

Justin Pollard on the history of a piece of paper engineering that has become an essential part of one of the world's biggest annual celebrations

the eccentric engineer



win!

We've got an IET goodie bag for the best caption suggested for this picture. Send your entries to jherbert@theiet.org by 20 February.

IN THE MIDST of the February European drabness, let's cast a nostalgic look back at the festive season, with all its cheerful snaps, pops and crackles.

Christmas just wouldn't be Christmas without the groaning sighs of disappointment and faint smell of gunpowder in the air, all produced by that most British of Christmas inventions – the cracker.

The traditional cracker with its chemical 'snap', cringe-worthy 'joke', flimsy paper hat and often rather shoddy 'novelty' was not the invention of an engineer, sad to say, but rather a young confectioner. Yet the bringing together of different technologies created a marketing sensation that we might all learn from.

In 1830, Tom Smith started out in a bakery which also sold a sideline of confectionery and cake decorations. This was an era when the sweet business was not overly sophisticated and the stuff Smith was making was little more than gum pastilles and fondants, unwrapped and undecorated. It was a business ripe for development and, in 1840, Smith, having set up his own shop in Clerkenwell, London, took a holiday to the sweetie capital of the world, Paris, to search for inspiration. Here he stumbled upon the bonbonnier, a sugared almond

like any other but wrapped in a twist of colourful waxed paper, turning it into a small present.

Smith loved the idea and back in London set about making his own bon-bons, which proved a great success that Christmas. After the holiday season, however, demand suddenly dropped off and Smith was forced to fall back on his cakes. Clearly, his customers saw the tissue-wrapped bon-bons as a Christmas treat and he desperately needed to widen their appeal.

So, the first development in the birth of the cracker came along – the motto. Smith cannot be blamed for the appalling jokes in modern crackers. His idea was altogether more saucy – love mottoes. In each wrapper he placed a piece of paper with a provocative line such as:

"The sweet crimson rose with its beautiful hue is not half so deep as my passion for you."

This seemed to do the trick and soon regular orders were coming in for what were, in effect, tasty chat-up lines. It was then but a short step to add a trinket or keepsake to the package to go with the protestation of love, although this of course involved a re-engineering of the whole package. Now the sweet, trinket

and motto were placed in a paper tube, which was then wrapped in a twist of paper to look like a large bon-bon.

There are only so many people in need of saucy sweeties, and Smith noted that he was still selling most of his wares at Christmas. It was one autumn, while sitting in front of the fire, according to Smith lore, that the great man came up with his most unusual but brilliant idea.

As he sat there wondering how to improve sales, he kicked a log on the fire which crackled and popped. In a revelatory moment, Smith realised that the logical next step in the development of his sweets was making the package burst apart with a bang to reveal its contents.

The unlikely alliance of paper, sweet, trinket and small explosive device was born. It took Smith two years to perfect the 'snap', early offerings either being so 'safe' as to be inaudible or so powerful that the cracker burst into flames. Finally, in 1860, the 'Bangs of Expectation' range was launched.

These were the first true crackers, although they were initially known as 'cosaques', as the 'snap' was supposedly reminiscent of the cracking sound the Cossacks made with their whips as they rode through Paris during the Franco-Prussian War. Success was instant and by 1900 Smith's factory was making 13 million crackers a year.

However, these cosaques were not filled with mass-produced bits of plastic and corny jokes. Along with the love mottoes came topical ones, referring to current events and the arts and Shakespearean quotes. Trinkets, scoured from across the globe, included Bohemian bracelets, German scarf pins, miniature musical instruments, model landscapes and stereoscopic images presented in novelty boxes shaped as everything from a traveling trunk to one entitled 'Love in a Cottage'.

Nor were crackers yet seen as

purely a Christmas item. Celebratory editions came about in the 1920s to mark the discovery of the tomb of Tutankhamun (the 'Treasures of Luxor' set) and Prince Edward's world tour – 'you've met the Prince, now pull the cracker!'

Bespoke crackers were also made. In 1927, a gentleman wrote to the company enclosing a diamond ring asking that the ring be placed in a special cracker. Sadly, he forgot to include his address and the ring and money still lie unclaimed.

Since the Second World War, the story of the cracker has been one of relative decline. Austerity did away with elaborate packaging, Tom Smith was bought out, and recent revivals have added precious little new to the repertory.

The cracker is one of those brilliantly simple, but ingenious, ideas – a piece of paper engineering that has become an essential part of our festive celebrations. But no real developments have come since the days of Smith himself and, if the cracker is to survive, it needs a new twist.

Surely, it can't be beyond the wit of the learned *E&T* readers to come up with an improved cracker – something to make old Tom proud. ■

■ Send your ideas of improved crackers to vitaliev@theiet.org

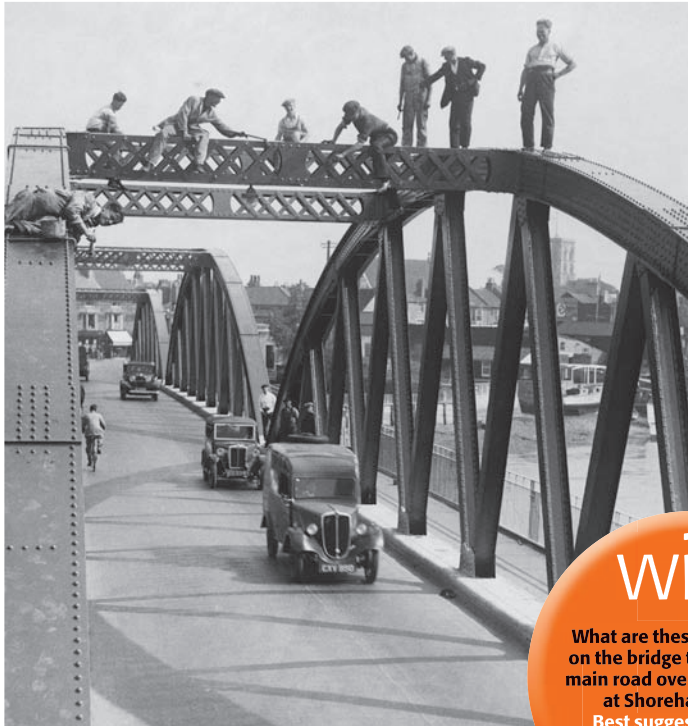
■ Winner of our last caption competition is Jason Bewley, who spotted that we'd inadvertently cropped Alfred Loomis from the edge of the photo of staff at his New York laboratory and suggested: "Take a step back. I'm not in the picture yet!"



Next issue:
Global Engineer

Justin Pollard tells the story of the Shoreham Towers – one of the British Admiralty’s greatest engineering secrets

the eccentric engineer



win!

What are these men at work on the bridge that carries the main road over the River Adur at Shoreham saying? Best suggestion sent to jherbert@theiet.org by 22 May wins an IET goodie bag.

EVERYBODY LIKES a mystery, provided they’re not paying for it, and few in engineering terms have been as strange or as costly as the story that began in June 1918 with the arrival of a detachment of Royal Engineers at Southwick Green in Sussex.

The work party that summer were all sworn to the utmost secrecy as they set about building a camp to house the staff for project ‘M-N’. Not long after, the locals in Shoreham noticed that a huge construction had begun on their doorstep as two gargantuan concrete-and-steel towers began to rise from the harbourside laboured on by over 3,000 men, mainly at night.

It being wartime, the nature of these towers was, of course, secret but their presence could hardly be hidden. Each tower stood on a hollow, 80ft-thick concrete base, and the 40ft-wide, 90ft-high, 1,000t steel column that emerged was surrounded by a lattice of steelwork.

By the autumn of 1918, the towers were visible from as far away as Beachy Head and were known as the ‘Shoreham Mystery Towers’. They caused speculation in the press as far

afield as New York with people wondering just what these enormous structures might be for.

Back in the Admiralty in London, the purpose of the mystery towers was, of course, known but that does not mean there wasn’t still a great deal of speculation. The towers were costing well over £1m each (or, using average earnings for comparison, £172m in modern terms) and eight (some sources say 12 and one even 16) of these towers were planned. There was some doubt that the rest could even be afforded.

But what were they for? Project M-N had been initiated by Sir Alexander Gibb, who was engineer-in-chief to the Admiralty. Gibb had engineering in the blood – indeed, the profession was so ingrained in him he might as well as have oil for blood. His father was the founder of the engineering group that would become Easton Gibb and Son, his grandfather had been a pupil of Telford, his great-grandfather was a founder member of the Institution of Civil Engineers, and his great-

great-grandfather was a contemporary of Brindley and Smeaton.

He had worked as resident engineer on the Whitechapel extension to the Metropolitan line before the First World War. He had overseen the construction of Rosyth naval base before being appointed chief engineer, ports construction, to the British armies in France in 1916, with special responsibility for rebuilding the railheads and ports that might be destroyed by retreating Germans. Then, in 1918, he had come to the Admiralty where his fabulously expensive towers were causing something of a headache.

Gibbs’ plan was typically bold. With the brilliant but untrained Major John Reith (later Lord Reith, first director general of the BBC) as his assistant, he intended to counter the menace of German U-Boats in the simplest but most dramatic way.

A chain of huge towers would be placed across the English Channel from Dungeness to Cap Gris Nez, each linked to the next by steel anti-submarine nets, effectively closing off the whole of the world’s busiest seaway to the U-Boats.

Each tower would have a steel superstructure containing gun emplacements and room for 100 troops to man each lonely outpost. The towers would be equipped with submarine detection equipment run off their own generator. Any U-Boat foolish enough to try to enter the Channel would get caught in the nets and be either sunk or detected and disposed of by the tower crews.

It was undoubtedly one of the most ambitious engineering plans of the war but it was a plan too late, much to the relief of the Admiralty accountants who were looking at a £2bn bill (in modern terms) to complete the project – enough to sink a few battleships, or perhaps float a bank.

On 11 November 1918, with Tower 1 just nearing completion, the war ended and the behemoths became redundant overnight. Tower 2 was eventually broken up for scrap in 1924, a task which took nine months – longer than it had taken to build the giant – but Tower 1 is still visible today as a new life was found for it.

In early September 1920, the honeycomb-structured concrete base was pumped free of water and the 30,000t structure rose from the Shoreham seabed.

On 12 September, the Tower was towed out of Shoreham harbour by Admiralty tugs, only just clearing the harbour walls. After a journey of 41 miles, which took them to the Nab Rock off Bembridge on the Isle of Wight, the tower was tethered and the seacocks in the hollow base opened. Slowly the tower began to sink, coming to rest on a sand bank at a jaunty angle of 3° from vertical. Not surprisingly for a 30,000t structure, that is exactly where it remains to this day.

The new Nab Tower lighthouse was now in place, and the four crewmen of the old Nab Rock lightship were transferred to their new high-tech, multimillion pound home. Solar-powered and unmanned, Tower 1 still serves as the Nab light and as a reminder of what was once the Admiralty’s greatest secret. ■

■ **Justin Pollard’s latest book, “Wonders of the Ancient World. Antiquity’s greatest feats of design and engineering” is published by Quercus at £20.00**

Winner of the issue 6 competition is John Langley: ‘The air vice-marshal’s surprise retirement cake was coming along nicely...’



Justin Pollard suggests an itinerary for an engineers' pilgrimage – to Malta, where the world's oldest engineering structures can still be found

the eccentric engineer



THERE'S a tendency to see engineering as something purely modern or at least recent. Ask people what image swims into view when you whisper 'engineering' in their ear, and they'll probably say something about Brunel, bridges or jet engines.

But engineering is, of course, part of the bedrock of civilisation and has hence been with us as long as civilisation itself. So, it's back to those beginnings and into that bedrock that I thought I'd venture.

Everybody knows that the first engineers were Egyptians – or Sumerians, or Chinese. Or were they perhaps Maltese?

It was in 1902 that a group of builders digging a well for a new housing development at Paola in the Hal Saflieni region of Malta fell into what they assumed was one of the natural caves that riddle the limestone foundations of the island. On closer inspection, however, the cave showed clear signs of human presence, which was a shade inconvenient, so the builders decided to keep quiet and just use the hole as a useful dump for building rubble.

For two years the builders valiantly kept their naughty secret but eventually news leaked out to Father Manuel Magri, a local priest with an interest in Maltese archaeology, who was asked to investigate on behalf of the Museums Committee. What

he uncovered, having removed the building rubble, was one of the most remarkable prehistoric sites in the world – the hypogeum – consisting of a complex of 20 rock-cut chambers, each connected to the next by sinuous passageways, descending in three levels and filled with human remains.

Malta and its neighbouring island of Gozo were already well known for their above-ground prehistoric temples but here was process in reverse – a temple created by removing material, being cut into the soft limestone bedrock, initially modifying the shape of natural caves and then cutting whole new rooms from the living rock itself.

The site covers over 500 square metres and descends into the ground in three distinct levels. At the highest level, the remains of over 7,000 people were found suggesting this was originally a communal burial place. The level below is more complex and seems to have been constructed from scratch. The main chamber here is almost circular in shape and was originally painted red. Its entrance ways, some of which are real and some false, were carved to mimic the trilithons (two upright stones with a third across the top), which form the doorways of the surface temples on the island. In this room lay a remarkable figure, known today as the Sleeping Lady – a statuette of a

woman with a tiny head and very large body, reclining on a couch. What she represents, however, is a mystery.

From this main chamber other rooms lead off. Their names are, of course, not original but were given by the archaeologists who excavated them. The Oracle Room, with its strange acoustic, the Decorated Room with its carved stone 'handprint', the two-metre hole known as the Snake Pit and the 'Holy of Holies', a small room with a coffered ceiling containing a window or 'porthole' in a trilithon framed by two larger trilithons. A third level exists below this but no human remains have been found there. Archaeologists have suggested that it may have provided a storage area for food.

Yet the greatest mystery about the hypogeum was its date. Carbon dating, which was invented nearly 50 years after the discovery of the site, finally answered the question and in the process changed both the history of Malta and the world beyond. Dates taken from organic remains (in the form of bones) and some ancient wood samples from the above-ground temples of the same style as the hypogeum revealed that these structures were not Bronze Age or Iron Age, as might be expected if the technology to

make them had diffused there from the Near East, but Neolithic, the earliest dates coming from a thousand years before the Egyptian Great Pyramid was even begun. In fact, one of the temple sites, at Ggantija, proved to be the oldest free-standing stone building known anywhere on Earth.

The discovery of the enormous antiquity of the hypogeum, which was begun between 3600 BC and 3300 BC (for the upper levels), finally being finished around 2500 BC for the lowest level, also had startling implications as to the sophistication of those early engineers who made it. Coming from the Stone Age, these beautifully caved caverns

must have been cut without the help of metals using just stone, bone and antler tools. Furthermore, as the flint and greenstone used in these tools cannot be found on the island, an extensive foreign trading system must already have existed to provide them.

Before the Egyptian Old Kingdom had even begun, here was a culture with a sophisticated architectural knowledge whose influence spread beyond its own shores. So perhaps any engineer thinking of going on a pilgrimage should cancel that ticket to the Near East and head for Malta instead. ■

■ **Winner of our last caption competition is Mike Sparks, with the topical: "Getting their local MP to adopt the bridge as a second home and then claim refurbishment expenses was a masterstroke".**



win!
 What would these Neolithic people have to say about the Maltese hypogeum? Best suggestion sent to jherbert@theiet.org by 26 June wins an IET goodie bag.

Justin Pollard recounts the spring story behind a very Christmassy piece of engineering

the eccentric engineer



win!

What's going on here?

The best caption suggestion sent to jherbert@theiet.org by 10 December wins a Kit Micro-tech portable toolkit worth over £165, courtesy of Facom.

CHRISTMAS has been in the shops since September, so it would be criminal not to tell the story behind a very Christmassy piece of engineering and one which may well have sparked the interest of many children in a future engineering career.

It was December 1945 when Richard James walked into Gimbel's Department store in Philadelphia, Pennsylvania armed only with a wooden board and 400 small, paper-wrapped packages. In the toy department, he was shown to his demonstration stand where he set his board on a slope, opened one of the packets and tentatively began. Outside – and unknown to Richard – his wife Betty and a friend were preparing to become his first customers in the hope that an initial sale might inspire others. They just hoped they weren't his only buyers as, with dollar bills in hand, they plunged into the throng.

The idea that Richard James, a naval engineer, was hoping to sell that day had come to him a couple of years earlier when he had been working at in Philadelphia's Cramp shipyard.

He had been tasked with devising damping equipment to mount sensitive horsepower meters in the engine-rooms of battleships and was experimenting with arrangements of torsion springs. During one of these experiments, he had casually knocked one of these springs off the table and noted something odd. Instead of just falling to the floor in a heap, the spring rolled end on end, almost walking off the table onto the floor.

Now James was something of an inventor; indeed, he was probably the only home in Philadelphia with ice-cold cola on tap, courtesy of the compressor he had installed to pump the drink from the cellar straight into the fridge. As such, his wife was not surprised when he came home saying he thought he had invented a wonderful new toy. James set to work looking for a steel with the correct properties which could be coiled to the right tension to make a 'walking spring'. When he showed the prototype to his neighbours'

children, even Betty was persuaded by their enthusiasm.

With a \$500 loan they set up the grandly named James Industries and spent most of the money at a local machine shop having those 400 springs – which James now hauled into Gimbel's department store – manufactured. The rest of the cash went on single-colour printed sheets of instructions, which Betty would wrap around the spring to form its packaging. With the 400 springs ready to go, all they needed was a name for their toy. After scouring the dictionary for hours, Betty found a word meaning 'stealthy, sleek and sinuous'. The word was 'Slinky'.

That was what had brought Naval Engineer Richard to the toy department at Gimbel's and Betty to the doorway. But as Betty approached the Slinky stand, she saw that a fake purchase would be wholly unnecessary. Richard was surrounded by real customers. He sold all 400 Slinkys, and one of the iconic toys of the 20th century was born.

The following year the Slinky was the most talked-about toy at the US toy trade-fair and James Industries opened its own shop. Betty set about upgrading their packaging to a simple box, while Richard devised a machine that could coil the 80ft of wire in a Slinky into the requisite 98 coils in just under 11 seconds. By 1950, the toy was so successful he'd had to build another five, all of which are still in operation today.

But it was not to be all fairytale endings. In 1960, Richard James suddenly decided to leave his business, his wife and his six children and join a "religious cult" in Bolivia. Betty took over the company and paid off the large debts that had arisen from her husband's lavish donations to his new Bolivian friends. Moving the toy business back to her home town of Holidaysburg, she not only saw off striking steel workers, but introduced innovations such as the goggle-eyed Slinky glasses, the Slinky dog and the plastic Slinky. In 1998, aged 80, she finally agreed

to sell the company, so she could spend more time with her family.

But the James' best-selling toy remains the original Slinky, whose only alterations over the past half century have been the introduction of crimped ends (for safety reasons) and the transition from Swedish blue steel to a cheaper American one. There is a Slinky in the Smithsonian, one has been in space, and the toy has even been honoured with its own stamp. But most importantly, over 300 million have been sold. ■

■ Winner of the issue 18 caption competition was Mark Everson with "At last, a working broadband connection!"



This issue's prize is provided by leading tool supplier Facom. 'Kit Micro-tech' is a handy set for any engineer working on IT or office equipment. The hard-wearing case contains five screwdrivers, a torch, a mirror, two pairs of pliers, two blades and a blade handle, a wrench and two pairs of tweezers. For more information on Facom's extensive tool ranges visit www.facom-tools.co.uk