2016 **Prime Numbers** by **John Powell**

John Powell asked the question "Why are Prime Numbers interesting?" They only have a low density in the range of numbers. They are only divisible by 1 and themselves.

The first one is 2 – the only even prime as it divides into all higher even numbers. The series starts:

	2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, …
Differences between primes:	1, 2, 2, 4, 4, 4, 2, 4, 6, 8, …
and between the differences:	1, 0, 2, 0, 0, -2, 2, 2, 2, …

There is no discernible pattern in the differences of Prime Numbers.

Finding a formula for other types of number series is straightforward:

		1	2	3	4	5	6	7	
Even numbers:	2N	2,	4,	6,	8,	10,	12,	14,	…
Squares:	N^2	1,	4,	9,	16,	25,	36,	49	…
	$N^2 – N + 1$	1,	3,	7,	13,	21,	31,	43,	…
	$2^N - 1$	1,	3,	7,	15,	31,	63,	127,	…

Sieve of Eratosthenes – Eratosthenes, an ancient Greek, wrote down all the numbers up to, say, 100 (this can be conveniently done in a 10 column array). He then deleted all the numbers

Divisible in turn by:	2	3	5	7	11	13	(2 divides for: 4 & 8, 3 divides for: 6 & 9, etc)
which leaves:	50	34	28	25	25	25	numbers

These 25 numbers are the primes: 2,3,5,7,11, 13,17,19,23,29, 31,37,41,43,47, 53,59,61,67,71, 73,79,83,89,97
The primes below 100 were sieved out at 7. Seven is the highest prime below the square root of 100.

John Powell had posed the question "What is the highest Prime below a million?" The square root of a million is 1000. The square of 999 is 998001. Try for primes above this. The answer is 99983, there being 78,000 primes below a million.

Beginnings of the Gas Industry by **Mary Mills**

Mary Mills gained her doctorate with a study of the Gas Industry, but after 25 years of continuing research can add more about: the involvement of professional chemists in the development of coal gas for lighting; and of industrialists in the manufacture of items from the by-products of gas manufacture.

Gas for lighting was developed in France (from wood) in the late 18C; then (from coal) by Boulton & Watt in England for use by individual factories. A small team led by John Southern used research on combustion and other processes by a Manchester based chemical consultant, William Henry *(see Boulton & Watt archive in Birmingham Reference Library*). In London a Mr Winsor (Dr Mills now thinks he is possibly one of three Winsors) proposed what was to be the earliest public supply gas works. Studies were undertaken by professional chemists – such as William Brande, Professor at the Apothecary's Company. There were also military/political interests by such as William Congreve *(contemporary scientific press)*. Frederick Accum and others brought chemical expertise from Europe to the London 'campaign', but none of them offered any helpful advice *(see 1809 Parliamentary enquiry evidence)*.

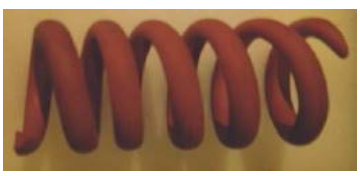
Use of by-products. Gas works needed to dispose of residual products. Mary looked in the gas company minute books for the names of customers for tars and ammoniacal liquid and then tried to find out/guess what they were doing. There was very little knowledge and much suspicion. Attempts to sell often failed (there were problems with rope workers in the Royal Dockyards). The first to succeed seem to have been manufactures of fertilisers and for various – often very crude – uses of tars (*Gas Company archives)*. As time went on various commercial (and very secretive) interests probably developed some important uses – a major German chemical manufacturer Beneke on Deptford Creek is cited to have developed something from what he bought from the gas works. There were others. *(Sourced from German AGFA)*

A number of secretive rival chemical entrepreneurs emerged who by the mid-19C were processing gas industry wastes - and suing each other with evidence designed to confuse *(Court reports, etc)*. Dr Mills closed by mentioning the local 'Deptford chemist' and ruthless entrepreneur Frank Clarke Hills (who also had works on the Greenwich Peninsula – and much else), who died one of the richest men in England – the basis being gas industry 'waste' products'.

Concrete for Non-Building Applications by **Ron Bennett**

Portland cement, based on clay/shale heated with limestone (Calcium carbonate), is commonly used. Its basic recipe is: 2 parts Cement & 1 part Water, to which 3 parts (sharp) sand and 3 parts aggregates can be added. The important reaction is hydration (not drying) – excess water weakens it. But many additives can enhance its properties:

- Accelerators and retarders – change setting time
- Plasticisers – reduce viscosity / rheological effects
- Corrosion inhibiters – protects steel re-enforcing
- Water-proofers/Anti-efflorescence agents – block porosity channels
- Viscosity reducers – allow low water additions and hence higher strength
- Adhesives/bonding agents – give higher strength or substrate adhesion
- Air entraining agents – reduce freeze/thaw effects
- Air release agents – reduces entrapped air
- Re-enforcing Fibres (eg polypropylene)



Alumina cement, bauxite heated with limestone, is good for high temperature use.

Mouldable cement can be made by adding lime with fibre included, and be used to make furniture. This can be designed with undersides hollowed out to reduce weight; various surface finishes can be added with adhesives that bond to the cement as it sets.

Concrete furniture can be moulded, hollow backed for lightness, and is inert. Taking this a stage further concrete springs can be made - with microlysed silica, fibre reinforcing, and no entrapped air.