A BRIEF ACCOUNT OF BRYAN DONKIN F.R.S. AND OF THE COMPANY HE FOUNDED

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CHESTERFIELD · ENGLAND

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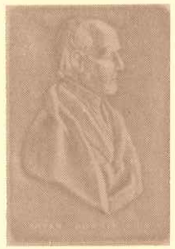

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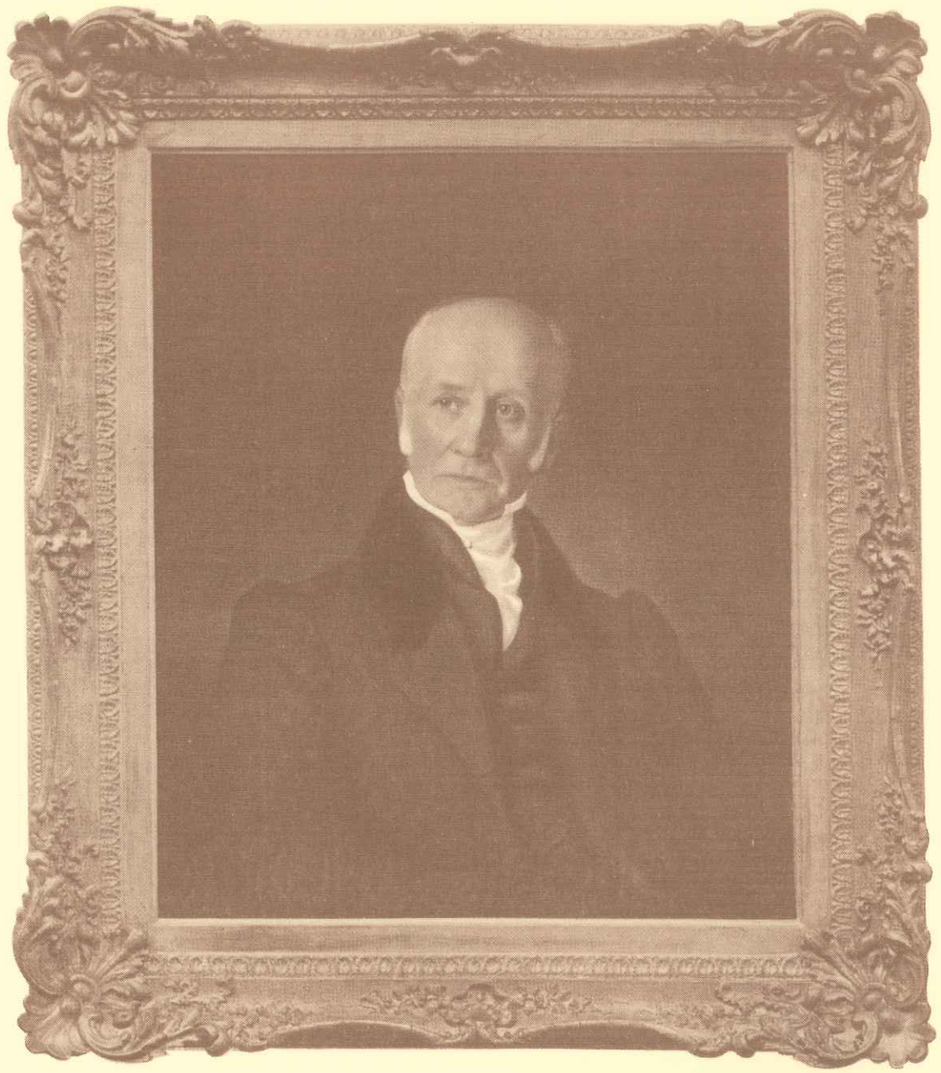


BRYAN DONKIN F.R.S.
1768-1855
Founder of The Bryan Donkin Company Limited

Foreword

TO have withstood the stress of time, the impacts of wars, and to emerge more vigorous after 170 years suggests some inherent soundness of the Bryan Donkin Company. The growth of the Company has its source in the ideas and ideals of one Bryan Donkin, its Founder.

The years around the turn of the eighteenth century produced a galaxy of stars in the British firmament. In the political field there were Pitt and Fox; in the Services Nelson and the Duke of Wellington; in Science Sir Humphry Davy and Dalton; and in Engineering a whole host of names including Watt, Bramah, Bentham, Brunel, Maudslay, Murdoch, Rennie, Telford. These were contemporaries of Bryan Donkin, yet he is not as widely known as his work deserved.

To Bryan Donkin must be given credit for perfecting and building the first practical paper-making machine in the world, for before his efforts all paper was made by hand. He invented the steel pen nib. He was the first to be successful in preserving food and fruit by canning.

Bryan Donkin received a gold medal from the Society of Arts for a Tachometer for measuring the speed of machines in 1810. In 1819 another gold medal was awarded to him for a counting machine.

The dividing machine he invented can be seen today at The Science Museum at South Kensington. His apparatus was long used at Greenwich Observatory, including the great Vernier. He was a pioneer in many engineering fields.

The foundation of the Company was at Bermondsey, London, in 1803. For reasons of expansion and in order to be closer to the sources of fuels, metals and skilled labour, the plant was moved to Chesterfield nearly a century later.

The contribution of apparatus to the Gas Industry which was made by the Company during the last 30 years of its activities is known throughout the world.

Donkin would have been proud to see his successors cope with the problems of British Industries, bombed during the recent war, by rushing emergency gas supply units to keep their wheels turning. Gallant Malta, during the terrible siege of the "George Cross Island" was provided with a number of High Duty Water Pumps in record time from the firm bearing his name. He would have warmly approved the supply of gas apparatus for the manufacture of penicillin.

Part One

THE BERMONDSEY WORKS 1803-1902

MAINLY HISTORICAL

The man

THE early history of the Bryan Donkin Company is the story of Bryan Donkin's achievements as an inventive genius; a resourceful thinker; an able designer; a mathematician and a skilled engineer. A business often expresses the quality of the thinking of one outstanding personality and this House of Engineering, which has endured for one hundred and fifty years, has maintained the versatility of its Founder.

When in the year 1803 Bryan Donkin, who was then 35 years of age, became the Manager of a new engineering works at Bermondsey, London, his supple mind began to unravel the design complexities of machines destined to revolutionise the Paper-making Industry. He contributed improvements to machines of other and varied industries and originated scientific instruments.

Early years of Founder

Bryan Donkin was born at Fountain Hall, Sandoe, Northumberland, on March 22nd, 1768. His father was a fairly prosperous surveyor and land agent who numbered the Duke of Northumberland and the Errington family among his clients. He had five sons and three daughters, Bryan being the third son. It was intended that he should adopt his father's profession and he actually spent four years, from the age of twenty, in the service of the Duke of Dorset at Knole Park, Sevenoaks.

Advised by Smeaton

He was intent on becoming an engineer and he consulted Smeaton, a friend of the family, who advised him to undergo training as an apprentice and recommended him to John Hall. In March, 1792 an agreement for three years was signed between John Hall, millwright, and Bryan Donkin, yeoman. He proved a brilliant apprentice and a firm and lasting friendship developed between him and his master. So strong was the friendship that when, three years after completing his apprenticeship, Donkin opened his own business making moulds for hand-made paper, in 1798 John Hall financed him to the extent of £350. The ex-apprentice, Bryan Donkin, had in the same year married the sister of John Hall's wife.

Fountain Hall, Sandoe.

Bermondsey in 1800

It is doubtful whether Donkin had much to do with the building of a works of modest size in the sparsely populated low-lying district of Bermondsey in 1803. The choice of Bermondsey for a works to make fairly heavy engineering products would be influenced by the fact that land was cheap but handy for the Thames and water transport; for in those days there were no railways and transport in horse-drawn carts was slow and unreliable. The works was financed by the Foudrinier Bros. of London who were prosperous stationers intrigued by the possibilities of a new, but undeveloped invention of a Frenchman who proposed to make paper by machinery.

The Foudriniers had gone to John Hall, the millwright of Dartford, to ask for his help, but after some desultory experiments Hall left the matter in the hands of his former apprentice.

He had proved his exceptional ability to Hall during his apprenticeship in the years 1792-1795. It was with confidence that Hall recommended him to the Foudriniers in 1803 as manager of the workshops at Bermondsey from which it was hoped to reap a very profitable return in what was of necessity a highly speculative venture. That he overcame not only many engineering hazards, but also some financial storms to which even old-established firms succumbed in great numbers at that time, speaks much for Donkin's ability.

Leadership

Bryan Donkin was later to become a Fellow of the Royal Society, one of the founders of the Institution of Civil Engineers, Chairman of the Committee on Mechanics of the Royal Society of Arts and the first Treasurer of "The Society of Master Millwrights."

TECHNICAL PROGRESS

The Royal Society

He joined the Royal Society of Arts in 1803 and became a Vice-President and Chairman of the Committee on Mechanics. In 1817 he helped three of his pupils, Palmer, Harris and Ashwell to form an engineering discussion society of which he persuaded Telford to become President in 1820. It was this Society that became chartered as the Institution of Civil Engineers in 1828 (Telford and Donkin contributing 200 and 100 guineas respectively as an advance to pay for the charter).*

Steam Boats

In 1817 he was called upon to give evidence before the Parliamentary Committee on steam boats. He also gave evidence, in 1824, before the Committee of the House of Commons to inquire into the state of the Combination Laws and their effects. These laws were restrictively applied against Trade Unionism and Donkin's attitude to them was, for the time, one of considerable liberality.

In 1836 Donkin was made a Fellow of the Royal Society, and subsequently served on the Council. Among his friends he could number Murdoch, Rennie, Maudslay, Bramah, Brunel (for whom he did work for Chatham Dockyard and the Thames Tunnel), Whitworth, Tredgold, Troughton, Telford and a host of others. He was called in to give advice on many matters out of which a variety of contracts came to the works at Bermondsey, also acting as arbitrator in several disputes and expert witness in others.

**This should not be confused with the "Society of Civil Engineers" founded in 1771 and now known as the Smeatonian Society of which Donkin was President in 1842.*

DEVELOPMENTS IN ENGLAND

Bryan Donkin tackles problem

It was in 1802 that Donkin first began to work on a practical paper-making machine. It should be appreciated that original designs were only the wet end of a paper machine; that it was crude and slow in operation; that fragile wet paper from it had to be taken away without breaking and subsequently dried in air lofts; that it showed economically no very startling advantage over hand-made paper, which was of substantially better quality except in the limited field of making tissues. It was hoped that machine-made paper would provide long lengths which could be used for wall-paper, popular at that time. There were no rotary printing presses requiring continuous feeding with paper from a long roll; in fact, the long lengths of paper had to be cut up small for use on the flat-bed presses of the time or into larger pieces for wall-paper. The slowness of the craft of making hand-made papers did lead, however, to shortages. Some of Bryan Donkin's early drawings still in the possession of the Company were made on the backs of obsolete army maps.

First Paper-Making Machine built 1803

The first paper-making machine to be built in Britain was set to work at a mill at Frogmore in 1804, the year after the Bermondsey works were founded. It was not immediately successful and a great deal of money was poured into development before a machine giving some evidence of economic success was installed at the Two Waters Mill in Hertfordshire in 1805. This machine reached a promising stage of development about 1806-7.

In the year 1807, Bryan Donkin made certain improvements, and these were incorporated in patent No. 3068, taken out by Henry and Sealy Foudrinier and John Gamble, and Donkin's original drawing, a fine piece of work, is still in the archives of the firm in excellent preservation.

Great Exhibition of 1851

An interview with Mr. Bryan Donkin Junior, the grandson, recorded in the "Paper Trade Review" of December 7th, 1888, throws some light on the relations between his grandfather and Didot. He says of this story that his grandfather:—"told me the circumstances related about the couch rolls when seated in the same room and chair at the lodgings where the first idea occurred to him." Donkin was working on the machine at the Two Waters Mill in Hertfordshire when his grandson was a young boy.

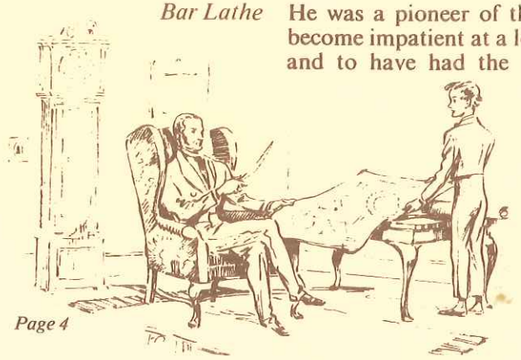
DEVELOPMENT OF OTHER INTERESTS

Machine Tools, Taps and Dies

With all the troubles and uncertainties surrounding the early development of these paper-making machines, by 1811 the works, although mortgaged, were Donkin's own. He was a qualified engineer and what is more, he understood the design, manufacture and uses of machine tools. He also made taps and dies to order, a matter of judgment and skill in which the final hardening process was by no means the least difficulty.

Bar Lathe

He was a pioneer of the bar lathe and was reputed on one occasion to have become impatient at a long delivery time required by the famous Mr. Holtzapfel and to have had the unfinished parts delivered for completion by himself.



TO TEMPER STEEL

A new mode of tempering steel at one operation, by quenching it in oil or where low temper is required, in molten metal previously heated to the temperature to which the steel requires to be heated after it has been hardened in order to bring on the proper colour which indicates the temper or degree of hardness required. I melted some lead and heated it until by throwing a piece of tallow into the ladle I observed the tallow burnt with that kind of whitish flame which we use in tempering springs. If we could get some mode of ascertaining the temperature it would be excellent. By heating steel and quenching it in cold water it is very apt to crack and fly and I have no doubt suffers in the constitutional arrangement of its particles and forms a new crystallization very different to what it undergoes in the new way.

—Bryan Donkin's Journal, October 1817

Steam Engine Design

Machine tools for cutting harder materials than wood and brass required something more powerful than a man-turned wheel as the driving element and the steam engine provided a sufficiently flexible medium. Donkin familiarised himself with steam engine design and became an expert.

Canals and Water Wheels

He also acquired a great knowledge of canals, on which he frequently advised, and of water wheels upon which paper mills depended for power. He became a friend of Maudslay, the inventor of the screw-cutting lathe, and in 1806 joined with him in patenting an ingenious combination of a spur gear, with an epicyclic train to give a compact and high ratio of gearing, particularly for grabs, lathes, etc.

STEEL PENS

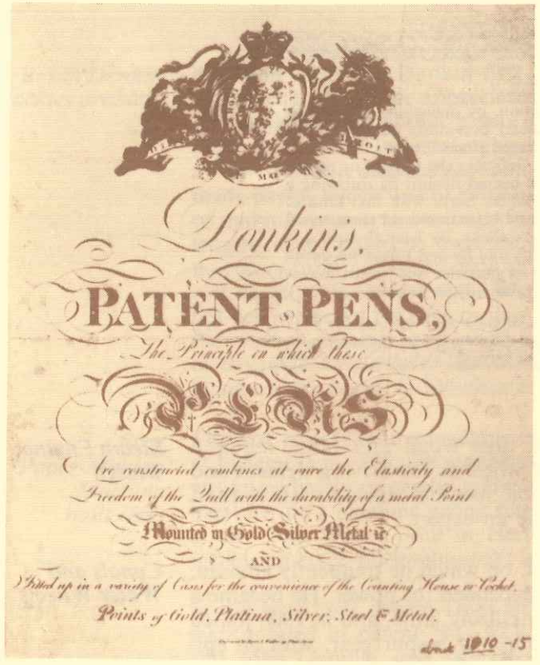
The first Steel Pen

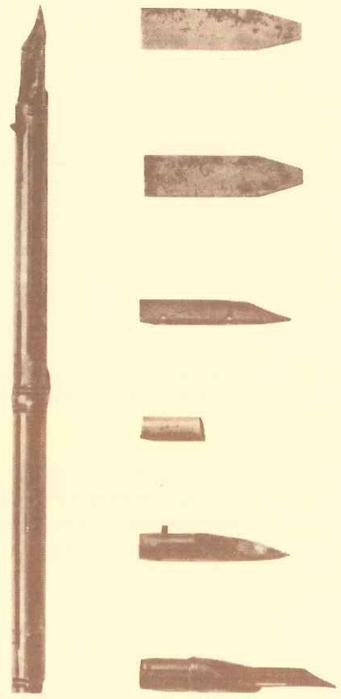
In 1808 Donkin patented the first practical steel pen as an alternative to the quill which was in general use. The nibs, made from two thin sheets of steel brazed together at an oblique angle, were made to retract into a brass tube when not in use. Complete pens were 3/6 and nibs alone 1/-. The patent was sold to Joseph Bramah in 1811 for £350 at a time when Donkin no doubt required ready money to finance his new responsibility for the Bermondsey works.

HARDENING

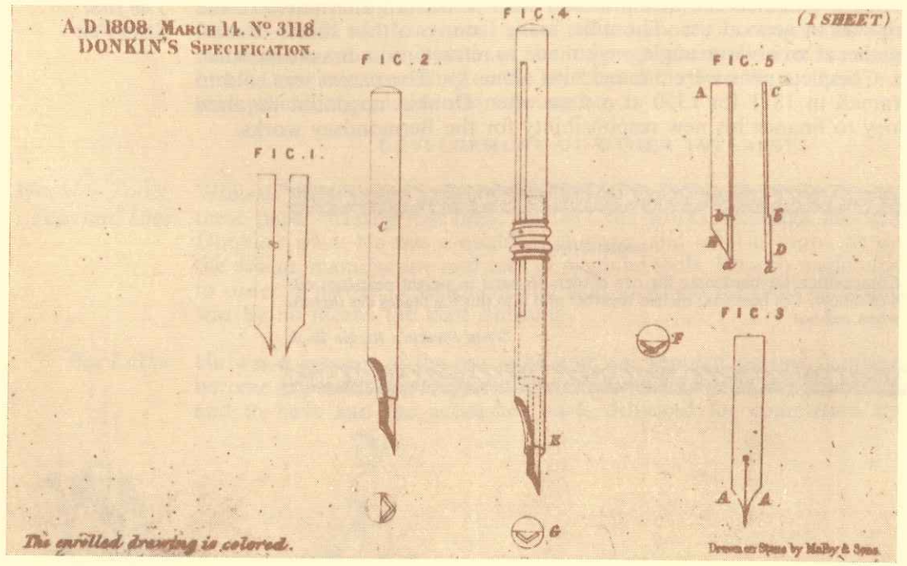
Composition for hardening the pen blades. 16 parts in weight neatsfoot oil; 4 of tallow; 1 of beeswax; melted together and into this the blades are thrown when red hot.

—Bryan Donkin's Recipe Book


Donkin's
PATENT PENS,
The Principle on which these
are constructed combines at once the Elasticity and
Freedom of the Quill with the durability of a metal Point
Mounted in Gold Silver Metal &c
AND
Fitted up in a variety of Cases for the convenience of the Counting House or Pocket.
Points of Gold, Platina, Silver, Steel & Metal.
dated 1810 -15



EARLY STEEL PENS.



Food Canning Pioneer

HIS next venture was to buy for £1,000 the rights in a process for "preserving animal and vegetable food." It claimed to preserve food "for a long time from perishing or becoming useless," and was undoubtedly the process for which Nicholas Appert, of Paris, was awarded 12,000 francs in recognition of his services in helping to feed Napoleon's armies. Appert's original process was for sterilisation in wide-mouthed glass bottles, but he is also credited with having sealed food in cans. From the balance account of 1811 it appears that the Bermondsey works made a first year's profit of £2,212 17 0 under the new proprietorship of Donkin so that he was not at that time short of money for another interest.

In May, 1812 there are many records in the Bryan Donkin diaries of experiments in cooking and sealing milk and soups and meats. At first they were trying to seal "white jars" but later concentrated on tinned iron containers.

Hammer and Chisel to open

The tin plate containers were heavy affairs by modern standards, a hammer and chisel being recommended in the instructions for opening. (Donkin has a recipe for tinning iron in his recipe book at a date that must have been about 1808.) The business developed rapidly with stocks and agents in many seaport towns. For ships' provisioning the only methods of preservation hitherto known had been salting, smoking or desiccation. Armies too found provisioning difficult and the interest of the Duke of York who had led two armies in the Napoleonic wars, was obtained.

One of the original Bryan Donkin cans of food, found by the Franklin Relief Expedition, embedded in the Arctic ice.

Royal approbation

Samples had been submitted early in June 1813 to the Duke of Kent, and the following letter was received from his secretary:

Kensington Palace,
30th June, 1813.

Gent'n,

I am commanded by the Duke of Kent to acquaint you that his R.H. having procured introduction of some of your patent beef on the Duke of York's table, where it was tasted by the Queen, the Prince Regent, and several distinguished personages and highly approved. He wishes you to furnish him with some of your printed papers in order that His Majesty and many other individuals may according to their wish expressed have an opportunity of further proving the merits of the things for general adoption.

I am, Gentlemen,
Your most obd. servt.,
JON. PARKER

Messrs. Donkin, Hall and Gamble.

TO TIN IRON

Throw your work into spirit of vitriol diluted with 8 times its quantity of water, and scower it clean with sand wet with it, when clean wet it well with solution of salamoniac in water, then throw it into powdered resin and dip it into your tin.

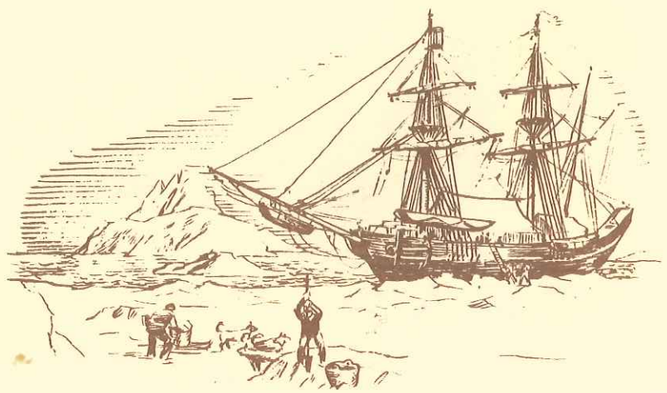
—Bryan Donkin's Recipe Book

On 30th June, 1817 Donkin was able in a letter to record as the one bright spot that he had sold £3,000 of canned meat in six months.

Food good after 113 years

In 1824 Parry took tinned beef and pea soup with him on his voyage to the Arctic in *H.M.S. Fury*. Some of this was opened in 1937, 113 years later, and was found still to be in good edible condition with bacterial spores that had been in a state of suspended animation all the time.

In 1829 Admiral Sir James Ross also took some and Sir John Franklin was equipped with it for his voyage of 1845 in search of the North West Passage. Some of his stores were found by Admiral McClintock in 1857 and were found to be perfectly edible.



THE CALEDONIAN CANAL

A friend of Telford

The Bermondsey works supplied much material for the Caledonian Canal, of which Telford was the Chief Engineer, on behalf of the Parliamentary Commissioners. Donkin described him as "a very good friend in giving us work." The Canal itself, 20 feet deep with locks 40 feet wide, could take ships up to 600 tons but there were no towpaths, and in calm weather Telford wished to tow the ships by means of steam tugs, converting for the purpose the steam engines that had been used for pumping when making the foundations of the locks. Donkin had already advised Telford that an Indiaman of 800 tons had been towed down the Thames at 3 knots by a steam boat.

On this occasion, after inspecting the engines in Scotland, he informed Telford that he did not regard the conversion scheme as practicable, and resisted a very determined attempt to get him to change his opinion. He decided that Telford must already have committed himself, but added "I should be very sorry to incur Mr. T's displeasure, as we have received a great deal of money from him, and the machinery for these boats must necessarily give employment to somebody to a large amount, but I will not disgrace myself." This was a brave decision in the circumstances and, as it turned out, he continued to enjoy the friendship of, and to receive orders from, Telford, who was later prominently associated with Donkin in founding the Chartered Institution of Civil Engineers.

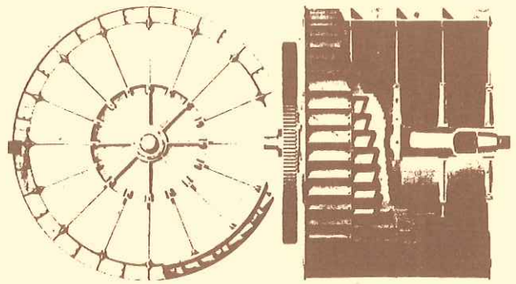
WATER WHEELS

76 feet diameter Water Wheel

Another activity in which Donkin showed both his versatility and the capabilities of his company was in the design and supply of water wheels. He acquired some knowledge during his apprenticeship to John Hall, the millwright of Dartford, as all paper mills and many corn mills were water driven.

In 1809, the year in which he was advising Mr. Foudrinier as to the expense of widening the wheel at Frogmore Paper Mill, he acted as consultant to the executors for the Greenwich tide mill and persuaded them to bring in Mr. Hall as contractor. His approach to problems in hydraulics was logical and showed considerable technical skill.

Of many contracts undertaken by the company the most spectacular was probably a wheel supplied to the Tuscan felted cloth works near Florence in 1843. There was little water, but the head was considerable. The wheel was only 2 feet wide but was 76 feet in diameter and had 160 buckets round the rim. It was built in sections and the framing was made up of iron bars in tension on the principle used in the modern bicycle wheel. The design, and in many cases erection of flumes, gates, etc., frequently formed part of these wheel contracts. The Bryan Donkin Company was also very early among constructors of water turbines several of which were supplied from 1846 onwards.



Pioneer of Recording Machines

Another matter of importance in the production of stamps and notes is to have an exact record of the numbers produced. Donkin, in 1819, had invented a revolution counter in which three wheels, numbered one to ten around their peripheries, were so geared together that the unit wheel operated the tens wheel once in every ten steps and the tens wheel operated the hundreds wheel in the same ratio. For this he received the Isis Gold Medal from The Royal Society of Arts. (This was his second gold medal from that body.)

MERCURY TACHOMETER

In 1810 he was awarded one for a mercury tachometer. A cup containing mercury was attached through a clutch to the rotating mechanism of which the speed was to be indicated. The rotating mercury assumed a parabolic surface form proportional in depression to the speed of rotation. The depression was measured by a scale, engraved in terms of r.p.m. on a tube containing spirits of wine that floated in the mercury.

The revolution counter of 1819 was incorporated in the Congreve presses built at the Bermondsey works. Between 1826 and 1827 the firm did nearly £3,000 worth of business with the Commissioners of Excise in London.

Donkin Pantograph Machine

The two machines that Bryan Donkin made for this work are not only preserved, but are still occasionally used at Chesterfield. They are now operated by two brothers, H. W. and F. Kirby, who are the third generation of this name to be employed on the work. The necessary skill and notes on the operations have been handed down from father to son, the original Mr. Kirby dying at the age of 94 and his son, aged 75 dying in 1935. One of the machines is a pantograph which cuts the apertures on the upper plate and the projections on the lower plate from fallers, and also cuts the lettering and design on the combined plate.

The same principle had been used by James Watt in his sculpture-copying machines, but this had never been published. Donkin had been to visit Watt in the company of Murdoch one day in January, 1814, when Watt was an old man of 78. It is unlikely that he saw much, if anything, of the copying machines in Watt's garret workshop at Heathfield, for Watt wrote to Peter Ewart on February 27, 1814 to say that "I have done nothing of consequence with the machine this winter, the place having been too cold for me." It is therefore probable that Donkin's pantograph machines were an independent invention.

Rose Engine

In addition he completed a rose engine with which to cover the surface of the duplex die with those complicated anti-forgery patterns so beloved of bank-note makers. The engine on order from Mr. Holtzapfel was required in such a hurry that Bryan Donkin took delivery in parts and built the machine himself.

Steam Engines

Mr. D. W. Farey became a partner in the firm with the two sons, Bryan and Thomas. He designed a horizontal compound steam engine, notable for its economy of operation and trouble-free running. The company manufactured many of these.

Paper Mills for Russia

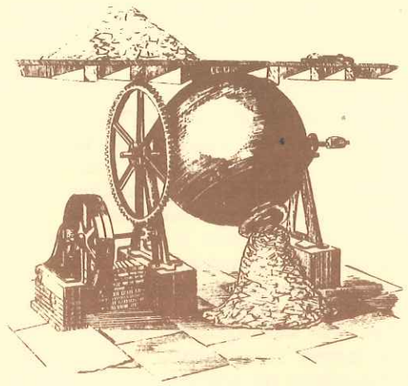
In 1858 the firm obtained by far the largest contract they had undertaken so far for the erection of a complete paper mill at St. Petersburg. It involved water supply and filtration plant, paper-making machinery, and a steam power plant of 2,000 horse power. Bryan Donkin Junior, the son of John Donkin, was put in charge of the project at the age of 24, having been educated at University College, London and in the engineering faculty of the École Centrale des Arts et Métiers in Paris. The erection of the largest paper mill in Europe was a task that took three years to accomplish and it was not achieved without many difficulties. On its completion Bryan Donkin Junior was taken into the firm as a partner by his uncles, and one of the Bermondsey-trained assistants, Richard Bowery, remained on the job in Russia, where he became General Manager of the Manufactory under the Ministry of State Papers.

Accessories

Before leaving the subject of paper-making—for the company seems to have given up most of its interest in the subject by about 1893—it may be remarked that the firm was a pioneer not only of the machines themselves and water wheels, but also of many accessories, such as rag engines, rag boilers, etc.

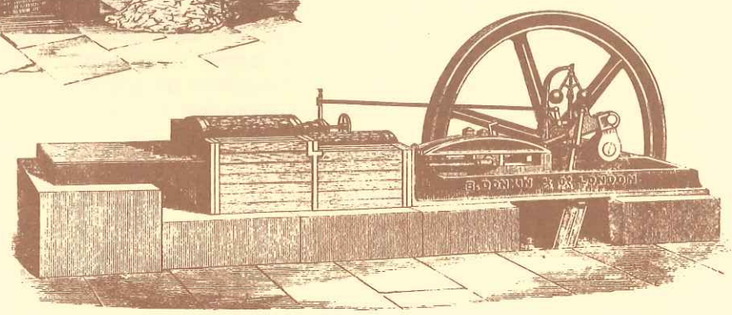
Spherical Rag Boiler

The spherical type of rag boiler made by Bryan Donkin in the early years has since been re-introduced as the only shape that can be depended upon to clear itself properly after the processing of each charge. Models of Donkin's rag beater, rag boiler and paper-making machines are in the National Science Collections at the Science Museum.



The drawing of Bryan Donkin's original Rag boiler.

The Farey Steam Engine.



Rack and Pinion Valve

DESPITE the multiplicity of his interests in the engineering field, the first commercial work for the gas industry, which the company has served so well ever since, was not done until 1847. This first job, the design, at the suggestion of the Chartered Gas Company of London, of a rack and pinion valve, was so well done under the aegis of Donkin's sons John, Bryan and Thomas, that the type was still being made and supplied in considerable quantities uptill 1964. The Founder, Bryan Donkin, died in 1855 at the age of 87. The sons ably carried on the traditions of good design, good workmanship and versatility that had been built up by the founder.

Of their first innovation, the gas valve, 110 were sold in 1848 for use in the gas works at the Westminster Gas Co.; Phoenix Gas Co.; Bankside; Royal Leamington Spa; South Metropolitan; Brighton; Richmond; Surrey; Shrewsbury and Kensal Green. Within ten years they were being made in sizes up to 27″, and today these valves are being made in much larger sizes. Although many improvements have been made the sound basic principles of the first design remain.

EXHAUSTERS

Rotary Gas Exhausters

The connection with the gas industry was further reinforced by the manufacture of Gas Exhausters, beginning with the patent by Bryan Donkin (the son) and D. W. Farey in 1856 for a rotary engine consisting of a disc set at an angle to its axis, and rotating in a casing that was part of a sphere. Several of these were made, one being used as a gas exhauster at the Pimlico works of the Chartered Gas Company. The principle is one that has been applied to several types of fluid meter since. Another way in which this patent proved useful in later applications was in the type of packing specified. This was metallic, consisting of shavings of soft metal compressed together round the piston or part required to be packed in just the same way as might normally be done with hemp.

SCHEUTZ DIFFERENCE ENGINE

Calculating Machine

In 1859 the company undertook a remarkable task calling for the highest class of workmanship and great ingenuity. This was the manufacture, to the design of Scheutz of Stockholm, of a "difference engine" on which could be calculated, for instance, the life tables issued by Somerset House. They had already made parts for the differential calculators of Sir Charles Babbage and this new production was so successful that it was in continuous use by the Registrar General's Department for half a century. It is now to be seen in the National Science Collections at the Science Museum, London.

A number of small component parts of complicated design had to be made to very high standards of accuracy, and the firm was well equipped, not only for this type of work but also for making the largest components. A few years before they had turned accurately for Mr. Troughton the grand mural circle for the Royal Observatory, Greenwich. It was seven feet in diameter.

THE Bryan Donkin Company's principal business today is with the Gas Industry and reference has already been made to the supply of gas valves from 1847 onwards. Early rotary exhausters, such as the one patented by Joshua Beale of Greenwich in 1848, itself only an improvement on Ramella's design of 1588, suffered from the disadvantage that there was great friction between the slides. The speed of the guiding segments on a 38″ exhauster running at 60 r.p.m. being as high as 600 ft. per minute. The segments had to run in circular grooves machined in the end plates of the machines.

Improved Exhauster

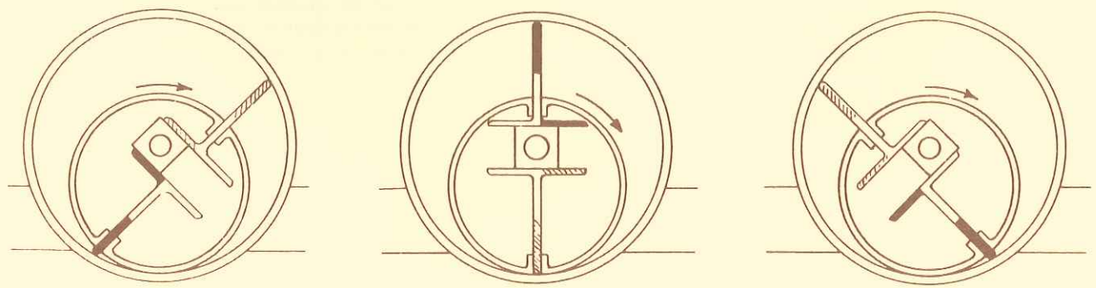
In 1866 John Beale patented (No. 1402) an improved type of exhauster of which the Bryan Donkin Company obtained sole manufacturing rights in 1870. They made about 100 of these in which the friction was reduced by about 20% by using rings instead of segments and letting only an auxiliary blade slide to take up differences in diameter.

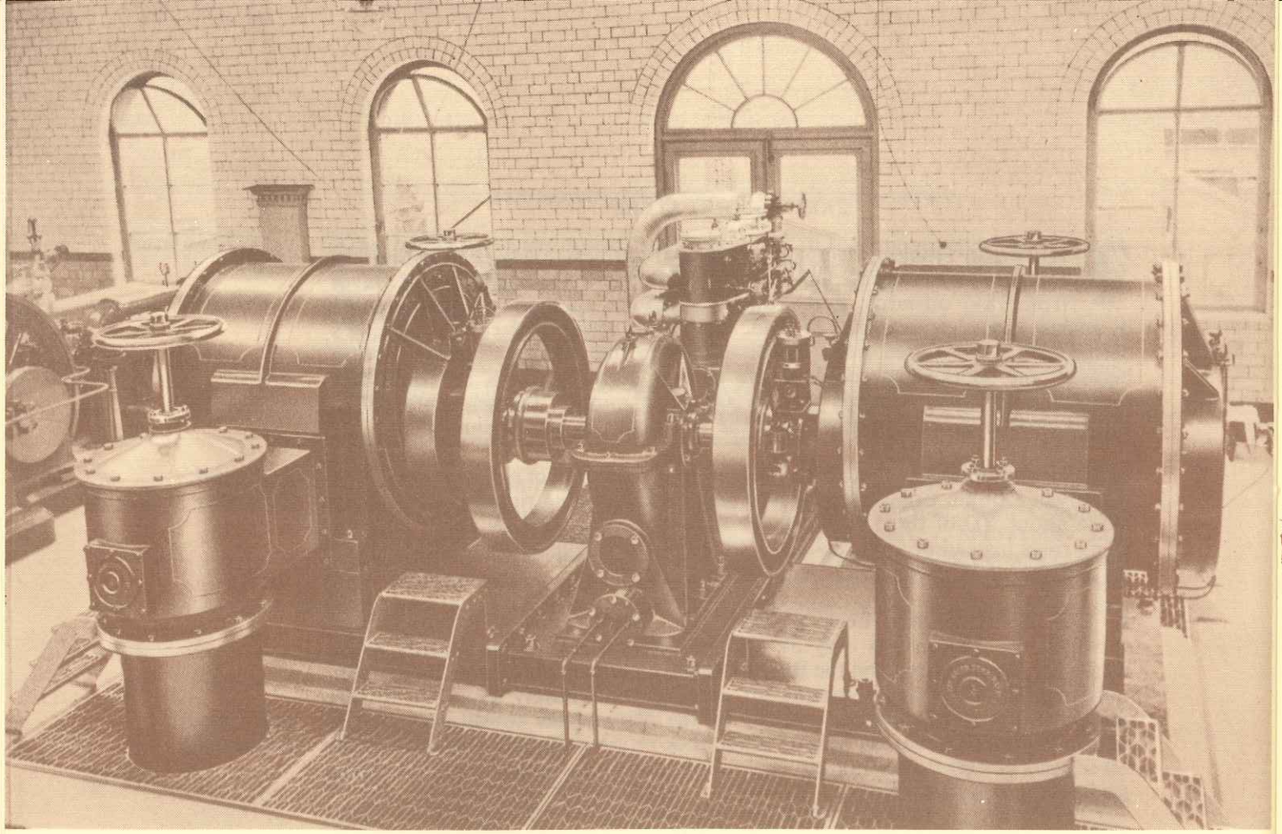
In 1877 the same John Beale patented (No. 2419) a greatly improved type in which the friction was only 30-40% of that in the original. Shortly afterwards Mr. Beale retired and the Bryan Donkin Company purchased his business outright. The rings and segments for guiding were entirely abolished in this design and a simple block, brought to the centre, was substituted. In the example quoted above, the velocity of the slide on the guide block became under 60 instead of 600 ft. per minute. The block also had a much greater wearing surface than the segments.

There is still sufficient interest in this long-lived type for "the 1877 patent" to remain a term in current use within the company.

The cylinders of these exhausters are bored with the horizontal axis a little longer than the vertical. This is an improvement over the true circle as it gives a curve swept by a slide of constant length and was employed originally by Franchot about 1860. An amusing result of this eccentric boring is that on more than one occasion maintenance fitters have "rectified" this ovality under the impression that it was due to wear. They then found the circular bore useless and a new shell had to be supplied.

DIAGRAM SHOWING METHOD OF OPERATION OF THE BEALE PATENT EXHAUSTER—1877





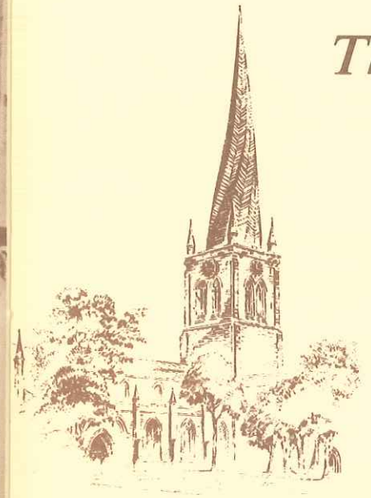
Two 4-bladed exhausters, driven by high speed steam engine through reduction gear.

Beale-Donkin Exhauster

The great advantage of these exhausters over other types was the small number of working parts. More than 600 exhausters of the various Beale types were at work by 1897, many of them driven by steam engines supplied by the Bryan Donkin Company. Nearly 100 had been exported, with examples in each of the five continents. The company also made some 3- and 4-bladed exhausters, the pioneer 3-blade type at the Old Kent Road Works of the South Metropolitan Gas Company, dating back to as early as 1873-4.

Beckton in 1880

Another early achievement was the installation of sets of gas boosters at Beckton Gas Works in 1880 which pumped the gas through 4 ft. mains over a distance of 8-10 miles to London. This pioneer installation was one of the very few examples of gas boosting in this country prior to the present century. There were 8 exhausters of the Beale 1866 pattern each of 225,000 cu. ft. per hour capacity at 50 r.p.m. The exhausters could pump 48 million cubic feet a day against a pressure of 48 in. w.g. They were driven by four steam engines connected to a common condensing plant. Other sets were subsequently installed at Bromley-by-Bow to discharge gas from that works into the same mains.



The Town of Chesterfield

IN the southern foothills of the Pennine Range was a sheltered hollow which became a Roman camping place in the year A.D. 138, known as "Lutudarum" and in the Domesday Book given the Saxon name of "Cestrefeld".

In more recent times, famed residences sprang up in the vicinage, such as Chatsworth; Haddon Hall; Hardwick Hall—and within easy reach are The Dukeries; Renishaw Hall, the home of the Sitwells; the lovely Peak District; also many exquisite streams beloved by Izaak Walton, including the Dove; the Lathkill; the Derwent and Wye at Rowsley; and beautiful Beresford Dale.

George Stephenson, who gave the world the locomotive engine "The Rocket" and whose activities developed our railways, lived at Chesterfield in his later years.

It was whilst head gardener to the Duke of Devonshire at Chatsworth that Paxton conceived the idea of building cast-iron framework with glazing, that was later utilised for building the Crystal Palace which housed the Great Exhibition in 1851 in Hyde Park and some time afterwards moved "piecemeal" and re-erected at Sydenham.

One of the landmarks of the town is the "crooked spire" of the Parish Church of St. Mary, which startles with an eye-arresting twist, said to be caused by warping of unseasoned timbers, for the spire leans over 7 feet to south and nearly 4 feet to the west. The Burgesses are proud of this unique pinnacle and would not now have it straightened.

Around it grew up a clean, bustling, town, which later became the centre of considerable coal- and iron-producing areas that attracted those needing fuel, ore and skilled labour.

Gradually, its characteristics changed from what was largely a market town serving agriculture to a more modern rendezvous of efficient industrial concerns, which included engineering; coal-mining; chemical-producing; box-making; tubes and containers; surgical and sanitary dressings; pottery (especially salt glaze); filters; refractories and numerous other products almost universally used.

Today, with a population of 150,000, excellent schools and technical training facilities—also good social and public services—Chesterfield is a well-balanced township not far from some of England's finest pastoral beauty.

The Arts are encouraged by good music and an efficient Civic Repertory Theatre; whilst those sports and recreations are enjoyed which add to the amenities of its people.

Its prosperity today is coincident with its Engineering activities; and it is of satisfaction to The Bryan Donkin Company to have contributed something to its prosperity.

Part Two

CHESTERFIELD WORKS 1902

A NEW ERA

Expansion demands new site

IT was becoming obvious that Bermondsey could not continue indefinitely as the company's works. In 1803 when the original building had been established, Bermondsey was a rather isolated country district of low-lying fields and open spaces. Now, a century later, the works had been expanded until there was no room for further building and the site was hemmed in by small property.

In 1803 there were no railways and Bermondsey provided a convenient site for the transport of heavy materials by water on the adjacent river Thames. When the original Bryan Donkin went to see Telford in Scotland in 1816 he sailed from Greenwich to Leith in 7½ days; but on another occasion he records reaching Liverpool from London by light stage coach in 36 hours. After a number of partnerships in all of which members of the Donkin family predominated, it had become Bryan Donkin & Co. Ltd., in 1889 with Mr. Bryan Donkin Junior as Chairman and Mr. E. Bryan Donkin as Managing Director.

In 1900 agreements were signed for an amalgamation with Clench & Co. Ltd. of Chesterfield, a firm founded in 1896 by Mr. F. Clench for the manufacture of high speed steam engines. The company was known from 1900 to 1905 as Bryan Donkin & Clench Ltd. The move from London was made in 1902 into buildings that were surprisingly modern for their time. The machine shops, for instance, had continuous bays nearly 400 feet long and 40 feet wide.

Workers move to Chesterfield

At the time of the move about 220 workers were employed at Bermondsey and many of them elected to live in Chesterfield in order to continue their association with the company.

The site of the new works had many advantages, being connected by sidings with the Midland and Great Central Railway Companies and being in the centre of the great coal and iron district of Derbyshire. The Bryan Donkin part of the business, at least, continued to display the initiative and versatility for which it had been renowned in Bermondsey.

The expansion of the Company was greatly influenced by Mr. George Clark. O.B.E., who joined the firm in the year 1893, and his 56 years of continuous service was marked by the steady development of all its activities.

Mr. George Clark

Starting as assistant Works Manager, he handled the Company's work so satisfactorily during the famous 1897 strike that he was placed in charge of the Works. He effected the transition of the plant and machinery from Bermondsey in 1902 and was Manager of both Works until the London factory closed down.

During his long connection with the Company, Mr. Clark transformed the Company's trade in paper-making machinery into the more profitable manufacture of the early internal combustion engine, and the pumps for the original vacuum cleaners.

He foresaw the advent in this country of high pressure gas transmission and secured the rights of manufacture of Reynolds District Governors. He negotiated the licence to manufacture the Rateau type high speed turbo exhausters and boosters. He introduced into this country the Coke Oven type Valve and the high pressure gas valves such as the Baurer and Hicks types. Other new lines among the Company's present manufactures that he developed were the Vertical Reciprocating Compressor, Retort House Governors and Centrifugal Water Pumps.

EXTENSION OF THE WORKS

The Floods

The history of the Chesterfield Works has not been devoid of incident, covering as it does a period which includes two World Wars, the General Strike of 1926; the slump of the early Thirties and the local floods of 1922, 1932 and 1933. The latter are commemorated on a plaque at the main entrance, showing the substantial levels to which the water rose. It was necessary to wait, like Noah, for the floods to recede before production could begin again. In 1932 the level was 3′4″ above the road surface.

Extensions

The works increased considerably in size since 1917 when the Fitting Shop was first opened to segregate this work from the Machining Bays. Other major extensions of these shops took place in 1927, 1944 and again in 1949. No. 2 Foundry was opened in 1922, the Correspondence Offices in 1925 and the "new" extended Drawing Offices in 1936. In the following year the Valve Stores were completed and this coincided with the re-location of the Governor Department which had far outgrown its original space.

As the works have grown, so the company's products increased in number, size and variety, and a comparison of outputs of certain departments is of interest.

The Bryan Donkin Works from the Air.

THE COMPANY'S PRODUCTS

GAS GOVERNORS

Reynolds Governor

THE first Reynolds Governor was delivered on February 22, 1905. These are of the diaphragm type and reduce gas from any pressure on the inlet up to 50 lbs. per square inch (i.e. the high pressure distribution side) to ordinary district pressure. The gas pressure is maintained constant on the district whatever the variations in demand and inlet pressure. The system of gas distribution through high pressure trunk mains from widely separated gas works may mean that a whole town or village is dependent for the steadiness of its district supply upon the functioning of one of these governors, which must react instantly to the slightest change in pressure on the low pressure, or district side of the system. With the load continually fluctuating, day and night, the district governor performs a most exacting task.

Governors

The water-seal governors illustrated in the firm's earlier catalogues became useless when gas pressures of 5 lbs. per square inch and upwards were in question. The American designs of governor manufactured included Low Pressure District Governors, High Pressure District Governors, High and Low Pressure Service Regulators and Holder Valves. These standard types have been improved and enlarged upon in the light of experience over many years in most parts of the world.

Later Developments

The past 20 years has seen the introduction of a new breed of regulators to match the changing needs of the world's Gas Industry, particularly with the advent of natural gas and the much higher pressures that this entails over the old manufactured gas distribution pressures.

The Company's latest regulator products have been designed with simplicity of maintenance in mind, which has led to the introduction of cartridge type construction regulators in the form of the Idaflo and Fig. 280 unit, to name but two. With the emphasis that the world Gas Industry now place on safety, the Company have also developed a range of unique magnetic type Safety Cut Off Valves and a complementary stream discrimination valve. These examples are quoted simply to indicate the Company's awareness of the Gas Industries problems and the efforts that have been made to help overcome them.

Modules

With the Company manufacturing most of the equipment required in modern gas metering and regulating stations it then, in the early 1970's, pioneered the module type construction involving fabrications of complete breakdown stations in the workshop. Using this construction a large amount of site installation is eliminated requiring only gas inlet and outlet connections to be made.

The past experience and present technique of the Company are unmatched by any other firm in the regulator business.

CENTRIFUGAL BLOWERS

Rateau Machines

The next important step in the provision of service to the Gas Industry was the acquisition, in 1910, of rights to manufacture turbo exhausters and blowers on the principles patented by Professor Rateau of Paris, who had built his original turbo-compressor in 1902. This innovation was most important to the rapidly expanding Gas Industry as it provided a means of dealing with very large volumes under constant conditions of pressure, giving an absolutely steady discharge and effectively reducing tar fog, while at the same time economising in space.

The Beale exhausters, though wholly reliable, had the disadvantage of being very large at a time when the high capacity of carbonising units made floor space a very important factor. The early Rateau machines, although at first little more efficient than the Beale exhausters, were by virtue of their high speed, able to deal with very much greater volumes of gas whilst requiring much smaller foundations and smaller buildings to house them. Their higher speed made them suitable for direct coupling to steam turbines and electric motors which were beginning to replace the slow speed steam engine.

By 1929, however, it was realised that even these machines had reached their limit for some of the larger works and that still higher speeds were desirable to keep down the size of the plant and to make better use of the higher efficiencies to be obtained from the use of turbines running at higher speeds.

Star Type and the new CM type Turbo Exhauster

The Rateau Star type Turbo Exhauster was developed to meet this requirement and to withstand the high rotational speed, a radially bladed impeller machined from a solid high tensile alloy steel forging was designed.

Boosters and Exhausters have been developed to cover an extremely wide range of duties ranging from 10,000 cubic feet per hour and a few inches water gauge to 1,000,000 cubic feet per hour at 15 lbs. per square inch. As development proceeds in the Gas Industry and volumes handled become larger, the centrifugal booster is more and more in demand.

The company has up to the present, supplied over 2,000 machines of numerous types and sizes, the majority of which have found their way to the Gas Industry.

Other industries, however, find a use for these highly adaptable units and some hundreds of them are at present in service in Chemical Plant, Steelworks, Sewerage Plants, Water Treatment Plants etc.

The original agreement with Professor Rateau proved to be the beginning of a long and cordial association. Since Professor Rateau's death in 1930, working agreements have been maintained with Messieurs La Société Rateau of Paris, the Company of which he was the founder.

CONNERSVILLE METERS, EXHAUSTERS AND BLOWERS

THE accommodation which had previously been used for the production of Simms motor units work was, in December 1920, utilised for the purpose of extending foundry capacity for castings made under contract with W. C. Holmes & Co. Ltd. of Huddersfield, Mr. P. F. Holmes joining the Board of the Company.

Connersville Development

Subsequently in 1926 an agreement was entered into between the two companies for the manufacture of Connersville Meters, Exhausters, and Blowers, Messrs. W. C. Holmes & Co. Ltd. having secured the rights under Licences for the patents covering the manufacture of Meters, Exhausters, etc. from the Connersville Blower Company of Connersville, Indiana, U.S.A.

A practical 'figure of 8' blower, in which there are two rotors resembling pinions with only two teeth which do not actually touch one another but rotate in relation to one another with very small clearances, was originally made by George Jones of Birmingham, England about 1840 as a gas exhauster and for clearing foul air from South Staffordshire pits. Nevertheless, a patent was granted to J. D. Roots in 1866 (No. 1333).

The idea was actually centuries old as a four-toothed design on the same principle was illustrated in "Deliciæ Physico-Mathematicæ" by Daniel Schwenter which was published in Nuremburg in 1636. The earlier blowers of this type, including those of Jones and Roots, were, however, only moderately successful. Theoretically, at each revolution, a volume of air or gas should be discharged equal to that swept by the portions of the teeth outside the pitch circles. The Roots blower was made more successfully in America where it was vastly improved by Mr. Wilkins, a draughtsman-designer of the works at Connersville, who founded his own company in the same town and eventually amalgamated the parent firm with the daughter company under the name of the Connersville Blower Co.

The secret of success relied largely on accurate design and workmanship. The design, when operated by an external power unit, provides an efficient blower or exhauster, but when rotated by gas pressure in the main it can be used as a meter, the number of revolutions made being accurately proportional to the volume of gas passed.

Exhausters and Blowers

The Connersville meter ultimately superseded the wet drum station meter, and there was a rapid increase in output of these machines. There was also a big demand for the Holmes-Connersville design of exhauster for gas works purposes, as well as air blowers used in a variety of industries and for scavenging purposes by the builders of Diesel type oil engines.

Inert Gas

Connersville units were also incorporated in the manufacture of inert gas producing equipment which was very widely adopted in the Gas Industry for the purpose of purging gas mains, gas holders, etc. and by the Oil Industry as a safeguard against explosion and fire in storage vessels. Subsequently these machines were also adopted for the purpose of manufacturing inert gas for flame throwing equipment by the Ministry of Supply Petroleum Warfare Department.

The manufacturing association with W. C. Holmes was concluded in 1967, but with the experience gained on Roots blowers and the fact that a sister company, George Waller of Stroud, Gloucestershire also had a small manufacturing facility for this type of blower, it was a logical step that in 1973 production of the Waller Roots type blower was moved to Chesterfield.

RECIPROCATING COMPRESSORS

Since the earliest days of the industry, the demand for gas by domestic and industrial users has been steadily increasing. In the early days, with small compact areas of supply the holder pressure was generally relied upon to ensure an adequate supply to all consumers. This simple state of affairs was, however, short-lived and it became necessary to adopt other measures.

Call for High Pressure Supplies

At first low pressure boosters were sufficient, but with the larger undertakings, the area of gas supply was gradually extended, following the new "dormitory" suburbs which were springing up round the large centres. To supply these outlying districts through the normal low pressure mains proved impracticable, and it became common practice to lay special feeder mains to these areas, carrying gas at much higher pressure direct from the works to the district where the pressure was reduced by governors to the more normal distribution pressure.

Beale type rotary machines were originally used for this duty and later, as increased consumption made higher pressures necessary, horizontal reciprocating compressors. These however occupied considerable space and their low speed severely restricted their potentialities.

Vertical Compressors

This led in 1927 to the introduction of the Vertical Reciprocating Compressor which was both totally enclosed and suitable for greater running speeds. The first vertical machine built at Chesterfield was installed at the Tynemouth Gas Company, North Shields, in April, 1927. It was an 8″ steam driven duplex compressor to pass 75,000 cubic feet per hour at 365 r.p.m. against an outlet pressure of 30 lbs. per square inch. Steam pressure was 75 lbs.

Numerous improvements, both in design and performance, have been made over the course of years and the efforts of the design staff are continually turned to achieving still greater efficiency. It is interesting to examine the sales figures which reflect, to some extent, the rate of expansion of the Gas Industry, and also show the rising demand for the vertical compressor.

In the three years following the introduction of this type of compressor (1927-8 and 9) a total of three machines was supplied. At the outbreak of war in 1939 an average of 18 per year had been reached and this was maintained through the war years. The end of the war in 1945 brought about an immediate increase and sales for the first four years of peace averaged 30 per year.

Gas Grid

It was inevitable that sooner or later some form of integration within the Gas Industry would take place on the lines of United Kingdom Gas Corporation's great enterprise, the West Yorkshire Gas Grid, which was built up long before the war. The coming of nationalisation in 1949 by grouping undertakings under Area Boards enabled similar systems to be developed in other areas. Bulk supply of gas between undertakings or from manufacturing stations to distribution stations was fairly common practice and for all these schemes compressing plant was required.

However with the advent, (during the late 1950's, early 1960's) of gas manufactured from oil rather than coal and the higher available pressures this process provided the requirement for reciprocating compressors in the gas industry quickly deteriorated.

With the need to develop new markets, particularly in the chemical, petrochemical and process industries, an agreement was made in 1965 with Crepelle and Cie of Lille, France for the rights to manufacture horizontal reciprocating compressors to their designs and since this time some 450 units have been installed.

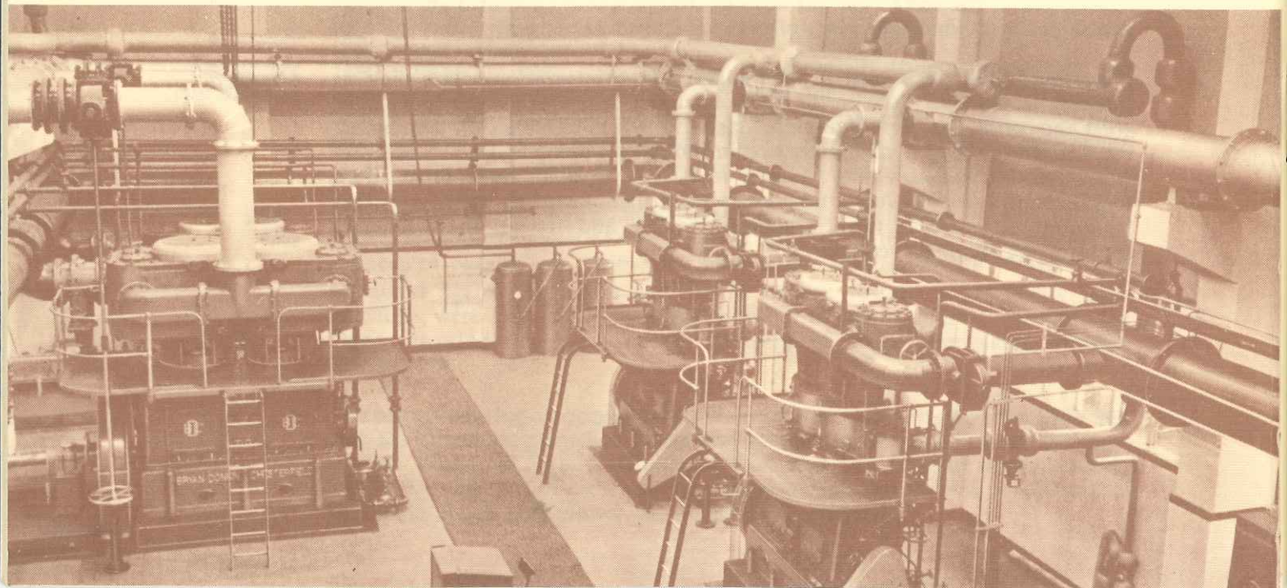
It is interesting to note the effect of general economic conditions on the design and selection of plant. On grounds of flexibility, steam is by far the most suitable source of power and in the 1920's and early 1930's it was unusual for other forms of drive to be considered.

Today, unless waste heat boilers can be used, steam raising costs are generally prohibitive. The result has been a swing in favour of electric drive, but the possibility of power cuts for some years to come has also to be taken into account. At the present time, electric drive is generally favoured, but many machines have also been installed powered by diesel, dual-fuel or gas engines.

High Pressure Storage

High pressure storage has been employed by some undertakings, to overcome distribution problems. Here gas is taken from the low pressure supply mains during periods of low demand and compressed into receivers at pressures ranging from 60 to 200 lbs. per square inch or more. During periods of high demand the gas is supplied from the receivers to the district through suitable pressure reducing governors. Plant of this type is generally fully automatic and runs without attendance for perhaps weeks at a time. Starting and stopping is controlled by receiver pressure and time switch, and automatic safeguards prevent mains being overdrawn.

The plant is protected by oil pressure switches, thermostatic switches and overload relays, and in the event of one machine failing to start, automatic switching starts up the standby unit. Compressors for this service must, of course, be absolutely reliable and The Bryan Donkin Company's machines have so far proved their worth in 15 installations of this nature.



EPILOGUE

IF THIS ACCOUNT OF BRYAN DONKIN AND HIS COMPANY HAS BEEN OF INTEREST TO ITS READER AND HAS ILLUSTRATED THE EXPERIENCE AND HIGH TECHNICAL ABILITY OF THE COMPANY, BOTH IN THE PAST AND PRESENT DAY, THEN IT HAS ACHIEVED ITS OBJECTIVE.

BRYAN DONKIN IS A COMPANY PROUD OF ITS TRADITIONS AND IS ALWAYS PLEASED TO RECEIVE VISITS TO DEMONSTRATE ITS EXPERTISE. YOU ARE WELCOME TO CALL AND SEE US, WE CAN PROMISE YOU AN INTERESTING VISIT.