The History of Chemistry In Essex and East London

by

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CONTENTS

FORWARD

On behalf of the Committee of the Essex Section of the Royal Society of Chemistry, I am very pleased to welcome this short history of chemistry in our region, written to commemorate the sesquicentennial of the RSC (1841-1991) and to coincide with the Historical Exhibition of Chemistry and the Chemical Industry in Essex and East London.

I hope you will enjoy reading about the growth of chemical science and technology in the old County of Essex, which now includes a substantial part of East London. May all practising and potential chemists carry on this fine tradition.

We are especially grateful to Mary James of the University of Essex for compiling this account from so many diverse sources and making a very interesting document from such scattered information and to all our members and friends who have contributed to the exhibition and the booklet.

Let us hope that the next 150 years of chemistry in Essex be at least as exciting and rewarding as the last.

Peter Thornton
Queen Mary and Westfield College
Chairman, Essex Section Committee

AUTHOR'S NOTE

Grateful thanks go to Essex University for helping to fund the production of this booklet. I would also like to say thank you to all those who, by kindly offering their time and expertise, have helped to make this project possible.

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PREFACE

The Importance of Chemistry in Modern Life

Chemistry plays a crucial role in modern life. This booklet aims to show just a few of the vast variety of ways in which, historically, the study and practice of chemistry has had an enormous impact on the everyday lives of individuals.

The largest specialised scientific society in the British Isles is the Royal Society of Chemistry. It has over 40,000 members world wide. The Chemical Society of London, forerunner to the RSC, was founded in 1841, and was the first of its kind in any country. The Society was one of three bodies to be granted tenancy of Burlington House in Picadilly when it was purchased by the Government in 1854 to provide accommodation for eminent societies connected with science and the arts. The original building was constructed in or soon after 1700 by Richard Boyle, 3rd Earl of Burlington who was a kinsman of Robert Boyle, the 'father of British Chemistry'. When the Chemical Society merged with the Royal Institute of Chemistry in 1980, Burlington House became the headquarters of the Royal Society of Chemistry which now occupies most of the East Wing of this handsome and historic building.

In the U.K. the quality of chemical science, at the basic level of research, is especially high. This is demonstrated by the frequency with which British chemists have been awarded the Nobel Prize in Chemistry. However expertise in the chemical sciences is by no means limited to academic activity. Applied chemistry has contributed much to the economic sphere. Since its massive growth in the nineteenth century, the British chemical industry has ranked amongst the largest and most successful in the world.

The range of the chemical industry is extensive. Firstly so-called 'basic chemicals', such as sulphuric acid, have to be produced. These are then supplied to other sectors to be used as vital components in various wide-ranging manufacturing processes. For example, one important area of the chemical industry which is based on the manufacture of sulphuric acid is the production of fertilizers.

Many sectors of the chemical industry utilise the by-products of the petroleum industry. As well as a source of fuel and energy, petroleum provides a great variety of commodities which are essential to the economy. A great many materials and commodities taken for granted in our daily lives are based on products from oil, and made possible by modern developments in chemistry. Manufactured synthetic polymers and plastics, for instance, have become so familiar to us now that we tend to regard them as indispensable.

The so-called 'fine chemicals' also play a significant role in our everyday lives. Today, in our society, most of us take for granted not just the availability of soap for basic hygiene, but also all sorts of vanity products from the fine chemical industry. More importantly chemical expertise in the pharmaceutical industry has led to the development and production of synthetic life saving drugs. Photographic science and many aspects of the food industry are also chemically based.

The British chemical industry, under its many different guises, exports about 40% of its output and, as the economic statistics reveal, it is highly profitable. For instance, in 1984, it achieved a positive balance of payments surplus of £1.8 billion, whilst the rest of the sectors of the British manufacturing industry suffered a deficit of £6.9 billion.

Despite the unquestionable importance of chemistry to us and to our nation, this science has, in recent times, acquired an increasingly negative image. In the popular consciousness it is closely associated with industrial pollution and with the short-sighted misuse of synthetic chemicals. Nowadays the term 'chemical' itself is often used in a pejorative way and this perception has tended to be reinforced by the media.

However, it is important to bear in mind that environmental issues must be thoroughly researched and systematically addressed, if we are to overcome the problems of pollution. The cleaning up process itself depends crucially upon the general advancement of chemical science and its application. With changing social awareness of the globally disastrous consequences of pollution, profound knowledge and understanding of chemicals are more important than ever before. There is a vital role for chemists to play in helping us to obtain a cleaner and healthier atmosphere and ecologically sound processes of production. The Royal Society of Chemistry is well aware of this and since its foundation in 1980, (when the merger of The Chemical Society, The Royal Institute of Chemistry, The Faraday Society and The Society for Analytical Chemistry was completed) the number of meetings devoted to ecological and environmental issues has continued to increase.

INTRODUCTION

Early History

At the end of the eighteenth century, Essex, like other southern counties of England, was principally agricultural. There were a number of traditional industries, and for example, milling and weaving were among the most important. However, local industry also included several areas that have, at least, a rudimentary association with chemistry. For instance, salt making in Essex dates back to pre-Roman times. Potash, used for making soap, glass and dyes, amongst other things, was made throughout the small villages of Essex and was a thriving rural industry until the early nineteenth century. Copperas, from which dyes for the local textile manufacturers and tanners were made, was collected around the Essex coast, and continued to be manufactured locally until the 1840s. The first documentary evidence of charcoal making in Essex goes back to the fourteenth century. Charcoal was put to many different uses but, from the late sixteenth century, the most important function of the local charcoal manufacturers was to supply the gunpowder mills of Essex. Explosives made at the Royal Gunpowder Factory at Waltham Abbey were used in the Civil War (1642-1649). In 1787, when the factory was taken over by the Crown, it became the first nationalised industry in Great Britain.

The Early Chemical Industry of Essex.

Factors influencing the early development of the chemical industry on the Essex side of the metropolis, and its subsequent heavy concentration in this region, can be traced back some six hundred years. In the time of Edward III, (1312-1377) a City Ordinance was passed prohibiting the slaughter of cattle nearer to London than Stratford. This act was to have a highly significant influence upon the subsequent development of industry in the locality. As a result of the ordinance, Stratford and its environs became the slaughterhouse for the city. The chemical industry in the area was initially based upon the raw materials of animal refuse from the local abattoirs.

Metropolitan Essex in the 19th century.

The first Post Office Directory, published in 1800, shows that chemical trades were already beginning to be established in Essex which at that time included the greater part of East London. Throughout the century these were to play an increasingly important part in the economy of the area. During the first two decades of the nineteenth century, makers of vitriol, turpentine and dye, amongst others, established themselves in the locality. Although many of these firms were small and short-lived, by the mid nineteenth century industry in the area to the east of London was predominantly chemical. This still included some small back-street concerns, but by and large operations tended to be much larger. The scale of the chemical works, amongst other manufacturers on the Essex side of the river Lea, was noted in Pigot's Directory of Essex as early as 1839.[1]

As the century progressed industry expanded and the character of the area continued to change. In 1841 the Post Office Directory noted three manufacturing chemists, as well as eleven makers of dyes, tallow, turpentine and such like, in the vicinity of West Ham. Since the surrounding area was still largely pastureland it still seems likely that animal refuse was readily available, although there is no direct evidence of a local slaughterhouse at that time.

The Impact on Industry of Railways and Docks.

The extension of railway networks in the nineteenth century was another important factor influencing the growth of industry in Essex. In 1839 the Eastern Counties Railway to Romford was opened. This helped to stimulate the rapid industrial development of south-east Essex. The railway connection between Stratford and North Woolwich, in 1847, had a similar effect. It led to the opening up of Canning Town and Silvertown to industrial development, a consequence which was intensified with the completion of the Royal Victoria Dock in 1855. The West India Dock, in use by 1802, had already made a significant impact on trade in the area. Through the development of docks and railways, cattle trade in the district was revived, and many industries on the east side of London became involved in processing animal refuse. However, after 1869 the import of cattle was restricted to Deptford in order to control disease.[2]

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[1] see Parkes (1950), page 11.

[2] Import was restricted by the orders in Council made under the Contagious Diseases of Animals Act,1864.

The provision of enhanced transport facilities in the mid-nineteenth century not only acted as a stimulus to trade but had a considerable effect on the local population. For instance, between 1841 and 1851 the population of West Ham increased by nearly half. Over the following decade this figure more than doubled. The chemical industry and related trades were the major employers of this rapidly expanding population. By 1931, 30% of the working population of West Ham were employed in this way.
19th Century - The Growing Demand for Consumer Products.

Between 1811 and 1871 the population of England and Wales more than doubled, but this overall increase was especially marked in the south-east. This factor, combined with an inherently upward trend in the economy, produced a spiralling demand for consumer goods. Consumer products based on chemical processes played an ever increasing role in the industrial expansion that characterised this period. In the district of West Ham, for example, the chemical industry centred primarily upon the manufacture of alkalis, acids, drugs, paints, varnishes, soap, ink, fertilizers, plastics and artificial fibres.

The Effect of Legislation on the Chemical Industry in Essex.

The growth of the chemical industry on the metropolitan side of Essex can be related to the increased use of legislation to restrict the operation of noxious and offensive trades within the boundaries of London. Within this category were trades such as bone and blood boiling and the slaughter of animals.[3] The marshland area of the river Lea lay just outside the jurisdiction of these Acts. This locality also offered extensive low-cost sites close to navigable water ways, and a ready supply of labour. These factors combined to make this area especially attractive to manufacturers whose processes were unpleasant and consequently made this a prime location for the early development of the chemical industry.

In 1856 a Local Board of Health was established under the Public Health Act of 1848 and the Nuisance Removal Act of 1855. Nevertheless the offensive trades of the Lea Marshes were relatively immune to prosecution providing they were situated at a reasonable distance from the dwellings of prosperous, middle-class inhabitants. Indeed, it seems this legislation was regarded as counter-productive because it could potentially damage the chances of industrial wealth being attracted to the area. In order to accrue this advantage, West Ham Council, in the nineteenth century, actively encouraged noxious trades. This locality consequently became a very popular site for firms processing animal refuse. West Ham had no by-laws relating to offensive trades until 1885 and even then implementation tended to be less rigorous than in London.

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[3] e.g. the Metropolis Building Act of 1844 on the effects of legislation in the district - see Marrott (1988) p124.

In a period of some thirty years the local Board of Health investigated only some twenty seven complaints in the district of West Ham. Amongst those trades acknowledged as possibly injurious to public health were Crow's sulphate of ammonia plant in Plaistow, where tar and pitch were distilled, and Neumann's in Stratford, where manure was made from fish oil and animal refuse. Seabourne's bone-boiling company in West Ham, where animal matter was allowed to decompose by spontaneous fermentation, was one of the few forced to close. Samuel Clay, who had farmed in Colchester, set up a plant in Stratford in 1875 to manufacture fertilizers from blood and bones. In 1878 he was charged under the Public Health Act, (1875). He was required to stop trading, but business was soon resumed after a successful appeal to the Court. Larger firms such as the Imperial Gas Company at Bromley-by-Bow, which manufactured methane, and James Odams at Silvertown, where fertilizer was prepared by boiling blood and treating it with sulphuric acid, were subject to complaint, but were able to remedy matters relatively easily.

19th-20th Century - The Spread of the Chemical Industry

The favourable atmosphere of the London side of Essex not only encouraged many new companies to set up, but attracted well established London firms to move further out. The fact that between 1860 and 1900 there were more than two hundred chemical plants in the West Ham district alone reflects the widespread recognition amongst manufacturers of the advantages that the area had to offer. Although many companies were short-lived and some merged or were taken over, others survived and prospered. Amongst these, names such as Jeyes, B.P. Chemicals, Bergers and Yardley are well known.

Whilst the portion of Essex adjacent to the metropolis has been, from the first, the main centre of the chemical industry in the county, the trend had been established by the early twentieth century for firms to move increasingly farther afield. Ilford, Barking and Rainham, although still in the metropolitan part of the county, became popular sites for the new industry. The Atlas Chemical Works at Rainham was established by W.C. Barnes in the late nineteenth century, specialising in the production of aniline dyes. Typke & King Ltd. were also established in Rainham about the same time. Their factory for the manufacture of valerates and rubber chemicals was operational in 1898.

Barking, like West Ham, proved to be an attractive location to tar distillers after the sulphuric acid plant was set up at Beckton gas works in 1879. The local gas works spawned numerous subsidiary industries in the area, including manufacturers of fertilizer, creosote, pitch, disinfectants, insecticides and dyestuffs.

In the rest of the county there was little chemical manufacturing. Amongst the few, The Victoria County History mentions Cuthbert & George Johnson who established a plant at Great Totham in 1832 and Alfred Payne who had chemical works at the Hythe in Colchester in operation in 1840.[4]

Nevertheless the more specialised chemical manufacturers have mostly been situated in the suburban part of the county. May & Baker, manufacturers of medicinal chemicals since 1839 are a case in point. Originally based in Battersea, they moved to Dagenham in the 1930s and later, spread to Ongar. The photographic company, Ilford Limited, had a factory built at Great Warley, near Brentwood, in 1904. The manufacture of xylonite, an early plastic, was transferred by the British Xylonite Co. from London to Brantham on the Essex and Suffolk border in 1887, whilst explosives for commercial use have been made at Great Oakley since 1907. The explosives industry in the county is one of its most ancient, with gunpowder being made at Waltham Abbey since the seventeenth century.

These are just a few examples of chemically related industries outside the metropolitan district of Essex.

Overall the number of industries in Essex associated with chemistry is so vast that it would not be possible, within the scope of this booklet, to cover them all. However, whilst far from providing an all embracing view of the history of chemistry in Essex, it is still hoped that the following pages will provide some idea of the enormous variety of ways in which chemistry is a pervasive presence in our local history, and continues to be so in our everyday lives.

[4] Page (1977) p497

THE PREPARATION AND USE OF CHEMICALS

Salt

At South Woodham Ferrers, archaeologists have discovered the remains of a hearth, now below the high tide level, which is thought to have been used for salt making around 1000 BC. For the Romans, salt was a highly prized possession and was used to pay their soldiers, hence the word 'salary' which was derived from 'salarium' which is the Latin word for salt. The Domesday Book, compiled in 1086, provides the first documentary evidence for salt making by natural evaporation in the area. It specifically mentions salt produced from about 45 pans on the Blackwater estuary which is reputed to be the saltiest in the country, facilitating salt to be derived by a process of natural evaporation.

Although for most of the eighteenth century, salt making took place on all parts of the Essex coast, as the century wore on, the industry began to enter a decline. By the end of the century saltworks survived at only three locations, namely Colchester, Manningtree and Goldhanger. The Colchester works soon folded, and by about 1840 Manningtree too had ceased to produce.

In the early years of the nineteenth century, the Goldhanger works transferred to Weybridge where salt was made by boiling sea water. The new site, however, did not prove successful and the owners of the company, Messrs. Bridges, Johnson & Co., sold out to the Worraker family who took the business to Maldon, on the opposite side of the river. They continued to produce salt until 1982 when the company was taken over by Mr. T. Elsey Bland of Maldon. The firm now became known as the Maldon Crystal Salt Company and rapidly gained an international reputation for the unusual purity of its product.

In 1884 the medical journal The Lancet endorsed the use of Maldon crystal salt. It was analysed by Dr. Arthur Hill Hassall, who found it to be 99.6% sodium chloride, and thus 'almost perfectly pure'. It was said that the traces of sulphates and of magnesium salts were so minute that the salt was non-deliquescent, and so would not spoil when stored, and would not leave a bitter after-taste as did most salt used for culinary purposes at that time.

During the 1880's, extensive enlargements and alterations were carried out at the Maldon saltworks, and new machinery was introduced. The salt was very carefully prepared by collecting water from the estuary every fortnight at spring tide. The water was allowed to settle and then the salt was crystallised by slow boiling. Foreign demand for the product grew steadily and the company soon began to export in considerable quantities to the South African colonies and the West Indies. The salt also became popular with bakers as chemical analysis showed that no lime was present in the bread that contained Maldon salt. Picklers, too, preferred it as a pure brine maker because it eliminated the problem of both scum and sediment in their wares.

Over the years, Maldon salt has become increasingly pure. An analysis carried out at North East London Polytechnic in 1979 showed it to be over 99% pure sodium chloride.

Charcoal Making

The manufacture of charcoal was once common and widespread in Essex. This industry dates back many hundreds of years. Documents at Great Waltham, for instance, mention a 'colyer', or charcoal burner living in that parish in 1399.

Charcoal is made from coppice wood around ten to twelve years old. The wood is cut into three feet lengths and then stacked and left for about a year to dry out. The wood, once seasoned, is piled onto a large circular hearth to form a cone shaped stack about six feet high, with an inner cavity. Bracken or straw are then placed over the wood, and these, in turn are covered with a layer of fine black ash from a previous burning. This serves to keep the smoke in and prevent rapid combustion.

In traditional charcoal making the stack was lighted from the top and left to burn for between twenty-eight and forty-eight hours. During this time the burner had to stay close to the fire to ensure that it did not burn through the covering, as this would cause the charcoal to spoil. Because the fire needed constant attention, the charcoal burners of old used to build turf huts for themselves on the woodland site where the burning took place. After sufficient time had elapsed, the fire was quenched with water and allowed to cool for twelve hours. The product known as 'pit coal' was then removed and graded for sale.

In the eighteenth century the production of Essex charcoal grew to meet the needs of the Royal Gunpowder Factory at Waltham Abbey. 'Pit coal' then began to be replaced by a different sort of charcoal known as 'cylinder coal', as this was preferred by the gunpowder manufacturers. Cylinder coal was so named because it was made by heating the wood in closed metal cylinders. Although almost any kind of wood in Essex was used for making charcoal, dogwood, alder and willow were favoured for the compounding of gunpowder. In the country as a whole, other uses to which charcoal was put included the tempering of gun barrels, making of fireworks, lamp blacking, and deodorising. In medicine it was used as a remedy for flatulence and administered in 'charcoal biscuits'.

However, during the nineteenth century, the industry began to decline. Not only was gunpowder replaced by more powerful explosives, but other purposes for which charcoal had long been used, such as the drying of hops, were now superseded by new methods. By the early twentieth century, the amount of charcoal produced annually in the whole of Essex was less than one third of the amount previously produced in Thundersley alone, and was confined to just three localities. While the cost of burning remained about the same as it had been one hundred years before, the value of charcoal had severely dropped as the result of reduced demand. Consequently, this ancient industry eventually died out in Essex. We are however reminded of its former importance by place names such as Collier Row, near Romford, where colliers, or charcoal burners, at one time used to live.

Explosives

Gunpowder is the oldest known explosive, and the powder mills of Essex were amongst the earliest to be found in England. The first of these, known as Three Mills, began manufacture in 1588. St. Thomas' Mill went into production in 1597 and Spileman's Mill followed in 1615. All three were situated in the district of West Ham. By the time of the Civil War (1642-1649) gunpowder was being made at Waltham Abbey. By 1662 this mill had been wrecked by five major explosions.

Gunpowder consists of a mixture of charcoal, saltpetre and sulphur. The charcoal was locally produced from three woods, alder, willow and dogwood, some of which were grown in plantations within the factory. Sulphur was imported from Italy and Sicily, and some of the saltpetre from Italy and India. Saltpetre, the common name for potassium nitrate, which in those days came from dung-heaps, was also obtained from local suppliers. The saltpetre makers of Essex, in the seventeenth century, had extensive powers entitling them to enter stables and dig up floors without requesting the owners' permission or being required to repair the damage.

The second half of the eighteenth century was a time of strained international relations and the Government, fearing the imminent outbreak of war, sought to control at least part of the production of the nation's gunpowder. In 1787, Sir William Congreve, the Deputy Comptroller of the Royal Laboratory at Woolwich, begun negotiations to purchase the Waltham Abbey Powder Mills from John Walton. In October 1787 the Crown took possession of the mills on payment of a sum of £10,000. A further £35,000 was spent on repairs, extensions and improvements. Production at what was now known as The Royal Gunpowder Factory, recommenced in 1789, making this probably the oldest nationalised industry in the country. During the Napoleonic Wars (1798-1815) more gunpowder than ever before was produced at the factory.

Until the middle of the nineteenth century the entire production of the factory had been gunpowder alone. Around this time, however, there was a growing interest, in Europe, in two new explosives, guncotton and nitro-glycerine.

Guncotton, also known as pyroxylin or nitrocellulose, was first developed by the German chemist, Schoenbein in 1846, and was prepared by nitrating acids on raw cotton. It held advantages over gunpowder in its smokeless combustion, rapidity of action and resistance to moisture. However, the early manufacture of gun cotton did not include the vital stabilizing stage, and several consequent serious explosions led to a widespread reluctance, both in Britain and abroad, to produce it. Only in Austria was interest maintained and the process of production improved. The Austrian government offered details to the British government and Sir Frederick Abel, the War Office Chemist, examined and accepted the improvements. As a result, in 1863, an experimental plant at Waltham Abbey was set up for the production of gun cotton. The plant was a success because the product now was stable, and so production steadily increased. By 1872 the output was 250 tons per year.

Eventually this level of production was inadequate and a larger capacity plant was acquired in 1885, on the south side of Waltham Abbey at Quinton Hill. By 1908 the output was about 2,000 tons per year.

Nitroglycerine, a colourless or pale-yellow oily liquid, is prepared by treating glycerine with a mixture of cold concentrated nitric and sulphuric acid, and was first made in 1847 by Sobrero. The famous Swedish chemist, Alfred Nobel (1833-1896) experimented with it to make it more easily handled. Under Sir Frederick Abel's War Office Explosives Committee, chaired by Lord Rayleigh in 1890, it was developed into cordite by combining it with gun cotton and mineral jelly. In 1891 a nitroglycerine plant was erected at the Royal Gunpowder Factory to make cordite. Production during the Boer War (1899-1902) was about 18½ tons per week. By 1907 this had risen to 40 tons.

The First World War created unprecedented demands for high explosives. Cordite production rose to about 64 tons per week. By the end of the war 1,000 tons of high explosives were being made every day. For two years the Royal Gunpowder Factory operated day and night, seven days a week. Around half the 5,000 strong workforce were women who were brought in from outlying districts of Essex. Eventually other factories were set up elsewhere and staff were transferred to supervise the new operations.

Trinitrotoluene, known as T.N.T. was not made at the Royal Gunpowder Factory until 1933. In 1915 caustic soda works in Silvertown were adapted for the re-crystallization of T.N.T. from alcohol. Although only relatively small quantities, about nine tons per day, could be produced, and the process was highly dangerous, it was thought that the risk was worth taking. However, in January 1917 there was an explosion at the plant, nearby houses were wrecked, and sixty-nine lives were lost. In 1917 the Three Mills factory at West Ham was converted in order to make acetone for cordite manufacture, but when United States entered the war it was no longer needed.

Production and employment decreased at the Royal Gunpowder Factory after the First World War. The emphasis was now primarily on experimental and investigative work. However, in 1933 the process of run-down reversed, and in the light of the international situation, the factory prepared for full war-time production. By 1941 new factories had been made operational and processes were gradually transferred. By 1943 most of the plant at Waltham Abbey was being run-down and finally the Royal Gunpowder Factory formally closed in 1945.

However, in 1944 the factory site had been surveyed and a report submitted, recommending that it should be used as an experimental station of the Armament Research Department at Woolwich, for explosive research activities. In 1946 the Chemical Research and Development Department came into being. In 1948 the title of the department was changed to Explosives Research and Development Establishment, (E.R.D.E.).

As part of a programme for the privatisation of the Royal Ordnance Factories in 1984, the site at Waltham Abbey was divided between the Royal Armament Research and Development Establishment, (R.A.R.D.E.) and the Royal Ordnance Plc. The research programme was modified to meet revised requirements. At Waltham Abbey RARDE was concerned with the chemistry and physics of energetic materials, as well as research into associated chemical processes and polymeric and composite materials. The fields in which work is currently being carried out include composite propellant chemistry and chemical synthesis of energetic materials and ingredients. These activities were gradually transferred to Fort Halstead in Kent and the Waltham Abbey site was closed in June 1991.

Commercial Explosives

In 1906 a French entrepreneur, **M. Barbier**, established a company, **Explosives and Chemical Products Ltd.**, at Bramble Island near Gt, Oakley in Essex. The site was previously owned by a German owned firm called **The High Explosives Co.** and M.Barbier acquired the existing facilities as a base for further development.

The island's 800 acres of marshland was a prime site for a number of reasons. Firstly it offered plenty of room for expansion. There were also two small docks for importing raw materials and a plentiful local labour force could be readily recruited as there was a road link to the mainland one mile away.

In the early days the company mainly concentrated on commercial explosives for mining and quarrying. However, when war broke out in 1914, the factory made a partial transfer to the production of military explosives. Many local women were then taken on, for the first time, to carry out war-time production, and they constituted a very high proportion of the workforce.

During the Second World War no military explosives were made, but the company contributed to the war effort by producing explosives for coal mining. At this time there was a serious explosion and fire at the factory and the Technical Manager at the time was awarded the Albert Medal (later to be the George Medal) for his heroism in dealing with the emergency.

After the war the another site was developed at Alfreton in Derbyshire which was closer to the major mining and quarrying markets. The Great Oakley site was completely inundated by the East Coast floods of 1953 and manufacturing facilities were destroyed. During the 1960's the company commenced production of ammonium nitrate, one of the main ingredients of commercial explosives, creating a subsidiary, **Thames Nitrogen Co. Ltd.** at Rainham in Essex. This firm, (now closed), supplied both the Alfreton and the Great Oakley factories. Surplus product was sold in the fertiliser market.

Gradually, in the 1970's, the production of explosives was transferred from Great Oakley to Alfreton and the plant at Bramble Island began to concentrate on developing a new nitroglycerine based product which was exported for processing into a range of commercial explosives.

The manufacture of the concentrate required fewer workers and so, in order to avoid redundancies, the company at Great Oakley decided to diversify. One interesting project was the processing of potatoes and production of parfried chips for the catering industry. This venture was not a success and was closed down in later years.

Although Exchem at Great Oakley is still licensed as an explosives factory, it no longer manufactures explosives. Explosives are, however, still stored on the island in 11 thick concrete magazines, reinforced with steel and surrounded by grass banks. Explosives are exported from the site using the company's private dock.

The manufacture of commercial blasting explosives ceased in 1985 and in 1987 the company was renamed **Exchem Industries Ltd.** Activity is now directed towards the manufacture of speciality chemicals. Exchem, for example, was amongst the first to recognise the need for a chemical to improve the quality of diesel fuel and the nitroglycerine plant was converted to produce octyl nitrate for this purpose. Nitration chemistry is also used to produce specialist intermediates used in the pharmaceutical, dyestuff and agrochemical industries.

Potash

Potash, or potassium carbonate, is derived from burning wood, weeds and other vegetable matter. Until the early nineteenth century, the making of potash was a very common and thriving rural industry in Essex. Most parishes in the county were involved in potash production.[5]

Potash was used for a variety of purposes, including washing clothes, soap and glass making, dyeing, and water softening. It was, in fact used for nearly all the purposes for which sodium carbonate or soda subsequently came to be used.

Dr Watson of Cambridge, in his Chemical Essays (1789), estimated that 1,300 tons of dry oak, or 1,800 tons of green oak had to be burned to produce one ton of potash. Production consequently would have been quite impractical if the ashes used had not been the by-product of cooking and wood-burning stoves. Local residents saved the ashes from their ovens and these were regularly collected by the potash maker who paid a small remuneration in return.

Potash was made by putting the ash into a tub with a perforated bottom and then percolating water through it. The solution, known as 'lye leach', was collected in a receptacle placed below. With each successive filtering the lye became more concentrated as all the soluble potash salts were washed out of the ashes.

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[5] Davidson 1978.

The next step was to soak wheat, oats or barley straw in the lye and then place this on a smouldering hearth until all the liquid had evaporated. Once this process had been completed the loose ashes were removed from the hearth to reveal a layer of dense black substance so hard that it had to be broken up with a pick. This was 'black potash', some of which was sold to local cottagers. The rest was packed into cases and sent to market, where it was purchased by those who carried the process a stage further. By a similar process they would produce 'pearl ashes', or purified potassium carbonate and other potassium salts, for many purposes such as soap making.

By the 1820's, the potash industry had begun to decline. Not only did the spread of railway networks facilitate the use of coal rather than wood as the most economic domestic fuel, but wood itself was becoming more scarce and the industry consequently could no longer get adequate supplies of wood ashes. With the clearance of large forest areas in the USA it became cheaper to import potash than to make it at home. However, the final extinction of the potash industry in Essex came when an economical method of making soda in large quantities was discovered. The last producers of potash in Essex were Townsend of Rochford and Porter of Great Wakering. Both though had ceased to operate by the 1850's. These days, only such names as Potash Wood, Potash Farm and Potash Road in Billericay and 'The Soap House' at Stondon remain as a sign of how important this industry once was in Essex.

Tallow and Candle Making

Before the days of gas lighting and electricity, candle making was a common industry in Essex, as it was in all other parts of the country. Every household depended upon candles made of tallow wax to supply their lighting. Throughout all the towns of Essex, tradesmen operated as tallow chandlers, that is as makers and vendors of tallow candles. Until the mid-nineteenth century every large wholesale grocer had a candle making department. In rural districts candle making was a small home-based industry. Farmers' wives made their own candles in the kitchen, using animal fat.

The trade of the chandler was an important industry of Essex throughout the seventeenth century, and was particularly important at Colchester from the mid fifteenth century. Tallow was made by melting the harder and less fusible kinds of animal fat. The earliest domestic forms of candle were tallow dips with cotton, flax or rush wicks. Candles made of beeswax were reserved for church use.

From the mid-nineteenth century improved candle making materials were introduced. New, high quality stearine candles were made by the extraction of glycerine from palmitin and stearine, the white crystalline constituent of tallow. This process released fatty acids which were mixed with some paraffin wax. Paraffin candles were derived from solid hydrocarbons in certain mineral oils. Chemically impregnated plaited wicks were also introduced, to provide a more consistent light. As a result the industry was transformed and continued on different lines, mostly in suburban and semi-suburban parts of Essex.

Pigot's Directory of 1823 shows that many small tallow chandlers and candle makers were then still in operation in Essex. However, as the century wore on, demand for dip candles decreased. By 1902 the Post Office Directory named only one candle maker in Essex. This was John Budd of Chelmsford whose business had first been founded in 1680.

The famous soap maker, John Knight Ltd., of the Royal Primrose Soap Works, founded in Silvertown in 1817, was also involved in making candles and glycerine and in tallow melting. Another soap maker, Edward Cook & Co., first founded in Norwich in 1776, moved to Stratford in 1858, where as well as soap, candles and edible oils were made. Other important nineteenth century candle makers in the Stratford district included J. Wilton & Sons, who made dip candles, and Messrs. Palmer & Co., who had a night light factory. In Rainham, Messrs. Field acquired fourteen acres for a factory on the river side in 1907.

The last firm to make tallow dip candles in Essex was the wholesale grocer Thomas Moore & Sons of Barrack Street, Colchester, whose candle making department was still in operation in 1907. Demand came from the local boiler makers, and others in the district's large engineering works. The engineers preferred tallow candles to wax, as they could be more easily fixed to parts of machinery to illuminate their work.

Moores, in the early twentieth century, also continued to make rush candles. These were used to light the long corridors of local workhouses, and there was also a market for them amongst some of the local cottagers.

Butchers throughout Essex supplied Moores with fat which was then melted down to make tallow, in fire heated pans. In the winter much of the tallow produced by Moore & Sons was exported to Siberia, where it was considered a delicacy and far superior in taste to steam melted tallow. In the summer, Moores used the fat to make soap as well as candles, as it could become slightly tainted before the melting process could be carried out.

Generally, by the early twentieth century, the candle making industry had become a chemical manufacture, rather than a craft, and took place in large factories. This transition was primarily due to increased knowledge of the chemical composition of animal fats. It was possible to remove undesirable constituents, making valuable by-products such as glycerine. Although by then gas and electricity were extensively in use, there was a great demand for the new, high quality candles, and although there has been a drastic decline in demand for household candles in the twentieth century, coloured and fancy candles are still popular.

Soap Making

Soap is a mixture of the sodium salts of palmitic, stearic and oleic acids. It is made by the action of caustic soda or caustic potash on fats of animal or vegetable origin. Soft soap, made with potash, is composed of potassium compounds and is usually very alkaline. Hard soaps, composed of sodium salts, require to be neutral. Glycerine is obtained from the spent lyes of soap boiling, but in the cold process of soap making, the glycerine is retained in the soap.

The traditional way to make soap was to boil together alkali, and any oily or fatty material. However, because tallow was a favoured fat for soap boiling, the soap industry has historically been closely allied to the candle making trade. Until the early nineteenth century both soap and candles were made either at home or by small local tradesmen. Also, many of the potash makers throughout Essex, undertook soap boiling as an important part of their trade, producing soft potash soap.

Although soap making was traditionally a widespread and predominantly small scale activity in Britain, from the early eighteenth to the mid-nineteenth century, this trade expanded rapidly. Originally the impetus to make soap on a commercial scale came largely from the textile industry. As industrialization proceeded, soap was demanded increasingly for a variety of manufacturing processes, as well as for personal hygiene. Liebig, in his <u>Familiar Letters on Chemistry</u> (1851), claimed that soap consumption, like sulphuric acid, was a national index of progress and prosperity[5].

From about 1830, soap as a small, but widespread home-based local industry rapidly declined. The 1841 census showed only four remaining in Essex. Steadily, soft potash soap was replaced by hard soda soap, made by scientific methods, in a small number of large factories, mostly situated in the London area, especially around Stratford.

Of these new factories, John Knight & Sons, founded in Silvertown in 1817, was probably the first[6]. The firm of Turner & Bailey established in Stratford in 1823 was also amongst the earliest large scale soap manufacturers in this area. Other important soap manufacturers established in Stratford, in the nineteenth century, were Yardley & Sons, and Messrs. Harris & Son, both of whom were also perfumery manufacturers. Edward Cook & Sons moved to a site of some 2-3 acres in Bow in 1858, and soon acquired land double this size. In the latter part of the nineteenth century Cooks employed about 100 workers, and Knights about 200, making them amongst the most important employers in the area. Both were extensively engaged in melting fat, soap boiling and candle making, and had their own tallow melting houses.

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[6] The Penny Magazine, p416 dated 28th October 1843, see also WARREN,1980, p10.

Fatty substances, purchased from local butchers, were taken in at the top of the melting house where they were cut up. The pieces were then melted down into tallow and sent either to the soap or the candle factory. Fibrous portions were also utilized in the form of greaves.

At Cooks the tallow was also used to produce a kind of dripping known as 'Extra Zuiver Runder Vet'. This product, which the English would not eat, was exported to Holland in large quantities in exchange for Dutch butter. At the factory the two processes of soap boiling and edible products were kept quite separate.

Across the yard from the melting house at Cooks was a bone works where toothbrush handles were made. Cooks also used bones to produce various fertilizers including dissolved bones, superphosphates of lime, wheat manure and mangold manure. This use of bones was a comparatively modern development in the 1870s. Until just prior to that, bones had been thrown away as useless, or else used on the land in a form that produced only a minimal result.

W. Crory, in what he described as his 'politico-economic' account of the industries of East London, in 1876, assured the reader that at Cooks the buildings used for tallow melting and bone boiling, were hermetically sealed at the roof, so that the gases generated could not escape. This, said Crory, ensured "the prevention of offence to nasal organs of neighbours"[7]. He went on to explain that "the soap trade is not unhealthy, on the contrary it seems, so much contact with grease may tend rather towards healthiness than delicacy"[8]

Shelley Holford, who was born in Stratford High Street in 1887, took a rather different view. Writing his reminiscences in 1945, he recalled that on the Stratford marshes anything could be manufactured that would not have been tolerated elsewhere. He described how the journey from Stratford Station to Liverpool Street was "always undertaken with a certain amount of misgivings and when the train left Stratford handkerchiefs were drawn out, windows closed and ladies giggled and blushed, such was the odour".[9]

At Cooks there was a laboratory where soap ingredients were tested and the soap examined chemically. This system also applied to manure and other goods. In 1910 they were the winners of several important awards at the Brussels Exhibition.

In 1905, Knights spent several thousand pounds on extending and modernising their works. Every variety of toilet and household soap was made there and they also did an important trade in oil refining and glycerine making. Later both Cooks and Knights became part of Lever Brothers.

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[7] CRORY, 1876, p79.

[8] ibid. p80.

[9] Newham Library Service Local Study Notes, No 27.

Copperas

Copperas is the name given to green iron sulphate crystals. Nodules of copperas the size of small sticks are found all around the Essex coast. Copperas is also found inland at cracks in the surface of the earth, especially in London clay, one of the most extensive geological strata in the county. The resemblance of copperas to twigs of wood suggests that wood originally formed the basis upon which copperas was deposited, the wood subsequently rotting away.

The main demand for copperas came from the clothmakers and tanners of Essex who used it for dyeing their products. Until the early part of the nineteenth century the industry was of considerable importance in many coastal locations around Essex. In Brightlingsea, records of copperas manufacture date back to 1542, and the industry at Walton-on-the-Naze, the most important site of copperas production in Essex, was mentioned by Daniel Defoe in 1724.

Traditionally, fragments of this mineral were gathered on the beaches by fishermen's wives and children. Also small smacks and sailing vessels dredged the stones from which copperas was refined. The best time for harvesting was after rough weather when stormy seas served to wash the copperas out of the cliffs in abundant supplies. The gatherers then sold their booty to copperas manufacturers, who would process the raw material into dyes.

The first stage of the manufacturing process consisted in piling the copperas pieces into heaps along with bits of scrap iron and then soaking these with water. The action of the air and water served to extract ferrous sulphate from the crude copperas and the solution was drained into pits. The solution, composed of sulphuric acid and green copperas, also known as green vitriol, took a few hours to produce. Next, more scrap iron was thrown into the pits to convert the acid in the liquid into more ferrous sulphate. The green solution was then heated in lead tanks and as the water evaporated, a concentrated and crystallised product was formed. Although the end result was by no means pure, it was adequate for the needs of the dyers.

During the first half of the nineteenth century, the copperas industry went into a decline. The most likely explanation is that demand from both local tanneries and woollen manufacturers dropped off around this time. On the one hand, the tanning industry was becoming increasingly less viable, while on the other hand the woollen industry moved from the eastern counties to locations in the north and west.

By about 1840, the copperas industry as such had ceased to exist. Nevertheless, fragments of raw copperas continued to be collected from the beaches until the late 1870's. These were sent to London, and later to Messrs. Packards Chemical Works in Ipswich to be used in the manufacture of sulphuric acid.

Sulphuric Acid

Sulphuric acid, formerly known simply as 'vitriol' or 'oil of vitriol', is a dense, colourless and highly corrosive liquid. Because it is widely used in a variety of processes in the chemical industry, it has great commercial value. These processes include the manufacture of hydrochloric acid, nitric acid, fertilizers, explosives and coal tar derivatives.

The manufacture of sulphuric acid has a very long history. It is said to have been produced in India over a thousand years ago[10]. Historically sulphuric acid was made by roasting sulphur and nitre in clay ovens until a fuming oily fluid, known as oleum, distilled off.

The famous Swiss physician, Paracelsus (1493-1541), who revolutionised medicine in the early sixteenth century, described the preparation of a spirit of vitriol, and an oil of vitriol, used for medicinal purposes, such as the treatment of cankers and ulcers. These products were obtained from the distillation of dried vitriols, and alchemists and druggists made their own, as and when required. From the time of Paracelsus until the end of the eighteenth century, spirit of sulphur was prepared by the 'bell' method which consisted of burning sulphur, usually mixed with a little saltpetre, under a glass vessel containing a dish of water.

The preparation of sulphuric acid, or vitriol as it was then known, was essential to the industrial development of the nineteenth century. Indeed the famous German chemist, Baron von Liebig (1803-1873) went so far as to say that the prosperity of a nation could be gauged by its consumption of sulphuric acid[11]. Production on a manufacturing scale began in 1736, when Joshua Ward set up his plant in Twickenham, making vitriol in large glass vessels. In 1749 Dr.John Roebuck, in Birmingham, introduced lead chambers which subsequently superseded Ward's glass bottles, and meant that acid could be made on an even larger scale. By the 1820s there were over twenty vitriol makers in the country.

Throughout the nineteenth century the manufacture of sulphuric acid became increasingly widespread and came to hold an important place amongst the industries of West Ham. By 1830 sulphuric acid was being made on Bow Common and in 1857 vitriol works were established at Plaistow and Silvertown. As sulphuric acid was required in considerable tonnages and was difficult to transport, most alkali makers produced their own. In 1882 there were three important alkali works in West Ham, and in 1865 there were nine in Chelmsford. Many fertilizer manufacturers, for whom Stratford and its environs proved to be an especially convenient location, also set up their own sulphuric acid plants.

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[10] Parks p11.

[11] Leibig in his 'Familiar Letters', 1851.

The Anglo Continental Guano Company, founded in Silvertown in 1873, is a case in point. This firm, one of the largest fertilizer producers in the U.K., having some eight acres of land, began making acid for their superphosphate works in the 1880s. For this purpose chambers sixteen feet high were built. In 1919 these were raised to twenty feet and in 1925, to twenty-five feet.

Dunn Squire & Co. were wholesale manufacturers of sulphuric acid and other chemicals at Stratford in 1870. Two years later, William Squire (1834-1906) amalgamated with Spencer Chapman (c.1844-1918) to form the firm of **Squire Chapman & Co.** A young German research chemist, **Rudolph Messel** (1847-1920) was made assistant to Squire at the new concern. Over the next three years Squire and Messel collaborated to develop the contact process for sulphuric acid.

Messel had experimented already, in Germany, with the use of platinum, as a contact catalyst, for the production of sulphuric acid by oxidation of sulphur dioxide. Squire and Messel now decided to develop this process industrially. The contact process had initially been devised by **Peregrine Phillips** of Bristol in 1831. Phillips' process involved reacting air with sulphur dioxide in the presence of finely divided platinum. Although this saved saltpetre and the cost of vitriol chambers it was unsuccessful because the technology necessary for its operation did not then exist and the problem of catalyst poisoning could not be overcome. The success of Squire and Messel's method in the 1870s depended upon the removal of all impurities from the platinum plates.

In 1875 this process was patented in Squire's name. With new improved methods of production the making of sulphuric acid was conducted on a progressively larger scale. Squire Chapman & Co. used the process to make oleum for which there was a growing demand for the synthesis of alizarin, unobtainable by the lead chamber process. In 1876 they set up a new plant at Silvertown with a capacity of several tons of oleum per week.

It was in 1878, when Messel took over from Squire as managing director, that the company became **Spencer Chapman & Messel Ltd.** Under the new directorship production rapidly expanded. During the First World War demand continued to increase drastically, and output was correspondingly stepped up. In 1887 12,249 tons of 90% acid had been produced. In 1889 this figure had risen to 16,682 tons and between 1916 and 1939 output ranged from around 40,000 to 62,000 tons per year. Before 1914 Spencer Chapman & Messel was one of only three companies in the country capable of producing the fuming acid known as oleum, and for many years it remained the only firm in the district with the ability to make it. Messel retired from the company in 1915. In 1923 platinum was replaced by vanadium pentoxide as catalyst.

In the late nineteenth century one of the main customers of Spencer Chapman & Messel Ltd. was the British Alizarine Co., whose dye and synthetic colour works was adjacent to the acid plant in Silvertown. The production of alizarin necessitated a cheap and plentiful supply of fuming acid. Other major customers included the Royal Gunpowder Factory at Waltham Abbey, most of the gas works of south-east England, oil refineries and the galvanising trade. Spencer Chapman & Messel Ltd. also manufactured copper sulphate in large quantities for export. This was used for vine dressing in the wine districts of Germany, France and Italy.

In 1905 Spencer Chapman & Messel Ltd. took over the London based company of William Pearce. In 1960 it was itself acquired jointly by Borax Holdings and its former neighbour in Stratford, F.W.Berk, then becoming known as Berk Spencer Acids Ltd.

In 1873 F.W. Berk purchased Thomas Bell's superphosphate works at Abbey Mills, West Ham, and this included a small sulphuric acid works. Over the next decade capacity was steadily increased. In 1885 a nitric acid plant was added and a few years later a hydrochloric acid plant. Oxalic acid, lead nitrate, potassium chloride and dichromate, Epsom salts and soda crystals were among other compounds Berk produced. By 1890 iron pyrites and Sicilian sulphur were being roasted in hand operated burners. The gases were then passed into lead chambers. To produce a purer (95%) acid, in the early twentieth century, chamber acid was concentrated in glass retorts set in beds of sand.

In 1937 F.W.Berk added a contact plant to their equipment. The Gas Light & Coke Co. at Beckton, who had been making sulphuric acid by the chamber process since 1879, installed a contact plant in the same year as Berk. In the first half of the twentieth century there was, nationwide, a gradual change over from the manufacture of chamber acid to the contact process. In 1924 less than 5% of the acid produced in this country came from contact plants. However, by 1939 this had risen to over 37% and during World War II had further increased to around 50%.

In 1940 F.W.Berk was badly damaged by German bombs. The manufacture of chamber acid had to be discontinued and business, for a while, was brought to a halt. Over the following decade the demand for oleum in the London area declined, but there was still some demand from local manufacturers who required a good quality water-white 96% acid, produced in contact plants. However, by 1980 F.W.Berk was the only manufacturer of sulphuric acid left in the district, making around 100,000 tons per year, overall production in the U.K. being then some four million tons. F.W.Berk has only recently closed down their plant in West Ham, which is currently in the process of demolition.

Petroleum

The River Thames has provided a natural haven for the beginnings of the petroleum industry in the British Isles. A good example of the early days has been provided by the booklet issued in 1984 to mark the 125 years of Carless, Capel and Leonard in oil refining.

Carless, Blagden & Company started a small business in Hackney Wick in 1859 which was known as the Hope Chemical Works. The firm became Carless, Capel & Leonard in 1872 and took such an active interest in the new fangled internal combustion engine that they actually invented the name 'Petrol' and began supplying petrol, lubricating oils and greases to the infant motor industry. In 1905 petrol was considered to be an expensive luxury and Carless delivered small quantities to their affluent clientele by horse and cart! Expansion saw the development of aviation fuel and many other commonly available oil based commodities and culminating in the refinery at Harwich.

Meanwhile, larger oil refining companies moved into the area and the refining and storage facilities at Canvey Island steadily grew to their present day capacity.

Specialist analytical companies were also developed to service the ever increasing demands of oil consumption.

The growing business of oil transportation generated a need for specialist consultant laboratories to oversee cargo quality. Caleb Brett International is a newcomer to Essex, taking over new premises close to the Dartford Bridge at Thurrock. Their founder, Mr Caleb Brett (1864-1955), travelled the world as an inspector of cargoes, and his son pioneered bulk carriage measurement methods for animal fats and marine oils. Expensive cargoes require accurate quality control and the Thurrock laboratory continues to apply accurate chemical methods to monitor a wide range of shipping cargoes. The company is now a part of Inchape Inspection & Testing Services which is an international company with 11,500 qualified personnel to cope with virtually any product transported by air, land or sea.

Gas Works

In the nineteenth century the production of gas was undertaken privately by companies who contracted with local bodies for the supply of gas. The gas works at Colchester were the first in the country. These were constructed in 1817 for private use, and from October 1819 were used also for public lighting. The earliest works for public supply were in Duck Lane, St. Martins. The gas was produced by carbonizing coal, and in 1838, faced with a constantly growing demand for the product, the plant moved to the Hythe where larger coal barges could come alongside.

Chelmsford gas works were established in 1819 and Romford was probably the next with the plant in South Street in 1825. Over the next fifteen years gas works were built at a number of different locations throughout Essex. (Eg. Halstead - 1835, Brentwood and Saffron Walden - 1836, Great Dunmow - 1837, Barking, Ilford, Malden and Manningtree - 1839). In the second half of the nineteenth century it became usual for the larger country houses to have their own gas works, situated at a suitable distance from the residence.

In the second half of the nineteenth century, when the coal gas industry was well established, town gas was made as follows: Bituminous coal was heated in fire clay vessels to the requisite temperatures, and then allowed to cool for between four to twelve hours. During this process the coal gave off gas and itself became coke. The gas ascended into the hydraulic main and then into the so-called 'foul main'. This lead to condensers where the gas cooled to the ambient temperature. During this process tar and ammonia were deposited by the gas, and these were drained into the tar well. A series of wetted surfaces were used to purify the gas, extracting from it ammonia liquor in progressively weaker solutions. This cleansing unit or scrubber, also removed quantities of carbonic acid and hydrogen sulphide. The next stage involved the purifiers, which were vessels four feet deep, containing wooden grids covered in lime or, in later years, slaked lime. These were used to extract the rest of the carbonic acid and sulphuretted hydrogen, and the gas was then passed on to the meter house to register the quantity, and finally to the gas holder where it was stored for use.

For every ton of coal burned in the manufacture of gas, approximately ten gallons of tar distillate and ten gallons of ammonia liquor are produced. These are important by-products for the manufacture of other chemicals. However, in the early days of gas making the only residual product which the companies realised they could sell was coke. This was one of the main raw materials needed by local foundries and so had a ready market. Coal tar, on the other hand, was considered by manufacturers to be a waste product and was consequently often regarded as a great nuisance and discarded. Before the potential of ammonia liquor to produce commercial fertilizers was recognised it was dumped on fields. However, by the 1870s gas companies began to cater to the needs of the growing chemical industry. Tar distillers established themselves close to large gas works, and chemical manufacturers made use of ammoniacal liquor to produce sulphates. In 1873 the Colchester Gas Light & Coke Co. built their own ammonium sulphate works, and within four years were producing seven hundredweight of salts per day. The Beckton Gas Works, too, set up a sulphuric acid plant and from 1879 ammonium sulphate was made and sold.

In 1870, in order to meeting growing demand in the metropolis, the gas works at Beckton was relocated on a site of approximately one hundred acres at Gallions Reach, then a rural setting. It was at this time the largest gas works in the world. The Beckton works were built with their own chemical plant from the beginning and tar and ammoniacal liquor were imported from other gas works to supplement their stock.

By the 1880s residual products were in constant demand to meet the needs of the large chemical industry which had grown up in the metropolitan part of the county, making it the main centre of the chemical manufacturing industry in Essex. The local chemical industries reliant on the by-products of gas works included manufacturers of alkalis, acids, drugs, paints, varnishes, soap, ink, fertilizers, plastics and artificial fibres.

Beckton continued to produce town gas until 1970. Colchester was the last town gas plant in production in Essex. It closed in 1971. Modern Gas Boards have used former works as holder stations.

Tar Distillers.

In 1872 the company of Burt, Boulton & Haywood purchased an extensive site of seventeen acres at Prince Regent's Wharf, Silvertown. This land, close to the river's edge, was till then a reed bed. The company had originally been founded in 1856 when H.P.Burt opened a tar distillery at Millwall, London, and as such, was one of the first to recognise the commercial value of the residual substance of gas making. The Silvertown plant for the distillation of gas tar was completed in 1876. The company, then, was the largest of its kind in the world. The next largest, La Compagnie Parisienne, was only two-thirds of the size of the Silvertown works.

All the gas tar made at most of the gas works of London was purchased by Burt, Boulton & Haywood and transported to Silvertown in their own tank barges. It was then transferred to stills by means of either pump or gravitation, and retained there until all the vapours were sufficiently condensed for it to be easily run out.

From the coal tar the firm manufactured some 120 different commercial products. Included amongst these were disinfectants, insecticides and pitch.

Pitch, a black resinous substance, is the residue of coal tar after the oils have been distilled off. It was used, amongst other things, for caulking the seams of ships. In the grounds of Burt, Boulton & Haywood was a large pitch lake holding some 100,000 tons of this substance.

Creosote oil was another important product made by the company and used by them to treat over a million railway sleepers per year, both for the home market and for export. Vast quantities of wood blocks and telegraph poles for government purposes were also creosoted at Burt's.

In 1876 Burt, Boulton Haywood bought Brooke, Simpson & Spiller, the dyestuffs factory at Greenford in Middlesex where Perkin's famous aniline dye had originally been developed and manufactured. The following year the dye works was transferred to Silvertown. The coal tar derivatives known as benzoles and naphtha essences of different qualities, were used at Burt's in the manufacture of aniline textile dyes. By this means they achieved what was described by an author on the industries of East London in 1876 as, "those brilliant tints, the discovery of which forms one of the greatest triumphs of modern chemistry".[12]

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[12] CRORY p31.

Dyes were also produced at Silvertown from another coal tar derivative called anthracene. This product, which occurs in the high boiling fractions of coal tar, was first discovered in 1832. As a result of what a contemporary commentator termed, "a beautiful chemical process",[13] anthracene was transformed into alizarin dye. This scarlet pigment was used for dyeing cotton and woollen goods and replaced the turkey red dyestuff formerly obtained from the root of the madder plant.

In the 1870s Germany became a major producer of alizarin, reaping a substantial profit. In 1881 the Alizarin Convention, a cartel to regulate the price of alizarin dyes and control sales quotas, was established. It was made up of nine German manufacturers and one British company, namely Burt, Boulton & Haywood. When Perkin's patent ran out in 1883 the Germans were able to force up the price of alizarin. In response to the threat of rising prices the major British consumers, the turkey red dyers mainly situated in Scotland, and calico printers, joined forces to buy a controlling interest in the alizarin section of the Silvertown works. This resulted in the formation, in 1882, of the British Alizarin Co. Ltd., manufacturers of dyes and colours for cotton and woollen dyeing and printing purposes. They were located at Victoria Docks in Silvertown, close to the premises of Burt & Co.

The new company flourished. Within seven years it had halved the price of alizarin and by 1914 supplied 80% of the alizarin consumed in the U.K. as well as nearly 20% of world demand for alizarin colours. However, with the outbreak of war in 1914, Britain was importing 250 tons of alizarin per month, as well as 100 tons of indigo and 1,200 tons of aniline dyes. Ironically the dyeing of British military uniforms was dependent primarily upon German dyestuffs, bought in the neutral Netherlands. In 1917, three years after the commencement of hostilities, there was a major explosion at the Brunner Mond TNT factory at Crescent Wharf, West Silvertown. The consequences for the neighbourhood were devastating. All buildings within 400 yards were completely demolished. Following this explosion the alizarin works were moved to Trafford Park in Manchester. In 1931 the British Alizarin Company merged with the British Dyestuffs Corporation thereby becoming part of I.C.I.

[13] ibid.

Fertilisers

A City Ordinance passed in the fourteenth century prohibited the slaughter of cattle nearer to London than Stratford. This law was to have far-reaching effects on the nature of trade in the locality. Many local industries, subsequently, were connected with the disposal of animal refuse. From the early nineteenth century artificial manure was one of the most important manufactures on the London side of Essex, which at that time was still a predominantly agricultural district.

An outstanding feature of the social history of the eighteenth century was the rapid increase in the population of the U.K. Under the impact of the Industrial Revolution, this growing population became concentrated in newly industrialised cities, creating an unprecedented increase in the demand for food production. To meet this demand it was necessary to apply knowledge of chemistry, plant nutrition and soil content to farming practice. The beneficial effects of nitrates on the soil had long been known. Several works were published on this subject in the seventeenth century. In the early nineteenth century interest in this study was heightened and considerable progress was made in the field of organic chemistry.

The English chemist Sir Humphrey Davy (1778-1829), after his appointment in 1802 as Professor of Chemistry at the Royal Institution in London, was largely concerned with agricultural chemistry. In a work entitled <u>Elements of Agricultural Chemistry</u> (1813), he stated the general principles upon which agricultural progress, over the next century, depended. Contemporaneous with Davy was the work of the German chemist, Liebig (1803-1873). He recognised that salts of ammonia acted advantageously on the soil when added to natural manures. Liebig emphasised the need to restore the soil's inorganic constituents. He also demonstrated that phosphates from bone or mineral sources were more effective when treated with sulphuric acid to make them soluble. The resulting product became known as superphosphate. Liebig's experiments were reported to the British Association of Chemists in 1840.

Three years later an English translation of Liebig's important work, <u>Chemistry in its Application to Agriculture and Physiology</u> (1843), was published. This proved to be a land mark in the development of agricultural chemistry. From the mid 1840s artificially prepared inorganic fertilisers were increasingly incorporated into farming practice.

1843 was also the year in which J.B.Lawes established a manure works at Deptford Creek in South London. Like Liebig, Lawes experimented with soluble phosphate formed by treating mineral phosphate or bones with sulphuric acid, and there is evidence to suggest that he embarked upon this process in 1839, the year before Liebig's report was made.[14] This process was patented by Lawes in 1842, and the following year the first superphosphate factory was established. Lawes' company made their own sulphuric acid and were among the first to do so. Later this became common practice amongst fertiliser manufacturers.

In 1857 Lawes' factory and acid plant were moved to Barking Creek. The choice of this location was possibly influenced by the Metropolis Building Act (1844), which sought to restrict the operation of noxious and offensive trades within the boundaries of London. The Barking site lay outside the jurisdiction of this Act and is still used for fertiliser production today.

In the second half of the nineteenth century farming steadily became more scientifically based. The potato blight of 1845-1846 stimulated interest in the new chemical fertilisers and demand for manures, other than farmyard manures, rapidly increased.

In the mid-nineteenth century James Odams of Holloway purchased land on the waterfront at Silvertown. This was used as a cattle market and slaughterhouse for imported cattle. Aware of the commercial opportunities created by the growing demand for fertilisers made from animal refuse, Odams developed his own method for treating blood, and in 1852 this was patented. In 1855, the year in which the Victoria docks opened, Odams set up a factory next door to the cattle market, to make the patent manure. The new business was known as the Patent Nitro-Phosphate & Blood Manure Co., and a chemist, named James Taylor, was employed.

At the new factory blood from the slaughterhouse was first strained and then heated in large wooden, lead-lined vessels, in quantities of 150 gallons at a time. To this was added 7 hundredweight of brown oil of vitriol and 8 hundredweight of animal charcoal, (coprolite) and mineral phosphates. It was then removed from the container and dried.

After 1850 there were several other vitriol makers and manure manufacturers in the Silvertown area. These included Thomas Farmer, Mark Finch and Henry Glover. Odams methods were adopted by others amongst whom was Frederick Hempleman of West Ham. From 1860 Hempleman prepared manures by using steam to boil blood which had first been mixed with water. The resulting coagulated substance was then strained from the liquid and dried. Hempleman, who remained in business until the early twentieth century, was one of the last to continue with this method.

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[14] Parks p217.

In 1869, as a result of the Contagious Diseases (Animals) Act, the import of cattle was restricted to Deptford. Odams subsequently sold the slaughterhouse to a German company controlled by Baron von Ohlendorff. The site, occupying some eight acres of land, made the Ohlendorff company one of the largest manufacturers of fertiliser in the country. Odams, however, continued to produce fertilisers at the Silvertown plant until 1920.

In 1873 Ohlendorff's new company, The Anglo Continental Guano Works Ltd., began to import guano (the excrement of sea birds) from Peru. Peruvian guano was first imported into this country in 1840, from which time it rapidly increased in popularity as a manure. In 1841, 1,733 tons were imported. By 1857, this figure had risen to 288,362 tons. (The import of bones for fertiliser during this period also drastically increased.) In 1880 the firm began to produce "dissolved guano" using their own sulphuric acid. The acid was produced in chambers 16 feet high, into which steam was introduced. Later water replaced steam and the chambers were extended in 1912 to 20 feet, and to 25 feet in 1925. Huge quantities of fertiliser of various kinds were exported, by the company, for use on sugar, coffee and tobacco plantations.

Ohlendorff's company was probably the first to undertake the large scale production of dissolved guano. However, the idea itself was not new. J.B.Lawes had carried out experiments with this product in 1865, and the process for making it was described in 1876 by Dr. Ballard, the Medical Officer of the Local Government Board in his report.[15] According to Ballard, acid was mixed into the guano in closed containers, using a mechanical stirrer. After about 15 minutes the mixture was removed and taken to a shed to cool. Dried fish heads were also mixed with sulphuric acid and left for about two weeks.

The Anglo Continental Guano Company were the first to introduce continuous mixing and feeding, which took place in 1932. The machinery, which made mixing more efficient, was designed at their Silvertown plant. As a result the maturing process of the guano was greatly reduced from about two months to less than a week.

Another old established fertiliser manufacturer was Clay & Son Ltd. Samuel Clay, a Colchester farmer, carried out various experiments with fertilisers, using blood and bones. Clay, who set up business in Stratford in 1875, obtained blood from the local slaughterhouses. This was then dried under cover, in shallow pits which were repeatedly raked over. Once dry it was placed on racks, still under cover, but in the open air. There it remained for a period of some six months, after which bone dust, animal charcoal and other ingredients, were mixed in.

[15] The Ballard report (1876) p217. see Parks W.A.(1950)p135.

In 1878 Clay was charged under the Public Health Act (1875) but, after a successful appeal, business was soon resumed. Two other blood manure manufacturers in the area, at this time, were also ordered to close.

J.T.Hunt established a bone meal works on the Thames at Lambeth in 1820, using locally collected bones. However, with the increasing stringency of local by-laws and Offensive Trades Regulations, in 1868 Hunt moved to a new site near Bow Bridge in Stratford. At Hunt's factory bones were boiled in large pans heated by perforated steam pipes. After a few hours the fat extracted was skimmed off and size, a gelatinous solution, was made. The remains were then put into a brick container, known as a "bone hole", where they were left to dry by spontaneous heating. At that time Stratford was still surrounded by agricultural land and it is said that Hunt's manures were so popular with local farmers they would queue, in their carts, outside the works for supplies.[16]

Hunt's also used boiled bones to make various other products such as soap and charcoal. To make charcoal the bones were burnt in horizontal iron retorts, (similar to the ovens used in making gas). Ammonia was removed from the vapours by scrubbing and after heating for several hours the charred bones were wheeled out onto iron trucks and crushed into a coarse powder. This powdered charcoal was used by local sugar refineries, such as Duncan's, established at Silvertown since around 1840.

Ammonium sulphate, a nitrogenous fertiliser, was a valuable by-product of the new gas works industry. In 1879 the Gas Light and Coke Company of Beckton, then the largest in the world, built a plant to treat with sulphuric acid, the ammonium liquor produced from the condensed vapours of coal distillation. This led to the production of ammonium sulphate on a large scale. In East Ham, ammonium sulphate was produced from bones by S.Carey from about 1865. Carey, like Hunt, also made animal charcoal, and was the only other firm in the area to do so at that time. Various soap manufacturers in the district, such as T.H.Harris and E.Cook, were also engaged in the fertiliser trade, making use of refuse from the tallow.

Some dispensing chemists, such as James Tomlinson of Chelmsford, established around 1840, acted as agricultural chemists, dealing largely in artificial manures, nitrate soda, salt etc. Since some chemists would deliver free of charge, up to a twenty mile radius, this was an important retail outlet for the product.

Whilst the fertiliser industry has received a bad press in recent years, the role it has played in increasing agricultural productivity, since the mid-nineteenth century cannot be disputed.

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[16] Parks & Rudge, Part II.

Agrochemicals

At the close of the 1930s the country was reaching the end of the agricultural depression and, with the threat of approaching war, the need was recognised for farming to be more productive. Farmers were actively encouraged by the government to increase their output. At that time there was very little pest control, and chemical weed control was in its infancy. In the 1930s sulphuric acid was used and a synthetic compound, known as Raphant, but both were corrosive and required special machinery. Very large quantities were necessary for spraying, making it a difficult and expensive business. Consequently it tended to be confined to a few high value crops such as fruit, hops and vines, as most farmers could not afford to purchase spray equipment for just one spray per season.

In 1938 **Sir Guy Marshall**, an eminent entomologist and head of what was then the Imperial Institute of Entomology, realised the opportunity existing in agriculture for spray contractors to provide a service for arable farmers. At the 1838 Entomological Congress in Berlin, Sir Guy discussed this project with another leading entomologist, Dr. Walter Ripper, who worked for the U.S. Department of Agriculture. Strongly influenced by the national drive for home food production, Marshall and Ripper decided to join forces and set up a new company offering a crop spraying service.

The following year a company called Pest Control Limited was founded by Dr. Ripper, to provide a service as consultant entomologists and spraying contractors. Cambridge was chosen as the location, not only for the facilities it offered as a University town, but because it was surrounded by some of the best arable farming land in the country.

To start with the business was run from Dr. Ripper's house in Harston. However, by 1940 a new site was acquired to rent. It was a disused petrol station with half an acre of land, near Hauxton Mill. The business grew steadily and before long Pest Control had purchased the garage and the four acre field in which it stood. This eventually became the headquarters of Schering Agrochemicals Ltd.

From the start the company applied the latest research results. Their first contract was for the application of nicotine vapour to remove aphids from field crops. Soon after they entered the potato fungicide market.

In the late 1930s a new weed killer DNOC (dinitro-o-cresol) was introduced in France. It was found to be effective, but was difficult to use. Pest Control recognised the potential of DNOC and began to purchase supplies. However, with the outbreak of war and the German invasion of France, by 1940 supplies could no longer be obtained. This was to profoundly effect the development of the company, as it led to the decision to embark upon the manufacture of their own chemicals. The first manufacturing plant was set up at Hauxton, in 1943.

During the Second World War the government was anxious that the country's essential sugar beet crop should not be damaged by blackfly. Pest Control Ltd., although only a small concern, was nevertheless the largest and most mobile spray contractor in the country, at that time. Consequently they were able to negotiate extensive dusting and gassing contracts throughout the South East of England.

Research at Pest Control began in 1942, but at that time was confined to one small room that had been a store room of the old petrol station. Research work amounted to little more than quick calculation of dosages of new chemicals, and tests were carried out on insects in about a dozen petri dishes. The company's main aim was to extend the season in which machines and spray crews could be in operation, by developing new spraying techniques.

In 1948 the company was joined by **Dr. Hartley** who took charge of chemical research, and particular attention was given to the safety of chemicals, both in manufacture and use. Around this time **Dr. Alan David**, a specialist in the health and safety of agricultural and industrial workers, was also appointed, and the first toxicological laboratory was set up.

In 1952 it became apparent that research and development needed to be centralized. Chemical synthesis and analytical control were carried out at Hauxton, whilst biological and field trial research, medical supervision and technical advice were, from 1947, based at Bourn, just outside Cambridge. Furthermore, laboratory facilities at this time were poor and inadequate.

To overcome these problems, in 1953 the company's R&D departments moved to Chesterford Park, near Saffron Walden in Essex. This estate, comprising a nineteenth century mansion, outbuildings and 250 acres of land, was purchased for £18,000. During the war the grounds had been used as a dump for wartime ammunition.

In 1954, faced with cash flow problems, Pest Control Ltd. decided to sell out to the fertilizer company, Fisons, and became Fisons Pest Control Ltd. After the Fisons take over, increased emphasis and resources were applied to innovative research. In 1956 the first purpose-built laboratories were constructed at Chesterford Park to accommodate the expanding chemistry section. In 1962, 600 new compounds were synthesised, compared with just 900 in the thirteen year period from 1946 to 1959. By 1972 the number of compounds being synthesised annually had risen to 1,000.

In 1967 a public health insecticide, known as Ficam (bendiocarb), was discovered at Chesterford Park. The following year a sugar beet weed killer, Nortron (ethofumesate) was also developed. Nortron began to be manufactured at Hauxton in 1973, but demand for this product was so great that in 1976 a new purpose-built plant was opened at Widnes. In 1977 the company received the Queen's Award for Technological Achievement for their production of Nortron.

In 1967 the various Fisons companies and their subsidiaries merged to form Fisons Agrochemical Division (FAD). By 1970 FAD employed some 1,900 people both at home and overseas. The contract service, for which the company had originally been established, however, had ceased to be profitable, and in 1972 was withdrawn.

The Royal Warrant of Appointment was granted to the company in 1979, for their regular supply of agrochemicals to the Sandringham Estates. The following year Boots and Fisons agreed to combine their international agrochemical interests, including FAD industrial chemicals. The new organisation was known as FBC Ltd. The merger established FBC as an international concern, with companies in all five continents.

The period 1977-1980 was one of major expansion at Chesterford. New facilities were established for Applied Biology and Technical Services Groups, and new stores buildings were constructed. With the creation of FBC in 1980, Chesterford became the base for all central R&D activity. Their main aim, at that time, was largely directed towards the development of Apollo (clofentezine) and Sportsak (prochloraz).

The acaricide, Apollo, was discovered at the Chesterford Park research station in the late 1970s. In February 1983 registration was granted for this product in Spain, and by March the first container load was en route. In July that year Boots and Fisons agreed to sell the whole of their shareholding in FBC Ltd. to the West German company Schering AG. In 1984 the company (still FBC Ltd.) again received the Queen's Award for Technological Achievement for the development of Sportak at Chesterford Park.

In 1985 a major expansion in research began at Chesterford Park. The capacity for new compound synthesis and screening was increased by 50% and 50 new jobs were created. The following year FBC became Schering Agrochemicals Ltd., and received the 1986 Royal Agricultural Society of England's Technological Award for the prochloraz based products, Sportak and Sportak Alpha. By 1989 the company, started fifty years before, from a house in Harston with two employees, had become part of a multi-million international concern with over 1,500 employees, and the once derelict mansion at Chesterford, an establishment of international standing and importance.

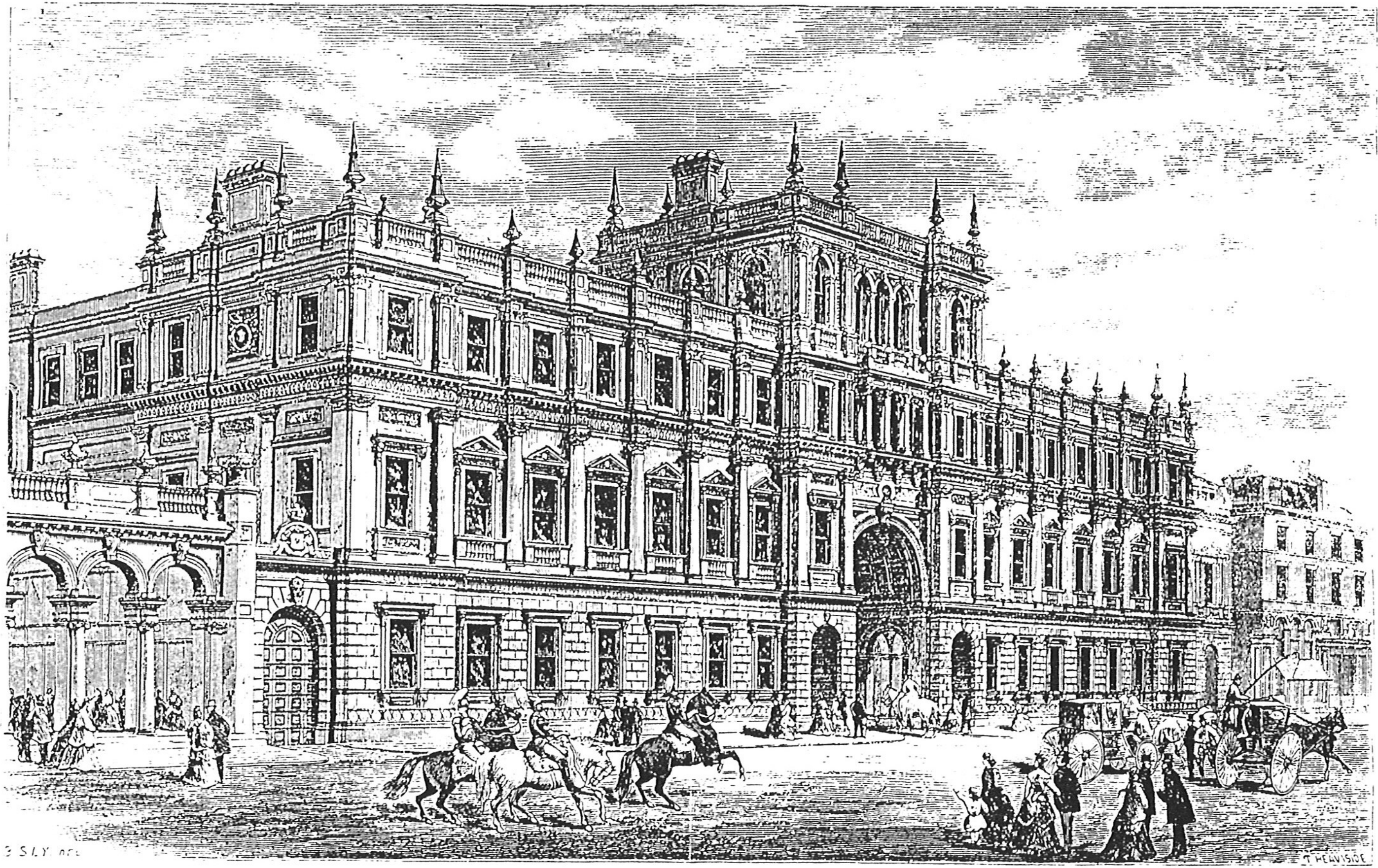
Pharmaceuticals

The story of the one of the oldest pharmaceutical companies began in 1715 when Silvanus Bevan (1691-1765), a Quaker of Welsh stock, opened an apothecary shop at 2, Plough Court, Lombard Street, in the City of London. This lofty, three storey building, constructed in 1668, was the birthplace of the eminent poet and satirist, Alexander Pope (1688-1744) some twenty seven years before Bevan's business began.

Historically, apothecaries were grocers, as were also some herbalists and sellers of drugs. In the early eighteenth century the old empirical drugs were all that was available, and these crude drugs, such as roots, barks, herbs and other vegetable and animal substances, were still wholesaled and retailed by grocers and some other traders, despite certain restrictions. By 1715, when Bevan began his business, much of this trade had passed to the druggists, but grocers, especially in the provinces where restrictions were fewer, often sold some drugs, and sometimes also dispensed medicines.

Around 1715 'chymists', who originally specialised in preparing mineral based medicines, were beginning to keep shops for the sale of drugs and chemicals. They also compounded medicines and made up physicians' prescriptions. Shortly after Bevan opened his business there were, in the district of Plough Court, nine other apothecaries, thirty nine druggists and two 'chymists'. However, despite such extensive competition, Bevan's business flourished. In the mid 1720s he was joined by his brother, Timothy Bevan (1704-1786) who soon began to develop foreign connections for the company.

An insight into the nature of pharmacy in the late seventeenth and early eighteenth centuries can be gleaned from the Pharmacopoeia Londinsis published in 1677. This is divided into six sections on the art of healing. Included in the lists of remedies are substances such as earthworms, woodlice, the cast off skins of snakes, and animal dung. Other named ingredients, even more outlandish to our twentieth century way of thinking, are for example, the fat of a man, moss grown on a human skull, and even, most fancifully, the horn of a unicorn! This Pharmacopoeia was the one used by the Bevans in the 1720s.



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12th May 1914.

Mr. A. R. Bolitho,

Primrose Hall.

Dear Sir,

In reply to your application of the 11th inst. we have much pleasure in sending you cheque value £2 as a contribution to the Childrens' Annual Outing Fund in connection with the West Silvertown Baptist Sunday School.

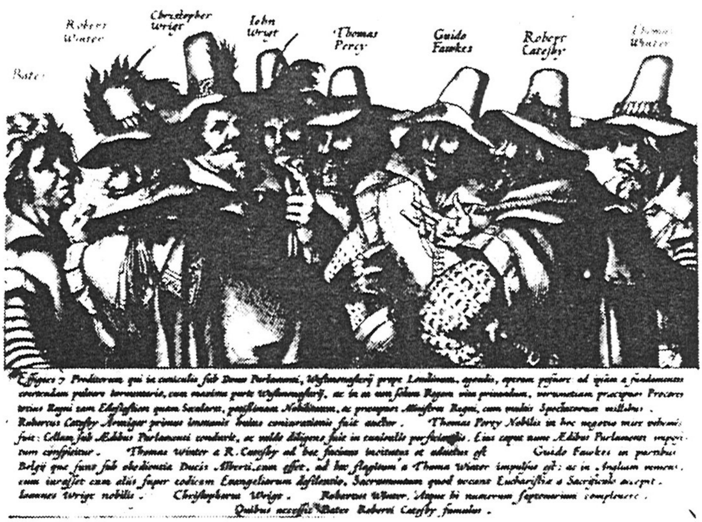
Please acknowledge receipt in due course.

Yours faithfully,

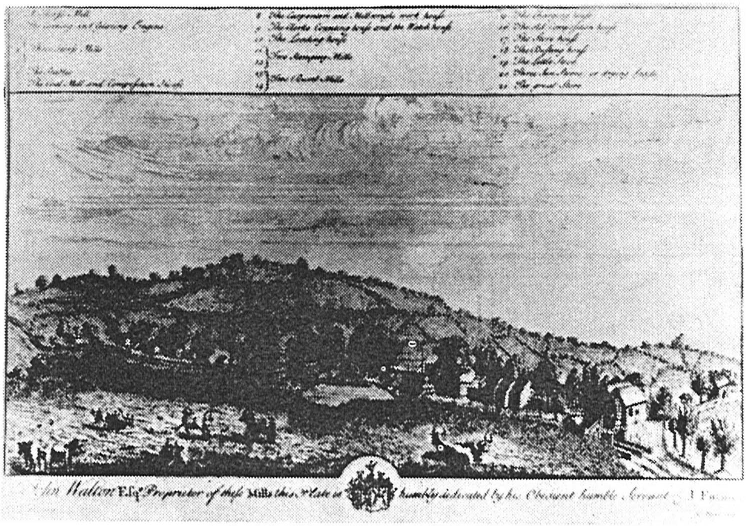
JOHN KNIGHT LIMITED.

Director.

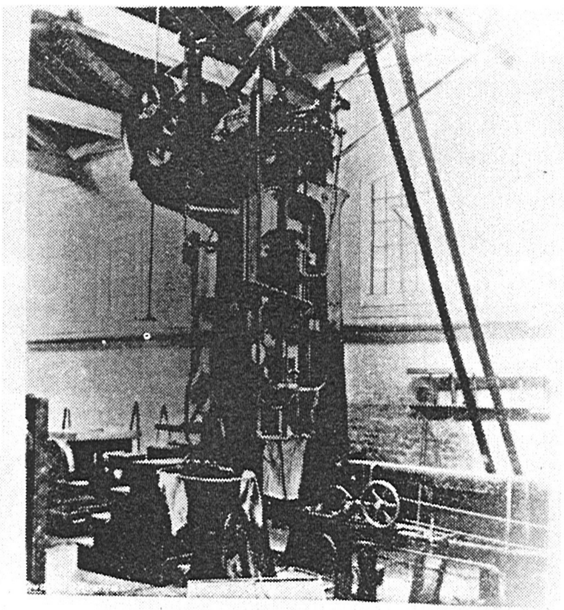
AN EARLY LETTER FROM JOHN KNIGHT LIMITED



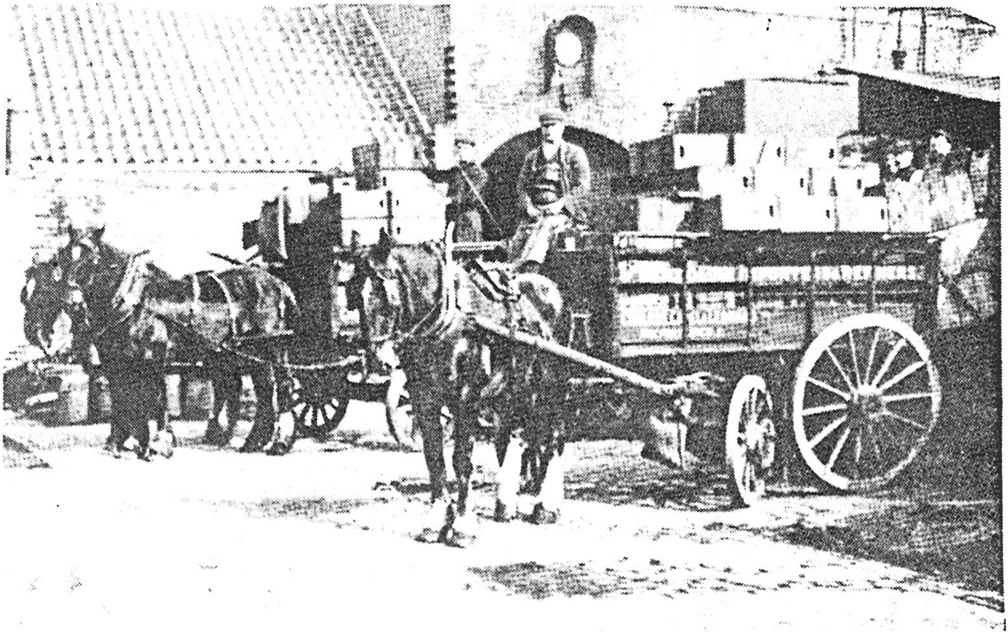
THE GUNPOWDER PLOT CONSPIRATORS (1605)



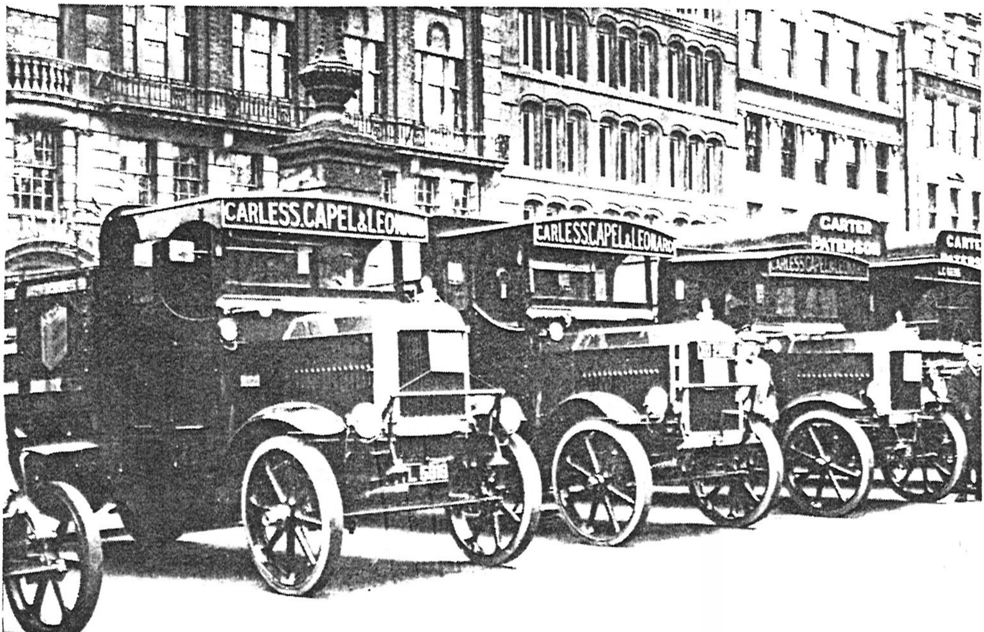
JOHN WALTON'S POWDER MILLS AT WALTHAM ABBEY IN 1735



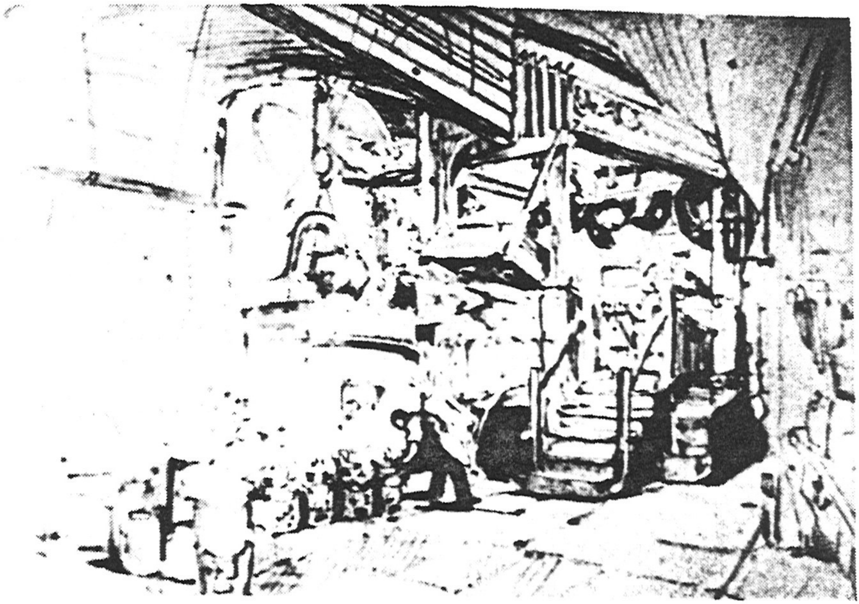
THE MASSIVE PRESS FOR CORDITE EXTRUSION AT WALTHAM ABBEY (1900)



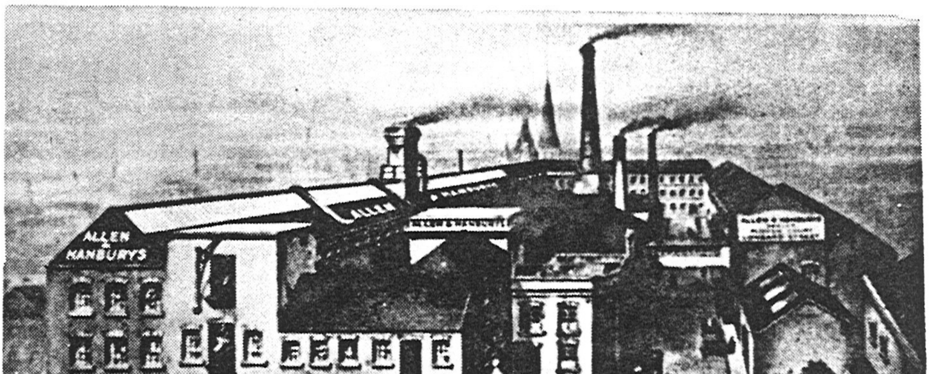
PETROL WAGONS circa 1920



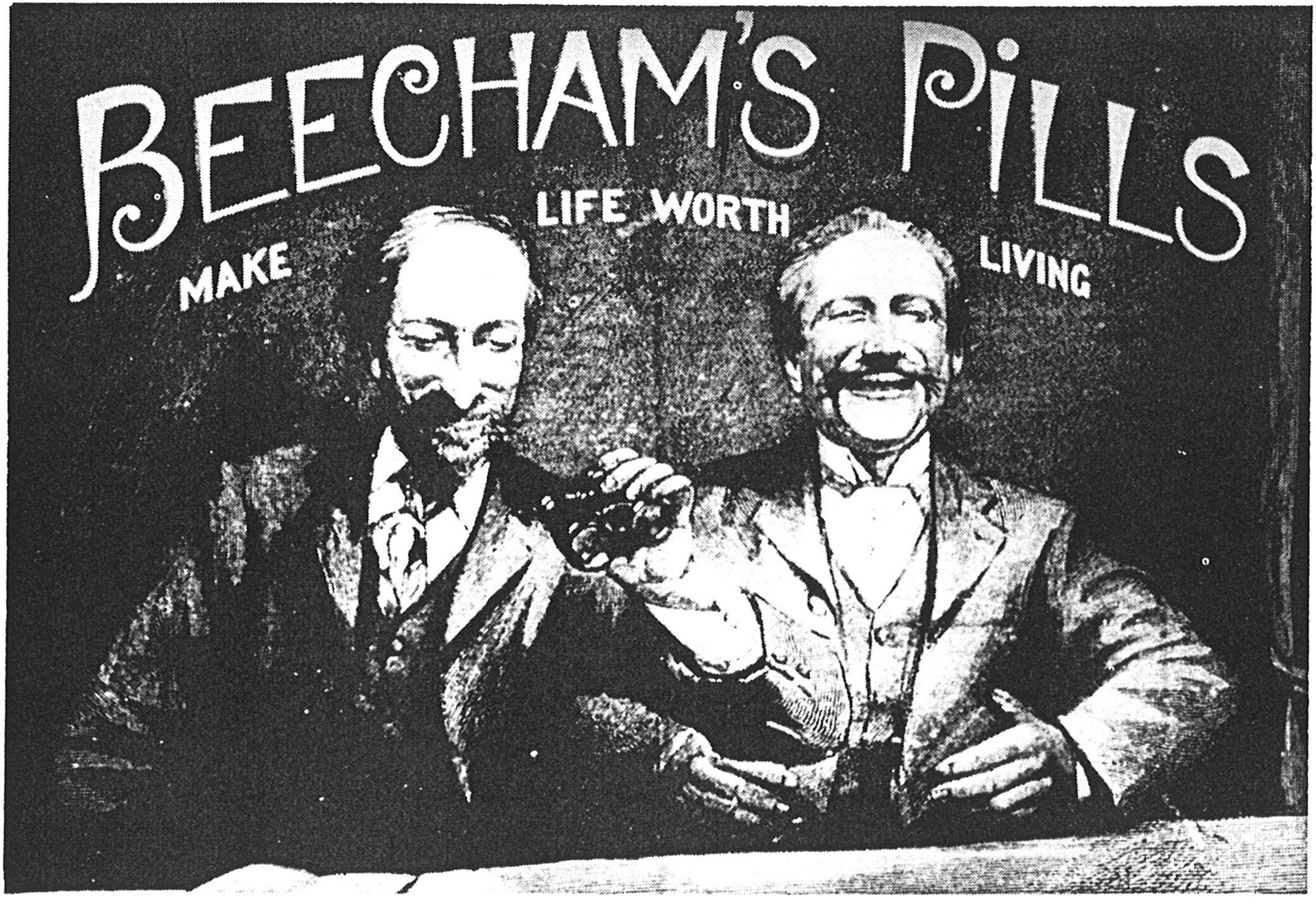
ROAD TRANSPORT IN 1905 FOR DELIVERING PETROL



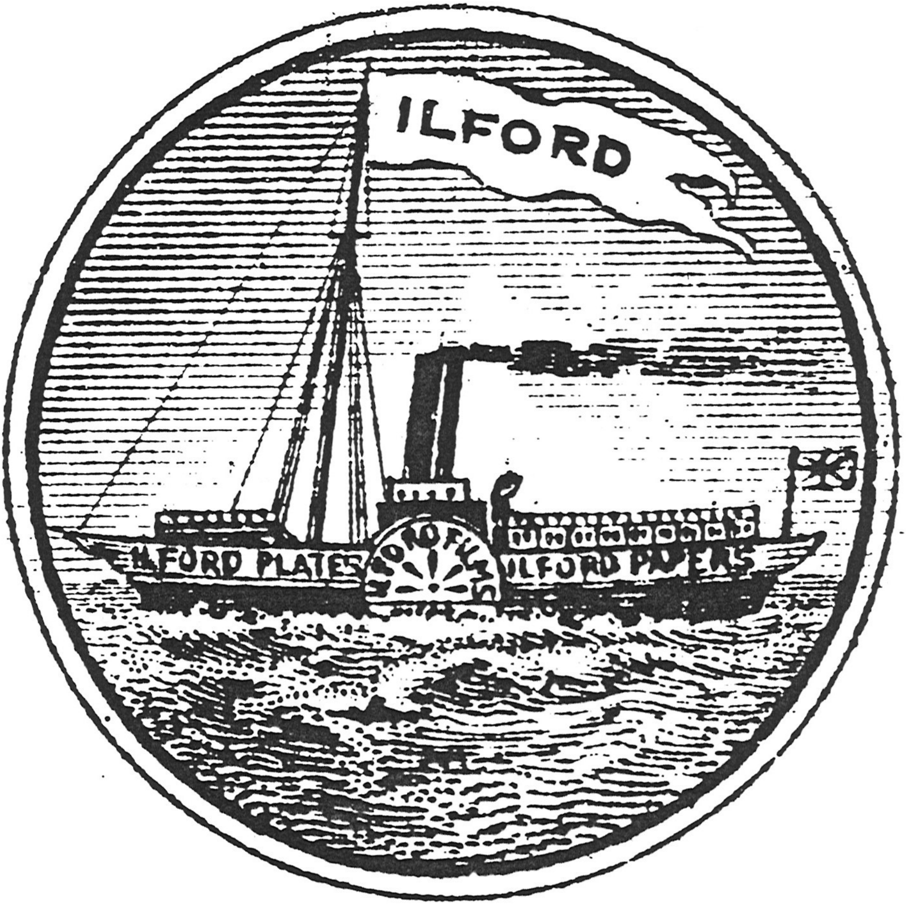
THE ANALYTICAL AND MANUFACTURING LABORATORIES
OF THE OLD PLOUGH COURT PHARMACY



BETHNAL GREEN FACTORY IN 1900

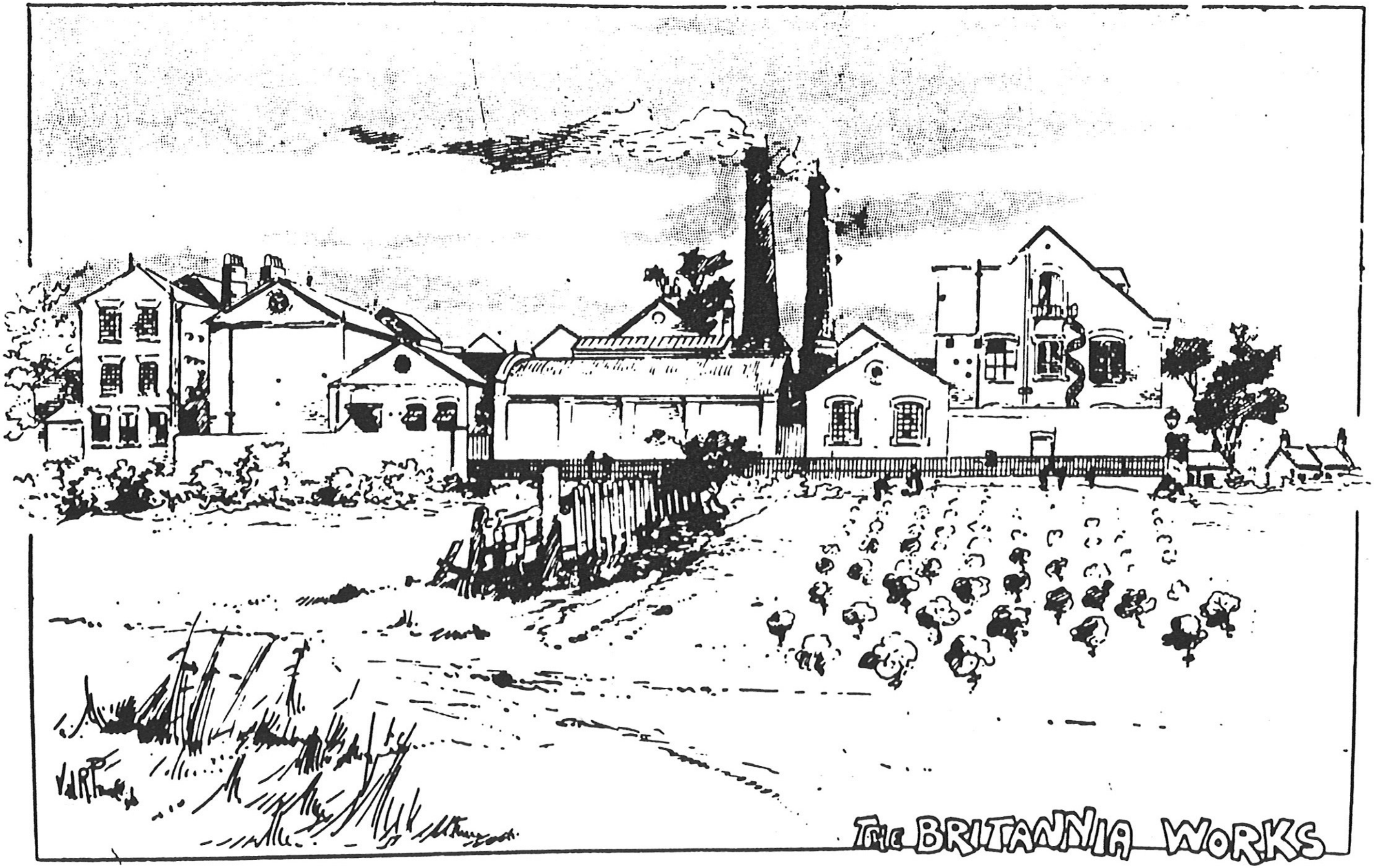


BEECHAMS PILLS



Reg.Trade Mark

THE SHIP TRADEMARK first used in 1886



ILFORD'S BRITANNIA WORKS FROM UPHALL ROAD IN 1895

In the mid 1720's, a wholesale list entitled, A Catalogue of Drugs and of Chemical Preparations and Galenical Medicines, Prepared and sold by Silvanus and Timothy Bevan in Plow Court, Lombard Street, London, was issued. However, this did not include any of the above mentioned remedies from the Pharmacopoeia. It seems Bevan, early on in his career, had established a laboratory for making many of the preparations used in the business. Comparatively few 'chemical medicines' were listed, and these were largely preparations made from roots, barks and leaves. Other substances in the Bevan list included arsenic, antimony and several of its salts, borax, calamine, magnesia, sal ammoniac, and sulphur. A number of the preparations made at the Old Plough Court by the Bevan brothers continued in use to the present day, although the methods for making them have changed.

The business continued to thrive and in 1725 Silvanus Bevan, aged thirty nine, achieved the highest possible professional status by becoming a Fellow of the Royal Society. In his later years, like many apothecaries, he practised as a physician. Bevan died in 1765.

In 1775 Joseph Gurney Bevan (1753-1814), took over control of the Plough Court business from his father Timothy. In 1792, two years before retiring at the early age of forty, J.G. Bevan took on William Allen as a clerk. Allen was to be connected with the Plough Court Pharmacy for over fifty years, and during this time the scope of the firm was expanded considerably. In 1794, when Bevan retired he was succeeded by Samuel Mildred & Son. From July 1794 to January 1795 Mildred carried on the business in his own name. In 1795 a factory for making heavy chemicals was set up in Plaistow, then still a rural village. This was the first manufactory of chemicals in Essex. Demand was growing apace at this time for pure chemicals and iron works, mills, coal mines, gas works etc. were beginning to establish their own chemical laboratories.

In January 1795 Allen was made Mildred's partner. The partnership was dissolved two years later when Mildred retired. Allen then took his friend the Quaker Luke Howard (1772-1864), into partnership, and the business became known as Allen & Howard. This partnership lasted for nine years.

In 1797 Allen and Howard embarked upon the production of certain chemicals on a manufacturing scale. Until then these chemicals had been compounded by dispensing chemists for their own use. To this end Howard, one of the leading experimental and manufacturing chemists of his day, took charge of the factory at Plaistow, then rapidly developing under the control of Joseph Jewell (1763-1843). Jewell had originally been a laboratory assistant at the Old Plough Court Pharmacy. As early as 1798 Howard was making ether which was distilled over red hot charcoal. Allen remained at the Lombard Street address where he took charge of the laboratory and retail business, concentrating on galenicals and certain chemicals not usually required in quantity, but whose manufacture necessitated much expertise.

Both the pharmaceutical and the manufacturing aspects of the business were expanding at such a rate, that in 1806 it was decided to dissolve the partnership. This meant that the two distinct sides of the business could now be run separately. Howard, who took over the manufacturing side, soon became famous for camphor refining and the manufacture of borax, calomel and Epsom salts, amongst other things, producing many tons per week. In 1823 Howard was amongst the first to make sulphate of quinine, at that time the only anti-malarial drug. Howard & Sons Ltd. continued on the river Lea at Stratford for nearly one hundred years.

Allen, whose interests in the experimental sciences of chemistry and physics were wide ranging, was associated with many of the most famous scientists of his time. From 1806 to 1816 he carried on the business at Plough Court in his own name.

In 1804 John Barry (1789-1864), at the age of fifteen, was taken on at Plough Court by Allen and Howard. Within five years he had become William Allen's confidential secretary, and in 1818, was made a partner. Allen's nephew, Daniel Bell Hanbury (1794-1882) started work at Plough Court in 1808. In 1824 he, and his brother Cornelius Hanbury (1796-1869), were also taken into partnership and the company became known as Allen, Hanbury & Barry. In 1856 Barry retired.

In 1841 William Allen and Daniel Bell Hanbury, who had proved himself to be a gifted pharmacologist, were founder members of the Pharmaceutical Society and Allen was its first president. The aim of the Society was to protect the interests and the increasing respectability of chemists and druggists and by 1842, it had nearly 2000 members.

Between 1874 and 1907 the business, now known as Allen & Hanbury, transferred to an old converted match factory at Bethnal Green, to accommodate the growing manufacturing and wholesale work of the company. Bethnal Green was then a semi-rural district. Among the many manufactures undertaken at the new premises was the making of refined cod liver oil. This was widely used in the treatment of ailments such as gout, rheumatism, scrofula, rickets, bone disease and phthisis.

Allen and Hanbury also led the field in the production of malt extract as well as medicated lozenges or pastilles, known as 'jujubes'. These lozenges date from 1850 when small batches of various kinds were first made at Plough Court. They consisted of gum, sugar and water, with the medicaments and flavourings added. The name 'pastille' first came into use when Cornelius Hanbury II (1827-1916), patented a method for coating the lozenges to preserve their shape and enhance their shelf-life.

In 1876 Frederick Hanbury (1851-1938), introduced machinery from the United States into the factory, for making compressed tablets. Allen & Hanbury were, themselves, among the pioneers in the designing of tablet machines and were the first to make a continuous rotary machine capable of compressing 1,000 tablets per minute. They also pioneered the preparation of the newer drugs in the form of tablets. Later, they came to be well known also for, amongst many other things, their improved food for babies, known as Allenbury's Milk Foods.

Allen & Hanbury have contributed to the advancement of modern surgery by developing muscle relaxants in their laboratories at the Bethnal Green factory. These are used in surgery, along with anaesthetics and sedatives. In 1942, two Canadian scientists, H.Griffith and G.Johnson introduced curare, an extract of the South American arrow poison, to obtain a relaxant. Curare was subsequently replaced by the pure alkaloid, tubocurarine, first isolated in 1953, from a specimen of the poison. Since then several synthetic relaxants, which act much more speedily, have been introduced. The research laboratories at Allen & Hanbury have played an important role in this development, amongst others too numerous to mention.

By 1900, the Bethnal Green Factory was working at full capacity and a new site was found by the old water mills further up the River Lea at Ware in Hertfordshire. Severe bomb damage at Bethnal Green on Whit Sunday in 1918 accelerated the move and by the end of the Second World War, both research and production were mainly situated on the Ware site. In recent years and in common with many other chemical and pharmaceutical companies, Allen & Hanburys were taken over by the Glaxo group and the location at Ware is all that remains of the original company.

However, pharmaceuticals continue to prosper in Essex in the hands of three large and many smaller companies.

The Medicinal Research Centre of SmithKlyne Beecham at Harlow grew out of the invention of Beecham's Pills which were originally manufactured at Brockham Park, Surrey in 1945. This led to many further innovations and the purchase of the site in Harlow New Town in 1968. Beechams merged with Smith Klyne & Beckmann in 1989 and the Centre continues to be the main laboratory of the company in the United Kingdom. Development of antiinflammatory and antidepressant drugs continue to be a major concern of SKB in Harlow.

Merck Sharpe & Dohme have built the latest research centre in the region at Terlings Park in Harlow. The company have had a manufacturing plant nearby at Hoddesdon for many years and was started in the UK in 1928 when the American founders, Sharpe & Dohme, merged with the English vaccine company, H.K.Mulford. They were responsible for the development of several antibiotics which included the commercial production of penicillin which was so vital during the Second World War. A merger with Merck took place in 1953 and the Neuroscience Research Laboratory at Harlow was opened in 1984. Investigations into the functioning of the central nervous system currently involves a staff of about 200 and will lead to new drug preparations to combat nervous disorders.

Fine Chemicals

Whilst fine chemicals, as we understand the term today, were not in existence at the beginning of the nineteenth century, there was, nonetheless, a great variety of vegetable drugs, processed (as we have already seen in connection with Allen & Hanbury) from leaves, roots, barks as well as from flowers and the whole herb. Some, though perhaps not all, of these had a high degree of pharmaceutical value. Certain drugs, such as belladonna, cascara, opium, digitalis, etc., have continued to be used throughout the centuries and still remain a part of modern materia medica. However, from the early nineteenth century, use was increasingly being made of pure or relatively pure, chemical substances, and there was a surprising diversity of these available for medicinal purposes. As well as the organic chemicals found in nature these chemicals were obtained by the subjection of natural substances to chemical experiment. One of the most important manufacturers of fine chemicals, and the first to be established in Essex, was the company founded by Luke Howard after the Allen & Howard partnership was dissolved in 1806.

Luke Howard (1772-1864) was born in Clerkenwell, London. His family were Quakers, and his father worked locally as a tinsmith. In 1788 Luke was apprenticed to Ollive Sims, a chemist and druggist in Stockport, Cheshire. He was then, for a brief spell, involved in wholesale and retail druggist businesses in London. Like William Allen, whose partner he was for nine years, he developed scientific interests and attended public lectures by the famous chemist and physician, Bryan Higgins (1737-1820), in London in the 1790s.

Besides being one of the most active experimental and manufacturing chemists of his day, he was also one of the founders of the science of meteorology. In 1803 he wrote <u>On the Modification of Clouds</u>, in which he introduced the now well known names of the clouds, cirrus, cumulus and stratus. This work attracted the notice of the famous German poet, Goethe (1749-1832), who wrote a poem on the subject and corresponded with Howard.

In 1818, Howard published a two volume work on <u>The Climate of London</u>. He also wrote a treatise entitled <u>Seven Lectures on Meteorology</u>. To aid him in preparing his data, he made a clock fitted with a recording barometer, the first of its kind. In 1821 he was made a Fellow of the Royal Society.

In 1806, when the partnership between the pharmaceutical chemists Allen & Howard was dissolved, Luke Howard took over the manufacturing side of the business, which became known as Luke Howard & Co. Six years later the firm became Howard, Jewell & Gibson, when Howard took into partnership his foreman Joseph Jewell and another chemist, John Gibson. Joseph Jewell, a self-taught chemist, had started work at Old Plough Court as a porter in 1791. However, Allen and Howard soon recognised that Jewell possessed a rare talent for observation and chemical investigation and so he quickly gained promotion. In 1824 the partnership was joined by Luke's son Robert Howard (1801-1871). Luke Howard and Jewell retired in 1831, and Gibson's son and Luke Howard's younger son John Eliot Howard (1807-1883) became part of the reconstituted partnership. The firm was then known as Howard, Gibson & Co.

In 1848 the firm became known as Howard & Kent, before acquiring, in 1856, its most famous title, Howard & Sons. When Robert Howard died in 1871, his son David Howard (1839-1916) became a senior partner. Later he was to become a founder member and president of both the Institute of Chemistry and the Society of Chemical Industry. Howards became a limited company in 1903.

When Luke Howard first set up on his own, the factory was moved from Plaistow to a new, six acre site at City Mills on the river Lea at Stratford. Here heavier chemicals were made, such as nitric and sulphuric acids and ammonium and mercury salts. The firm also soon became famous for processing certain specialities among which were calomel, borax, camphor and soda bicarbonate. It was the first time some of these had ever been manufactured in England. By 1823, two other chemical works were in existence in Stratford, namely H.S.Crane, and Macmurdo & Pitchford, the latter being distillers of turpentine as well as general manufacturing chemists.

During the nineteenth century the Howard company was renowned for its ether, ethyl acetate and cocaine. By the mid-nineteenth century, Howards were receiving orders from chemists for quantities of rectified ether, required for anaesthetic purposes. The earliest of these is dated January 1847. Anaesthetic ether was first used by the surgeon Robert Liston at University College Hospital in December 1846. Joseph Lister (1827-1912), then nineteen years of age, was present at this operation. Lister, an Essex man, later became one of the greatest surgeons of his time, as well as gaining international fame as the inventor of antiseptics.

About 1827, Howard began on a very small scale to manufacture sulphate of quinine, which was then rapidly gaining importance in medicine. Quinine was the company's most profitable product for much of the nineteenth century.

Quinine is the chief alkaloid contained in cinchona bark which, in the nineteenth century, was widely grown in Java, Malaya, the Dutch East Indes, Ceylon, Jamaica and elsewhere. Luke Howard was the first to bring this bark to England from the east and to set up the regular isolation of quinine on a commercial basis. J.E. Howard did considerable work on the cinchona alkaloids and was responsible, not for the discovery of quinine, but for its wide availability. Howards made a number of quinine derivatives with medical application, this being an important aspect of the business in the first half of the twentieth century.

In 1888 Howards bought the chemical manufacturing business of Hopkin & Williams, established in Wandsworth in 1850, making laboratory and photographic chemicals. In 1898, Howards again short of space, purchased some twenty acres of land on the bank of the river Roding at Uphall in Ilford. Between 1898 and 1923 the operations of Hopkin & Williams, and Howards own manufactures were gradually transferred to these new premises, which were close to the Great Eastern and London, Tilbury and Southend railways.

In 1905 Howards obtained an interest in Robert Bowman's company in Warrington, Lancashire, established that year, chiefly to provide chemicals for the brewing trade.

In 1914 another new company Thorium Ltd., was set up jointly by Hopkins & Williams, the Volker Lighting Co. and Howards & Sons Ltd., next door to the new premises of Ilford Ltd. This company not only isolated thorium, a very rare, mildly radio-active element, but also rare earth elements. These were extracted from a rock known as monazite sand, found in Travancore in India and brought to Barking. Extracts from the rock were purified and very valuable derivatives obtained, such as gadolinium, (used in medical X-rays) and cerium, (used in lighter flints). It was also used to produce phosphor, a synthetic fluorescent or phosphescent substance used, among other things, for television screens in later years. Thorium nitrate was used by the company in the manufacture of gas mantles. Thorium Ltd. were world leaders and probably the only company of their kind in this country at that time.

In 1916 Howards began making aspirin and, like Allen & Hanbury, were one of the first companies to use a tableting machine. Until these machines were introduced the administration of drugs was very imprecise and consequently hazardous. In the home there was no means of accurately measuring correct dosages of powders and potions. The arrival of the tableting machine overcame this problem by assuring that the active constituent of the medicine was present in precisely determined amounts.

Following post-war financial difficulties it was clear that the company was no longer able to sustain a lead in the increasingly competitive pharmaceutical business. Consequently it was decided that the firm should move into the large scale production of solvents and organic intermediates, and from then on many of their new products were organic chemicals. By World War II a wide variety of solvents and plasticisers constituted a very important part of the business. By the 1930s it was making cyclohexanol by the nickel-catalysed hydrogenation of phenol, and it became the first firm in the U.K. to make the important wetting agent, lauryl alcohol. In the mid 1940s many of Howards products were marketed by other companies. At this time some 500 people were employed by the firm.

From 1953 **Howard & Sons Ltd.** became the holding company and manufacturing operations were carried on by Howards of Ilford Ltd. In 1961 the business was acquired by Laporte Industries Ltd. They isolated lactic acid making this into other products by the fermentation process. These derivatives of lactic acid included ethyl lactate, a treatment for calcium deficiency and ethyl acrylate used for aircraft windows.

May and Baker has a long history dating back to 1834 when John May, (1809-1893) established himself as a manufacturing chemist in Battersea. May was born in Harwich, the son of a ship's captain. On leaving school he served an apprenticeship with a chemist and druggist in Ipswich. In 1830 he left for London, where he gained experience working for a manufacturing chemist in Battersea, and in 1834 decided to set up business on his own.

William Garrad Baker (1815-1902) was made a partner in May's business in 1839. Baker was the son of a Chelmsford chemist and druggist and, on leaving school, he served an apprenticeship with his father.

In the early days of May & Baker's history the company's main factory was at Garden Wharf in Battersea, with smaller premises at Bell Lane, Wandsworth. From its inception, in 1834, May & Baker chiefly produced inorganic chemicals such as mercurials and bismuth salts, which had both long been known to have medicinal value. Mercury, for instance, in its various forms, had been used in the treatment of venereal diseases as early as the fifteenth century. Later it came into common use for all kinds of skin complaints. May & Baker made mercurial ointments, pills and other preparations. In the later decades of the nineteenth century the company also established a reputation for the high quality of their camphor. Camphor, in its crude state, came from camphor and laurel trees mostly from the East Indies, China and Japan. Originally it had been used in Arabian medicine. In the nineteenth century it was used in a variety of liniments, potions and tinctures as a mild stimulant and as a pain reliever. At this time May & Baker were also noted for their calomel, ammonia preparations, ether and chloroform.

In 1851, at the Great Exhibition sponsored by Prince Albert, May & Baker, along with others in the chemical industry, exhibited a number of their chemical pharmaceutical products. These included nitric acid, bismuth and silver nitrate, potassium and zinc acetate, camphor, and calomel. Howard & Kent of Stratford exhibited iodine and Howards baking soda was noted for its quality. May & Baker were awarded the Prize Medal for their acids. They also received awards at the Paris Exhibition of 1855.

In the late 1870s May & Baker sold large quantities of hydrochloric and nitric acid, which were guaranteed analytically pure. In 1878, their wholesale price list included eleven antimony compounds favoured by the medical profession, as well as eighteen varieties of fruit and alcoholic essences. These were for jam making and food processing factories and for other pharmacists. They also produced fourteen grades of ether, which had been used as an anaesthetic since the 1840s.

Ether, which is highly flammable, was the cause of a serious fire at the plant in 1882, in which several of the workers were injured. More common, however, were outbreaks of fire during the manufacture of camphor, another extremely combustible substance. In 1878 the large camphor refinery was extensively damaged. The constant risk of fire at the factory was noted by a journalist for the Chemist and Druggist in 1889. In giving his description of a tour of the works he remarked; "I choked in the camphor-making sheds, which when they periodically catch fire have simply to be left to burn down and a rare blaze they make"[17].

It was not just from fire that workers were at risk at the factory during this period. That working conditions were unpleasant and uncomfortable, even dangerous, is clear from this same journalist's account of how at May & Baker, he passed into "a land of huge retorts and seething furnaces." He went on to say, "I shuddered as noxious compounds like corrosive sublimate and nitric acid and other diableries, to which vitriol is as mother's milk, were dealt with around me by the hogshead and the hundredweight"[18]. One of the workmen he noticed had burnt his hand "with some devil's broth he was stirring." He was treated with 'Phenacetin', a coal tar analgesic produced by May & Baker with which the workers, who not infrequently had cause to resort to it, were much impressed.

In 1903 May & Baker decided to move into the manufacture of salts of lithium, prepared from the extraction of the metal lithium from various minerals. These salts were used medicinally for various purposes such as the treatment of gout, as diuretics and antiseptics, amongst other things. However, a source for lithium was not found until 1904 when, with the co-operation of the French firm, Poulenc Freres, May & Baker acquired exclusive concessions for supplies from a Spanish mine.

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[17] The Chemist and Druggist 4/5/1889, see Slinn p46

[18] ibid.

Around the turn of the century May & Baker employed about one hundred workers. In the years leading up to World War One the company grew, but there was little in the way of research and development or technical innovation. Raw materials, such as chloride of lime, were shovelled into buckets and passed through a window into the factory. Finished products were removed from the factory in horse drawn vans. The horses were stabled behind the warehouse.

With the outbreak of war in 1914, German supplies of organic chemicals, primarily dyestuffs and synthetic drugs, were cut off. The exigencies of war meant that the British chemical industry, generally, had to diversify. May & Baker, as a result, began the manufacture of new products during the war years, and these were to play an important part in shaping the company's future.

During the war May & Baker were asked by the Government to make acriflavine, for dressing wounds, and organic arsenicals such as neoarsphenamine, for treating syphilis. They needed assistance with the manufacture of the latter and for this they turned to Poulenc, in France. This led, ultimately, to May & Baker becoming part of the French group, Rhone Poulenc SA, and more recently, R-P Rorer.

In 1917 Dr. A.J. Ewins joined the company to develop the arsenical drugs and he later became the first director of research. At this time also, interest was aroused in the new concept of chemotherapy which was then directed to protozoal disease. May & Baker entered into chemotherapy via the production of Salvarsan preparations which had previously come from Germany. In 1914 they also started making the anti-malarial drug, quinine, which was much in demand during the war. The war meant shortage of labour and at May & Baker, as in many other industries, women worked for the first time on the production line.

By the 1930s May & Baker needed more space. Dagenham, at this time, held considerable advantages for industrial development. It offered good transport facilities, a plentiful labour force of cheap female labour, plus a good water supply. In 1933 a sixty four acre site was purchased and building commenced. By May 1934 the cocaine and ephedrine plants were almost ready and by early June the methyl bromide plant was complete. During World War Two every R.A.F. plane carried fire extinguishers filled with methyl bromide made by May & Baker.

Over the next decade most of the company's business focused on mercurials, bromides, iodides, bismuth, quinine and cocaine. However, in 1934, because of the difficulty in getting certain raw materials, especially iodine, the directors decided to expand manufacture into some new fields such as photographic chemicals, arsenates and certain synthetics for perfumery. These extensions would not have been possible at the Battersea or Wandsworth premises.

In 1936 May & Baker began work on sulphonamides. These are sulpha drugs, a group of chemicals which are bacterio-static. This means they prevent germs from multiplying and also have a stimulating effect on the blood's white cells which then engulf more bacteria than they would normally. In November 1937 synthetic sulphapyridine, known as 'M&B 693' was developed at May & Baker, and soon gained the reputation of being a new wonder drug. It was of major importance as a cure for the previously lethal disease of bacterial pneumonia, and was much in demand during World War Two, when it was used to avoid gangrene. In 1942, despite the war, the U.K. death rate was the lowest ever recorded. In 1943 'M&B 693' saved the life of Winston Churchill.

The great success of the drug, posed the problem of large scale production. In the early days, the plant could produce one ton per month. Soon twelve tons was not enough! 'M&B 693' was manufactured until 1984 when, because it was slightly toxic, it was succeeded by 'M&B 760' sulphathiazole. For many years, however, it remained the product for which May & Baker were best known.

Photographic Industry

The first photographic processes, the daguerreotype and the calotype were both pioneered in 1839. In France, L.J.M.Daguerre (1789-1851) collaborated with J.N.Niepce from 1829 until the latter's death in 1833, when he continued alone to elaborate the process which bears his name. Daguerre's experiments were communicated to the French Academy of Sciences in 1839, eleven days after the publication of the calotype method developed in 1840 by the British photographic inventor, William Henry Fox Talbot (1800-1877). These contemporary experiments laid the foundation of modern photography.

In 1851, Scott Archer introduced the wet plate with collodion sensitised by silver iodide. From Archer's collodion process research on emulsions and gelatine reduced the exposure time from 10 seconds to 1/100th of a second by 1900. However, until 1871 when Maddox and others started making photographic emulsions, photographers had to prepare their own sensitive material just prior to use. With the new emulsions, coated sensitised plates could be made and kept dry. For this reason the method was known as the dry plate process. It greatly simplified the use of photography with the result that it became much more popular and widespread. The new process also opened the way to the commercial manufacture of sensitised photographic materials.

Among the pioneers of this new method, in the 1870s, was Alfred Hugh Harman (1841-1913), a photographer with studios at Peckham and Surbiton. In 1879 he moved to a house in Cranbrook Road, Ilford, where he started to manufacture photographic dry plates by hand, at popular prices.

Harman's plates were marketed by a well-known London dealer, Marion & Co. who registered them as Britannia Dry Plates. Harman himself delivered the plates, by dog cart, to their Soho address. Harman's business was a great success and he soon required more space. In 1882 he took over premises on the Clyde Estate, on the south side of Ilford High Road. The following year his first purpose-built factory was erected, off Roden Street, Ilford. There glass was prepared for coating. The business became known as The Britannia Works Co. Ltd. A research chemist was employed at the new plant and also a business manager who started the publication of the Ilford Manual.

Plates and photographic papers were also made at the Ilford factory, and until 1886, were sold under the trade name of Britannia. However, in 1886 following a disagreement with Marion's over the registered name, Britannia became known as Ilford's and the "Little Ship" trade mark was adopted. Technical advances were being made by Harman at this time, and in 1891 a gelatine printing paper, known as Ilford Gelatine Chloride P.O.P., was introduced. It was the first of its kind in the country. The following year the company made the first dye sensitive plates, the Isochromatic Plate. In 1895 a rollable film began to be manufactured and by 1902 this was being produced on a large scale.

In 1891 Ilford's became a private limited company. It was then the largest company of its kind in the world. In 1894 Harman retired and was succeeded by E.B. Knobel as managing director. Knobel had been the chief dye chemist at Courtaulds and before that had worked as an analytical chemist at Bass & Co. In 1895 Ilford's acquired Austin Edward's plate making business in Tottenham, and the works at Ilford were again enlarged and improved. The factory then employed over seventy workers. Some thirty clerks were also engaged by the company, for whom new office buildings were erected in Roden Street. Amongst improvements at the factory was a patent air-cooling system, whilst the offices were lit by electricity and heated by steam. These, at the time, were highly modern innovations.

Towards the end of the nineteenth century the business was converted into a public company known as The Britannia Works Co. (1898) Limited. In 1900 it was renamed "Ilford Limited", the local authority insisting on the inverted commas and the full spelling of "Limited".

In 1902 the Ilford premises were again found to be too small and fourteen acres of land were purchased at Great Warley, near Brentwood. This district was chosen in order to avoid the pollution problems of urban and industrialised Ilford. A well 1,000 feet deep was bored to secure the company's water supply. The new factory was completed in 1904. However, because air conditioning and refrigeration plants were installed by the company at the Ilford factory around this time, followed by further extensions in 1908, the works at Brentwood did not contribute much to the expansion of output and in May 1910 were temporarily closed.

The first X-Ray plate was produced by Ilford's in 1907 and was highly successful. In 1910 Hyptona and Intona papers were made for the first time. This was soon followed by the Panchromatic plate which was found to be very reliable. The manufacture of X-Ray Dental Film commenced in 1912. Shortly after this the Brentwood factory was reopened. Research was undertaken there into the production of roll film, however, before this could be perfected, production was halted by the outbreak of war.

By 1916 it was recognised that photography could make an important contribution to the war effort, and demand from both the Armed Forces and industry rapidly increased. Different manufacturers of photographic materials saw that problems could best be solved by a common effort and that amalgamation would help to meet the increased demand for their products. Consequently, in 1918 "Ilford Limited" made an agreement with the company British Photographic Plates & Paper Ltd., which had recently acquired a controlling interest in Imperial Dry Plate Co. Ltd., and its subsidiary Gem Dry Plate Co, Ltd., for mutual co-operation.

In 1920 Selo Limited was founded by "Ilford Limited" and Amalgamated Photographic Manufacturers Ltd. (APEM). The new company was devoted entirely to the manufacture of materials coated on film, at the factory at Brentwood, after the works had been de-requisitioned. Throughout the 1920s a number of small photographic manufacturers were taken over by Ilford's. These included names such as Illingworth, Imperial, Rajah and Paget's, making "Ilford Limited" the largest wholly British manufacturer of photographic sensitised materials.

In 1930 APEM sold its interest in Selo Ltd. to Ilford. Also in 1930 the group was joined by Wellington & Ward Ltd., and an interest in the Cassio Photo Paper Co. of Watford was obtained, which meant that the company no longer had to rely on outside suppliers of paper. As a result of the absorption of these companies Ilford acquired a number of sites scattered mostly around the perimeter of London and also at Mobberley in Cheshire.

Despite the economic depression of the 1930s, Ilford found that demand from the public, the press, medicine and industry all continued to increase. In 1932 a Process Department was set up to offer advice and assistance to the printing industry. By 1933 the manufacture of non-inflammable film on imported base was underway at Brentwood. In 1940, with the aid of BX Plastics Ltd., production was dramatically increased to meet war-time needs and was later increased still further to meet the post-war dollar crisis. The Brantham factory of Bexford Ltd., owned by BX Plastics Ltd. and "Ilford Limited", not only met all the demand for home consumption, but was able to produce a surplus for export.

With the increased demand for film during World War II, Ilford's factories worked overtime. Laboratories were set up for the study of aerial photography, and mass miniature radiography was also developed. In 1945 the plate factory was put out of action by a German bomb. At the close of the war in 1945, the "Little Ship" trade mark was abandoned and the company adopted the brand name of llford Selo, changing again to Ilford in 1949.

In 1946 Butlin's Photographic Services Ltd. was formed jointly with the Butlin company, and photographic goods and services were provided at the holiday camps.

In 1954 Ilford's first colour film was marketed. The colour processes required a whole range of new chemicals with very specialised properties. The photographic industry, consequently, is highly dependent on research into emulsion making techniques and chemical additives for the emulsions. Processing solutions to make visible and finalize the exposure of the sensitive materials is also an integral part of the photographic process. This is another important area of research and experimentation. Ilford's research in this field has led to an entirely new type of developing agent, Phenidone, which has facilitated the preparation of highly concentrated solutions.[19]

With the consolidation of sites in the 1950s, Ilford's main manufacturing locations were at Ilford and Brentwood, and a large new multi-purpose factory was built at Basildon in order to concentrate the work previously done at several scattered locations.

In 1958 Ilford entered into an agreement with Imperial Chemicals Ltd. and the latter's colour film research information was transferred to Ilford with arrangements made for further research to be carried out. In 1969 ICI sold their 32% share in Ilford Ltd. to the Swiss chemical group CIBA AG. Ilford then became an overseas group of CIBA and, from 1970, of CIBA-Geigy.

[19] Welford

In 1965 Selo Ltd. was revived in order to take over the production of film products at Brentwood. In 1989 the company again changed hands, becoming associated with International Papers of America, the largest paper manufacturer in the world.

In the 112 years of its history, the Ilford company has grown from Harman's original home based industry into the present day 'llford Limited', Britain's largest photographic manufacturer and one of the leading photographic companies in the world. It owes its success to its strong research and development programme with qualified chemists, and to its policy of buying up its smaller rivals.

Plastics

The chemist and inventor, Alexander Parkes (1813-1890), is the founding father of the plastics industry in this country. The compound of pyroxylin (cellulose nitrate), subsequently known as xylonite, was invented by Parkes, and formed the subject of a number of patents commencing in 1855. This product was developed almost simultaneously in the U.S.A. where it was known as celluloid. From the very early days of its manufacture, the history of xylonite has been associated with the county of Essex.

Parkes and his brother Henry, also a trained chemist, displayed articles made of this substance at the Great International Exhibition in Kensington in 1862. In a leaflet distributed to visitors Parkes said of the new product, which he named "Parkesine", that it could be made as "hard as ivory, transparent or opaque and could be worked in dyes and pressure or used as a coating".[20] It could also be ornamented to resemble tortoise-shell and woods, by a method patented by Henry Parkes.

Parkes hoped that eventually Parkesine would replace far more expensive materials such as ivory, tortoise-shell, bone etc., much used in those days for making small articles. The (now Royal) Society of Arts who organised the exhibition, awarded Parkes a Bronze Medal for the excellent quality of his product. He gained a similar distinction at the Paris Exhibition of 1867.

It was at the Kensington exhibition that this new product first came to the notice of Daniel Spill (1832-1887). Spill was the manager of his brother George's successful waterproof clothing factory at Hackney Wick. Spill was interested in Parkes' claim that Parkesine was waterproof. He approached Parkes with a view to making Parkesine at his factory, using some of the rubber processing machinery. An agreement to this effect was drawn up in 1864.

From 1864 the factory of George Spill & Co. Ltd., was used to develop the product. Many experiments were carried out, often with little success. Nevertheless by 1886 Parkes had persuaded several people to subscribe to the formation of a new company, The Parkesine Co. Ltd. One of the principal shareholders in the new concern was George Maule of the dyestuffs firm, Simpson, Maule & Nicholson, whose colour factory was next door to Spills. New buildings were erected at the rubber works, adapted for the Parkesine process. Daniel Spill was the works manager with a workforce of twelve men and boys.

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[20] Merriam p12

The basic raw material for the process was cellulose, that is vegetable fibre, and "cotton or flax mill waste, old rags or paper-makers' half stuff (pulp)" were used.[21] This was converted into nitro-cellulose by steeping in a mixture of nitric and sulphuric acid. This highly explosive compound was first discovered by the German chemist, Schonbein in 1845. However in the 'Parkesine ' process, the nitro-cellulose contained a lower percentage of the nitro compound and so was less dangerous.

After nitration the material was washed with water and then, while still damp, mixed with wood-naphtha, which acted as a solvent to produce a plastic dough. This was then well mixed and rolled out into a sheet on a calender. The dough could then be pressed into the desired shape.

The main problem of production in the early days was that the solvent was highly volatile and consequently led to considerable shrinkage afterwards. Also the cheap cotton used by the company produced a rather dirty appearance.

A number of experiments were made with the use of other solvents such as a mixture of nitrobenzene or aniline with varying proportions of cotton seed or castor oil according to how hard the finished product was to be. Sometimes a little camphor was used to reduce shrinkage. It was not realised until several years later that camphor could be used on its own.

The new Parkesine factory was not a success and in 1868 was liquidated. Spill, however, did not give up, and the following year formed the Xylonite Co.Ltd., in the same premises. The name "xylonite" derived from the Greek word, xulon, for wood. Amongst those involved in the formation of the company was W.C.Barnes, a prominent manufacturer of chemicals in London's East End. However, this company, too, soon failed and was wound up in 1872.

Still undeterred, Spill set up his own company, Daniel Spill & Co. Ltd., and started trading again at new premises in Homerton High Street, Hackney, in 1876. The following year the company became the British Xylonite Co. Ltd. The only member of the workforce of twenty nine with any knowledge of chemistry was Alfred Loeber, the foreman. He had been Spill's assistant from the start at Hackney Wick.

Next door to the factory was a business, established with Spill's collaboration, by an American immigrant, L.P.Merriam. This company manufactured fancy goods from xylonite. When Spills became the British Xylonite Co. in 1877, Merriam's business was incorporated as Homerton Manufacturing Co. Ltd. They made all sorts of small articles from xylonite, such as handles for umbrellas, pistols and knives as well as combs, imitation jewellery and dentures. However, the quality of xylonite was poor and the work place, which was lit by open gas jets, was hazardous and cramped.

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[21] ibid. p18

In 1885 the company began to look for more suitable premises for making flammable material, and in April 1887 a 130 acre farm was purchased at Brantham on the Essex/Suffolk border. The new site, on the north bank of the River Stour, offered water as well as railway transport.

The construction of a new factory commenced at once and by November 1887 the business had almost completely transferred to the new premises; most of the factory's workforce moved with the company to Brantham.

Cargoes of acid were brought to the new factory by barge from the works of Spencer, Chapman & Messel, on the Thames. The sailing barges were used by the company until 1938.

The production of fancy goods remained at Homerton until 1897, by which time the business was prosperous enough to move to a spacious new factory at Hale End, a small village between Chingford and Walthamstow, in Essex. In 1901 the company's collar factory, originally set up at Holloway, also moved out to Hale End, where in 1898 a new Head Office had been built.

Hair and tooth brushes, hand mirrors and a whole range of trinkets were made at Hale End. The company's 1899 catalogue lists 200 different shapes and sizes of comb, many in six colours. These were made by a succession of processes, as if they were being shaped in horn or real ivory. Until the early 1920s the Hale End factory only made articles formed mainly in xylonite, but with reduced demand for combs and collars, considered using alternative materials. They introduced compression moulding of synthetic resins such as Bakelite, and injection moulding of cellulose acetate. In the 1930s the name Halex was introduced as the trade name for the factory's products.

After 1945 xylonite began to disappear, replaced by injection moulding of a number of modern plastics. Table tennis balls, first made from xylonite in 1902, were the only product for which no other material was found to be suitable.

After 1895, the Brantham factory production began to grow steadily and the quality of xylonite was constantly improved. By that time camphor and alcohol were in use as the ideal solvent for nitro-cellulose. Supplies of camphor were obtained from the island of Formosa (Taiwan), where there were extensive forests of camphor trees. The Sino-Japanese war of 1894-5 resulted in Japanese victory and the annexation of Formosa. This led to a difficulty in obtaining supplies of camphor, as the Japanese took control of all sales. By 1901 the price had risen by 60%.

In 1904 the German firm, Schering, began to produce a synthetic camphor. This was tried at Brantham and found to be successful. However, with the outbreak of war in 1914, German supplies were cut off and Japan became again the only source. This prompted the company to buy a synthetic camphor process from Howard Brothers, in Ilford. A new camphor plant was erected at Brantham. The raw material used was pinene, distilled from turpentine trees and transported by ship from the U.S.A. Although at first this new process was not very efficient, after several years of experimentation a suitable product was obtained.

In 1938 British Xylonite was converted into a holding company, with the subsidiaries BX Plastics at Brantham and Halex Ltd. at Hale End. With the outbreak of war in 1939 all the production at Hale End came under Government control. Xylonite sheet was used extensively as a protective covering for aircraft propellers. The Hale End factory also made eye pieces for gas masks and mortar cartridge cases, whilst the Brantham plant switched to making non-flammable cellulose acetate sheet, used for a variety of aircraft fittings.

After the war in 1945 the Hale End factory was equipped with improved injection moulding machines, using cellulose acetate, polystyrene, nylon etc., and their range of products was greatly increased. It became clear at this time that change was also necessary at Brantham. The exigencies of war had led to the development of many new plastics, both in the U.S.A. and Germany. It was decided that Brantham would have to accommodate these and consequently, in 1946 a research laboratory for the development of new plastic materials was established.

Research on the new materials was carried out at Lawford Place, two miles from Brantham. Laboratories and pilot plants were installed and the scientific staff was greatly increased. It was here that Margaret Thatcher was employed as a young research chemist.

By 1960 the British Xylonite Group had become a very large organisation. It had 12 factories scattered around the country and employed some 6,000 workers. It was, however, becoming increasingly expensive to carry out adequate research into new materials. These, by then, were mostly being developed by the large oil and chemical companies. In 1961 financial problems led to the company being sold, with all its subsidiaries, to the Distillers Company.

In 1963 Distillers went into partnership with the Union Carbide Corporation of New York, to form Bakelite Xylonite Ltd., known as BXL. Ten years later, Distillers transferred their share to Union Carbide, and in 1978 the company was sold to the British Petroleum Company. In the 1980s control of the Brantham factory was taken over by Wardle Storey plc. The new company continue to make celluloid and is one of only three manufacturers surviving in the world. The other sites are in Italy and Japan. Other parts of BXL have become BXL Plastics Ltd., a subsidiary of BP Chemicals.

Rubber

In the early nineteenth century, the Scottish manufacturing chemist Sir Charles Macintosh (1766-1843), discovered that latex dissolved in coal tar distillates produced a solution that could be used to waterproof fabrics. The raincoats made from this fabric were known by his name, but spelt 'mackintosh', and became famous world-wide.

The making of a variety of rubber goods has been carried on in Essex since the mid-nineteenth century, making this district not only one of the earliest locations of the industry, but also one of its main centres.

From the mid 1840s gutta-percha and india rubber goods have been manufactured in the metropolitan section of Essex. Gutta-percha is a tough, inelastic, greyish black plastic substance. Like rubber it is derived from the coagulated juice of certain tropical trees of the Sapotaceae family, but it is less resilient and durable than rubber. Also, unlike rubber, gutta-percha is thermoplastic, that is to say that it becomes plastic on heating, hardening on cooling and able to repeat these processes. Its chief use is in insulating cables, for belting and for acid-proof vessels.

Charles & Walter Hancock began experimenting with rubber from Singapore in 1842. In 1846, after taking out several patents, they set up a small manufacturing company in the City Road and at Stratford. The Gutta-percha Company was formed shortly after and in 1848 employed 330 men in all, 80 of them in Stratford.

In 1852 S.W.Silver & Co., a waterproofing outfitters based in Greenwich, moved to an acre of land on the West Ham Marsh between Bow and Barking Creek. The business throve and the company soon acquired five more acres for its plant. In 1864 the firm amalgamated with Hancock's company and became known as Silver's India Rubber Works & Telegraph Cable Co. Ltd. The new concern employed some 3,000 workers and manufactured an extensive range of india-rubber and gutta-percha articles in immense quantities. These included sheet rubber, rubber tubing, tennis and playing balls, motor car and bicycle tyres, mackintosh cloth and vulcanised rubber. In addition there was a large submarine cable works which, by the early twentieth century, had constructed and laid some 40,000 miles of cable in all parts of the world.

Later, other manufacturers of rubber to establish themselves in the county were London Rubber Industries, based in Chingford, and, since 1957, Revertex in Harlow, who also manufacture polyvinyl acetate emulsion for paints.

Telecommunications

At first sight, it may be thought that the telephone has little to do with chemistry but in fact this 'High Tech' industry depends on chemistry to prepare the ultra pure materials used for the complex technology required to power modern telecommunications networks. In Essex, the GEC-Marconi Research Laboratories at Gt. Baddow and the laboratories of STC Technology at Harlow make major contributions to the world wide development of materials for the telephone industry.

GEC is a well known British company with beginnings in many parts of the Country but in fact STC has its roots firmly placed the old County of Essex. The company started life in the now demolished factory on the edge of the River Thames at North Woolwich and from there spread to many locations throughout the British Isles including the factories at Basildon and Harlow as well as the research laboratory at Harlow.

The Woolwich factory was formerly owned by the Fowler-Waring Cables Company which was registered in 1889. Western Electric, an offshoot of the American Telegraph and Telephone Corporation (ATT, otherwise known as Ma Bell), took over the factory in 1897 as part of the Bell expansion into Europe. The American Monopolies Commission in the 1930's required that Bell divest all its interest in Europe and so Standard Telephones and Cables became the UK flagship of the International Telegraph and Telecommunications Corporation (ITT).

Chemistry did indeed play little part in the early days as cable manufacture consisted of copper wires insulated with paper and protected with an outer sheath of steel wire. However the development of plastics and in particular polythene provided a significant improvement in cable insulation and the more stringent requirements of the improved telephone networks demanded that more reliable cables and exchange equipment had to be produced. The chemical laboratory at North Woolwich was able to provide the essential service required assay the materials used in these developing systems.

One of the first submarine cables to cross the Atlantic Ocean to North America was manufactured at the Woolwich factory. This involved valve amplifiers encased in submerged repeaters which were strategically placed at intervals along the ocean floor to amplify the signal. Chemistry now provided the high purity materials for the construction of this new underwater system and at a later date made a vast contribution to the semiconductor technologies needed to power the larger and increasingly more sophisticated networks across the ocean and in land based exchange systems.

STC Technology Ltd (STL, formerly known as Standard Telecommunication Laboratories) moved to Harlow from Enfield in 1960 and has played a very important part in the development of electronics and communication. Much of this had been based on materials innovations in which chemistry has played a vital role. For example, amorphous silicon, which is now widely used in solar panels, was invented at STL, as were the concepts of optical fibre transmission which now has a world wide domination of modern telecommunication networks. Improvements in semiconductor technology to cope with high capacity transmission systems led in 1990 to a Queen's Award for Industry which is much more commonly given for manufacture rather than innovation. Current materials activity includes the development of specialist liquid crystal display systems, the fabrication of ultra high capacity optical fibre materials and the expertise in modern chemical analysis methods which plays an essential part in the construction of high reliability electronics.

STC plc became an independent publically owned company in 1982 but recently lost it's new found independence to become a part of the Canadian company, Northern Telecom in 1991. In the meantime it had bought the British computer company, ICL, in 1984 and sold it to the Japanese company, Fujitsu in 1989. These actions reflect the demands of modern industry where expensive investments are required to remain competitive and these in turn require a large financial base to achieve the end result.

FAMOUS NAMES IN THE HISTORY OF CHEMISTRY IN ESSEX

SIR WILLIAM HENRY PERKIN (1838 - 1907) made possibly the most important contribution to the development of synthetic chemicals when in 1856 he synthesised the mauve dye which marked the beginning of the aniline dye industry.

He was born and bred in East London at Shadwell and was educated at the City of London School. His chemistry teacher was Thomas Hall, himself a gifted chemist, who had received his training at the Royal College of Chemistry in London. Hall recognised and encouraged Perkin's talent and it was on his recommendation that Perkin's family allowed him to attend the College.

Early on in his student days, Perkin set up his own small laboratory in the family home. Here he experimented first with photography, then with chemicals and finally with the dyeing of fabrics using the new mauve colour. The famous Perkin's purple dye was discovered while he was trying to prepare quinine synthetically. In the endeavour to make quinine Perkin unintentionally produced a thick black substance. Instead of discounting the experiment as a failure, in true scientific spirit, he decided to investigate further. From the black tar-like mass he eventually obtained a violet dye known as mauvine or aniline purple. It is said that he tested the dye straight away by dipping a silk handkerchief into it. This is still preserved in the Science Museum at South Kensington.

Dr Alexander Carson, who lived in the neighbourhood, took an interest in Perkin's trials with the newly discovered purple dye, and introduced him to silk dyers so that he might conduct further experiments in conjunction with them. By this means he came into contact with Keith & Co. of Bethnal Green who realised that, providing the dye could be produced cheaply and in large quantities, there would be a good market for the new colour.

Aniline, from which Perkin's dye is derived, is one of many substances found in the tar that occurs as a by-product in the manufacture of coal gas. In the early days of gas making the tar was discarded as a useless waste product and so when Perkin had refined his dye-making process, coal-tar dyestuff could be cheaply made on a large scale.

Still only seventeen years old, Perkin decided not to return to college but to concentrate on perfecting his dye in the family's small back garden. He acquired the coal-tar chemicals he needed from John Bethell's Distillery in Bow Common Lane. Subsequently he moved to a new site of one acre, situated near to Greenford Green. Here he had the advantage of a plentiful supply of labour as well as good communications. Within six months commercial quantities of aniline dyes were being manufactured. Very soon mauve became the height of fashion, and a dress dyed in Perkin's purple was presented to Queen Victoria.

Perkin's discovery of aniline dyes in the mid-nineteenth century, led in turn, to important advances in the new sciences of bacteriology and organic chemistry. Many disease causing organisms could now be stained and examined with more precision than before. Also, it became possible to synthesise a variety of new substances from aniline which were found to act upon the organisms causing disease.

In 1859 William Perkin married his cousin Jemima Lissett. They had two sons, both of whom were to become eminent professors of chemistry. Sadly Jemima died shortly after the birth of their second child. William Perkin received a knighthood in 1873, and around that time sold out and spent the rest of his life in academic work. Burt & Co. who bought the aniline dye factory at Greenford, transferred it to Silvertown where it manufactured textile dyes as well as other products such as creosote, insecticide, disinfectant and pitch.

JOHN WILLIAM STRUTT, THIRD BARON RAYLEIGH, (1842 - 1919) is widely regarded as one of the most eminent British scientists of the nineteenth century. As an experimental and theoretical physicist he made an important contribution to the advancement of almost every branch of what, in the twentieth century, is termed 'classical physics'. However, Rayleigh's most famous and dramatic achievement was as relevant for chemistry as for physics, namely the discovery of argon gas, for which he was awarded the Nobel Prize in physics in 1904. There is little doubt that from the scientific point of view this was not his most significant accomplishment, but because of the Nobel accolade, it is the one with which his name is most usually associated. The discovery of argon captured both the scientific and the popular imagination.

Argon, a colourless, inodorous gas, is a constituent of the atmosphere to the extent of about 1%. It is characterised by its inertness or inability to combine with other elements. It was because of its relative inertness that this element remained undiscovered for so long. Rayleigh's discovery was the result of noticing that nitrogen obtained from the air was heavier than when prepared in other ways. Once argon had been isolated it soon came to be used instead of nitrogen for filling tungsten filament electric bulbs.

Lord Rayleigh was a peer by inheritance, with a family seat at Terling Place near Chelmsford. His commitment to following a scientific career, rather than pursuing the life of a country gentleman, was considered by members of his family and friends to be something of an eccentricity. Nevertheless, from the time his graduation from Cambridge University in 1865, until his death in 1919, he devoted himself relentlessly to scientific research.

His professional activity was prodigious. During the course of his career he published 430 scientific papers and his magnum opus The Theory of Sound (2 Vols. 1877-8) was revised periodically to keep it up-to-date. As well as his intense research activity, he was actively engaged in various professional scientific societies. In 1873, the year in which he succeeded to his father's title, he was elected to the Royal Society. In 1905 he became its president, an appointment that he held for three years. From 1879 to 1884 he served as professor of experimental physics at Cambridge. In 1884 he became president of the British Association for the Advancement of Science, and in 1896 accepted an appointment as scientific adviser to Trinity House, a post once held by Michael Faraday. Other examples of his extensive public service, too numerous to name in full, include his chairmanship of the Explosives Committee of the War Office and the duties he undertook as chief gas examiner of the London gas supply.

In the early years of his career Rayleigh was predominantly occupied with a series of experimental studies of optical instruments, in his laboratory at Terling Place, where most of his later scientific work was done. During the 1880s, however, he began to broaden the scope of his research. Wide ranging experimental and theoretical work was undertaken, embracing radiation, optics, acoustics, electromagnetism, mechanics, capillarity and thermodynamics. It was also during this period that he made his measurements of the density of nitrogen. This led to his discovery, in conjunction with Sir William Ramsay, of argon. Ramsay was awarded the Nobel Prize for chemistry for his part in this.

Lord Rayleigh married Evelyn Balfour in 1871. She was the sister of Arthur James Balfour (1848-1930) the philosopher and statesman who became Prime Minister in 1902. Their son Robert John Strutt Rayleigh born in 1875 followed in his father's footsteps to become an eminent physicist in his own right. He was Foreign Secretary of the Royal Society and Emeritus Professor of Physics at the Imperial College of Science in South Kensington. He is best known for his work on atmospheric optics and active nitrogen.

JOHN CLOUGH THRESH (1850 - 1932) was the first Medical Officer of Health for Essex, a post that he held for twenty two years. As well as being a doctor of medicine he was an expert analytical chemist and bacteriologist. It is largely due to his pioneering work on water analysis that the households of the United Kingdom are supplied with clean water[22].

Thresh received his medical degree from the University of Manchester and a D.Sc. from London University before gaining a Cambridge Diploma for Public Health. Later in his career he became a lecturer on Public Health at London Hospital Medical College. He was also an examiner in state medicine at the University of London, and in chemistry for the Pharmaceutical Society. His various publications and reports show the first scientific and systematic endeavour to analyse the contents of domestic water supplies, and to apply a positive strategy, based on the principles of chemistry, to improve its condition. Thresh's volumes Water Supplies and Water Analysis were, and to some extend still are, standard handbooks on the subject.

In the late 1870s and throughout the 1880s advances were made locally in the provision of water and drainage. This was largely due to the Public Health Act of 1875 which aimed to provide every household with wholesome water. Progress was slow and even in 1890, when Thresh examined fifty five sources of water around Writtle, he found that only fourteen were 'good' and four 'usable'. The rest were discovered to contain oxidised sewage. The chlorides and nitrates found by Thresh in the wells at Writtle and Oxney Green indicated that much of the water had come from nearby cesspits.

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[22] Davidson, 1982

In his report for Maldon Rural Sanitary District (1891) Thresh drew attention to the fact that village water pumps were often located near to cemeteries which had been in use for centuries. This proximity, he said, would account for large quantities of nitrates in the water.

Thresh was perturbed that local people were vulnerable to receiving untreated sewage and other pollutants in their water. In 1874 there had been an epidemic of typhoid fever in the district of Epping, afflicting some five hundred people. Although typhoid was frequently related to the consumption of polluted well water, Thresh was disinclined to condemn wells as a source of supply, rather, he urged that wells should be constructed according to certain guidelines, to guard against contamination. Thresh, more than anyone, promoted these improvements. By 1913 most cases of typhoid were no longer due to contaminated water, indeed that year half of the cases were traced to a typhoid carrier working in a Harwich dairy. Shellfish, too, were found to be a significant cause of this disease.

Whenever a public water supply was suspected of causing infection, local authorities called upon Thresh's expertise. Often he was able to show that the water was not to blame. Even so, it was largely due to his dedicated efforts towards improving water supplies, that water increasingly rarely was a source of disease.

BERNARD DYER (1856-1948), Public Analyst to the County of Essex, was one of the leading exponents of Analytical Chemistry in the old county of Essex which in those days included most of East London. In 1880, he passed the Science and Art Department Honours Examination at the City of London College and was subsequently appointed to a lectureship at the College and became a consulting chemist for the Essex Agricultural Society. At the early age of 21, he established an analytical laboratory at 17 Great Tower Street in London in order to meet the requirements of the Essex appointment and similar ones in Leicester and Devonshire.

At the time of his appointment in the latter part of the 19th Century the value of chemical fertilisers in improving crop growth was little known to Essex farmers and indeed to many others. Dyer was responsible for the many field trials on different farms in Essex which were reported in the Annual Reports of the Essex Agricultural Society. In due course, the trials were extended to the manuring of fruits and vegetables and the results of this work, which extended over a period of 20 years, were reported in a book entitled <u>'The Manuring of Market Garden Crops'</u>.

A study of the root sap acidity of many different agricultural crops led Dyer to devise a method for the determination of available potash and phosphate based on extraction with a dilute citric acid solution. The efficacy of the method was checked by applying it to soils that had received different manurial treatments over several years and in due course the method was widely adopted. As the use of artificial fertilisers became more commercially important, the improved methods of chemical analysis, which were evolved in Dyer's laboratory for both fertilisers and feedstock, contributed much to economic farm management.

Bernard Dyer was appointed Public Analyst to the County of Essex at the turn of the century. Public Analysts were first appointed under the act known as 'An Act for preventing the Adulteration of Articles of Food and Drink, 1860'. At first, their work was solely confined to the examination of food and drugs but it soon spread to cover fertilisers and feeding stuffs.

With the gradual realisation of the value of the scientific approach to many aspects of everyday life, the Public Analyst was the first person to be called upon to provide expert scientific advice. Initially this was mainly concerned with forensic work, as there were no forensic laboratories in these early days, and the examination of water supplies for drinking water which subsequently included the control of sewage effluent and other forms of river pollution.

As the Government became more regulation conscious, any scientific tests embodied therein were automatically carried out by the Public Analyst and local industries and merchants requiring chemical advice automatically sought his services. By degrees, the work of public protection was extended far beyond the purity of food and drugs to cover the quality and safety of many consumer goods.

From the initial beginnings of being concerned solely with the analysis of food and drugs, the Public Analyst was now involved with so many aspects of the scientific work of the County that he is now their scientific advisor. He is required by Law to hold the qualification of M Chem A conferred on him by the Royal Society of Chemistry.

EDUCATION

Writtle College

Throughout the eighteenth century, there was a growing interest in mechanical innovation to improve farming methods. In 1793, the Agricultural Society was founded. The aim of this body was to make farming more efficient. New ideas were brought to bear upon traditional techniques, and then tests and trials were carried out. A new kind of plough known as the 'mole plough' was pioneered in Essex. Drills and hoes were also modified and improved.

In the early part of the nineteenth century, changes in farming practice continued to be empirical rather than scientific. That is to say, that innovations were based on trial and error in actual practical experience rather than on theoretical or abstract principles. Experimentation continued to be basis for invention.

However, by the 1870's, with the development of reliable steam ships, the import of cheap foreign produce began to have a detrimental effect upon the local agricultural economy. Wheat came in bulk from America, Canada and Argentine. In the face of powerful foreign competition, land values plummeted and many local farmers went out of business. It was in the context of this depression that farmers began to realise the need for a more sophisticated approach to farming. In order to make British agriculture more productive, there was a growing interest in the chemistry of the soil.

In 1893 Technical Instruction in Agricultural Counties by Sir Henry Roscoe was published. This work both promulgated and reflected the demand for scientific knowledge to be brought to bear on farming practice. Roscoe advocated the education of farmers so that they might combine practical experience with an expert scientific approach. This, it seemed, was the only way to combat the economic depression.

It was against this background of strong competition from foreign markets that the government first decided to fund agricultural education. In 1890, revenue known as 'whisky money' became available in Essex as the result of a special liquor tax. This was raised mainly in order to compensate tavern owners for the forced closure of their businesses after a Government decision that there were too many public houses in the county. However, as most of the owners were wealthy brewers, compensation remained unpaid and was instead diverted into promoting the floundering agricultural industry of Essex.

At that time technical laboratories which undertook the chemical analysis of such farm products as milk, butter, feeding stuffs, soil and manure, were already established in Chelmsford. At first the new agricultural studies operated from the county laboratories, but in 1893 the college transferred to the old King Edward Grammar School when this became available for purchase.

At first, courses were held mainly in the evenings and on Saturdays, but in 1896 the first three week course in agriculture was started. Steadily, more courses in various specialised fields were introduced. The early teaching was based on chemistry and biology.

In 1903 the courses were transferred to King Edward Avenue and in 1911 the college became known as the East Anglian Institute of Agriculture. The college continued to expand, and in 1913 purchased a farm of 150 acres to the west of Chelmsford. In the 1930's it acquired a poultry station and orchards were laid down. Agricultural instruction stopped during the two World Wars, but with the outbreak of hostilities in 1939 the college took on an important role as a demonstration farm and all the land was turned to the production of maximum food supplies.

After the Second World War, artificial fertilisers continued to be used in greater quantities, and there has also been considerable use of chemicals for the protection of crops. Yields have consequently been enlarged. For instance, in 1945, a cow on average produced 1.8 gallons per milking. In 1980, the yield had increased to 2.5 gallons. Similarly, in 1945 one acre of land produced 1.3 tons of wheat, this rising to 2 tons by 1980.

In 1972, the college became known as Writtle Agricultural College and a Crops Teaching Centre laboratory was opened to supplement the demonstration plots which had been used since 1965.

The Polytechnic of East London and the technical colleges of Essex.

The spread of industrialization throughout the United Kingdom, in the nineteenth century, was accompanied by a growing need for technical education. This was initially provided by Mechanics Institutes, the first of which was founded in Glasgow in 1796, by the English doctor and philanthropist, George Birkbeck (1776-1841). Others soon followed in large towns throughout the country. The London Mechanics Institute, established in 1823, became part of London University in 1920 and was named Birkbeck College, in honour of its founder.

In Scotland the new institutes for technical education flourished, but in England few students enroled for classes in science and technology. The Great Exhibition of 1851 drew attention to Britain's technological weakness in comparison with many of her European rivals, but it was not until 1889 that the Technical Instruction Act allowed a penny rate per capita to be spent on furthering technical education. Additional funds were provided the following year by the Local Taxation Act (1890). This Act sought to finance technical education from the liquor tax known as 'Whisky Money'. Essex was one of the first counties to take advantage of this revenue. Since then the history of higher chemical education in Essex has been largely linked to the various colleges of what is now known as the Polytechnic of East London (P.E.L.), based at West Ham and Barking.

In October 1891 the South West Essex Teachers Association decided that 'Whisky Money' might best be used to further technical education by the provision of one main centre in the district. A plan was drawn up and accepted, and in October 1896 the foundation stone of the new technical institute, at the site on Stratford Green, was laid by the Mayor of West Ham. The college, known as West Ham Technical Institute, was opened in 1898 and its main function was to provide a wide variety of evening classes for the local population.

In 1899, just one year after the college was completed, the science block was entirely destroyed when a fire broke out in the advanced chemistry laboratory. This wing was subsequently rebuilt in 1900 and, as a safety precaution, all the chemical laboratories were isolated from the main building. By 1902 the new Chemical Department had 63 day students and 236 evening students.

To start with the college provided facilities only for craft courses but it was soon realised that professional and academic day and evening courses were also required. By 1902 the college had received recognition from London University for external degrees in various subjects including chemistry. These London degree courses continued until the 1970s when they began to be replaced by C.N.A.A. courses. During this period the apprentice and craft courses were gradually phased out and in 1970 this college became the West Ham precinct of the North East London Polytechnic (NELP).

During the inter-war years there was a period of expansion in technical education to meet the growing needs of industry. Essex responded to this demand by establishing the South East Essex Technical College, at Barking in 1936. Shortly after, in 1939, the South West Essex Technical College and School of Art at Walthamstow opened officially, although classes had begun there the previous year. In 1970 these two colleges became the Barking and Waltham Forest precincts of NELP.

A variety of courses were offered, including the National Certificate of Chemistry. Also many smaller colleges were established, such as the technical colleges of Havering and Rush Green. These were mainly for the teaching of City and Guilds courses in plumbing, bricklaying, building etc. as well as 'A' level courses in technical subjects. The Ordinary National Certificate (ONC) and Ordinary National Diploma (OND) were also taught at some of the new colleges. At the technical college in East Ham (now Newham Community College) a course was run on paint technology, to provide the necessary expertise for the various paint making firms in the area.

When the college at Barking first opened in 1936, it had only two chemistry laboratories. After 1945, with the growing volume of work undertaken in the sciences, these laboratory facilities were woefully inadequate. However it was not until 1955 that proposals for an extension were put into practice, by the provision of two additional storeys, to the originally single storey science wing. This effectively doubled the space of the Chemistry Department.

The Waltham Forest college was used during the war for the technical training of some 12,000 servicemen and, after the war, specialised in training men returning from active service, offering them a wide variety of courses.

The Chemistry Department at Waltham Forest gained a prestigious reputation through the research and various publications of a number of members of staff. H.Holness, a member of the department from 1938 to 1957 did research on analytical chemistry and published some text books, as well as several articles in specialised journals of chemistry. Dr.I.Finar published a two volume text book on organic chemistry and carried out research on aminoacridines and sulphonic acids. He later went to the North London Polytechnic. Dr. S. Lewin joined the Chemistry Department in 1945. He was involved in a wide range of chemistry research projects, the results of which were published in the Biochemical Journal and the Journal of the Chemical Society, amongst others. He founded an active research school at the college.

In 1970 when NELP was formed on the instructions of Margaret Thatcher, then Secretary of State for Education, Dr. Lewin became Head of Department of Postgraduate Molecular Biology at the Walthamstow precinct and nearly all of the chemistry courses at Barking were moved to the West Ham precinct. In 1973, Dr Lewin's department was moved from Waltham Forest to West Ham, so that a single chemistry department was formed from what had been the Chemistry and Biology Departments of the three former colleges.

However, since 1974 the teaching of chemistry at the Polytechnic has continued to contract. Research students in chemistry, mostly overseas students working for London M.Phil and Ph.D. degrees, have been deterred by the Government's imposition of greatly increased fees. Only a few research students, mainly financed by industry, remain. Full-time students wishing to study chemistry, after 1974, tended to go to Queen Mary College, some two miles away in the Mile End Road.

The number of part-time students also declined. Many local firms, such as Howards and Ilfords, which had sent students to the local colleges, were now closed or moved away. In an unfavourable economic climate, other employers became less inclined to send their workers on day release courses.

Walthamstow opted to leave NELP in the mid 80's to become a College of Further Education and in 1989 the Polytechnic, in common with others in the country, became independent of local government control and changed its name to the Polytechnic of East London.

In 1970 there were 44 chemists on the staff of the Polytechnic. This number has since dwindled to about six as Government cuts in funding have made it much more difficult to recruit chemistry students. Chemistry, however, still retains a presence at PEL and some chemistry is also taught to biologists and forms a part of the new degree in Modern Sciences.

Queen Mary and Westfield College.

The history of Queen Mary College can be traced back to 1802 when Bancroft's Almhouses, built in 1735, were converted into a boarding school. At that time the Mile End Road, where the school was situated, was surrounded by open fields.

In 1885 the Lord Mayor of London set up a fund to build a cultural centre, known as a People's Palace, in the East End. The following year the school and almshouses were purchased for this purpose. The recreational facilities provided at the site included a library, swimming pool, gymnasium and Winter Garden. A People's Palace Day Technical School, (now the East Wing of the main building) was also built alongside the facilities, and was opened in 1887 to students over twelve years of age, orphans and boys from poor families. From the start chemistry was part of the school's academic activity.

The two year course initially run by the People's Palace included provision for instruction in chemistry, under the direction of A.P.Laurie. In 1894 J.T.Hewitt took charge of the teaching of chemistry. The scope of the school, at this time, was extended to more advanced studies, including the external B.Sc. of London University. By 1897, the title of the College had been changed to East London Technical College and Hewitt was a recognised teacher in the University of London. He published numerous research papers and in 1910 was made a Fellow of the Royal Society (FRS).

In 1905 the name of the College was changed to East London College and an Arts side added. In 1907 provisional recognition obtained by the College, for three years, as a School of the University of London, and it then became largely separated from the recreational facilities of the People's Palace.

The change in the College's status prompted a period of expansion and in 1914 a new chemistry building was opened. The money for this was donated the Drapers Company, who, under the will of Francis Bancroft, had originally administered the Bancroft Almshouses. The building commemorated the 550th anniversary of their Charter of Incorporation. In 1915 the College was admitted without limitation as a School of the University.

In 1919 Hewitt resigned to form his own chemical company and J.R.Partington was appointed as his successor to the University Chair of Chemistry in East London College. Partington's, interests embraced both physical and inorganic chemistry. He published a number of University textbooks and also gained a prestigious reputation as a historian of science.

In the inter-war period the college expanded steadily. New chemistry laboratories were built and an extra floor was added to the Chemistry building. In 1934 the College was granted a Royal Charter. From that time it was known as Queen Mary College until the merger with Westfield College in 1989.

With the outbreak of war in 1939 further extensions planned for the College had to be postponed and it was not until 1966 that a new Chemistry building was finally completed. This provided excellent facilities for teaching and research.

During World War II the College was evacuated to Cambridge where the chemists were allowed to occupy the top floor of the University Chemical Laboratory and some rooms in King's College. After the war, returning to the Mile End Road site, the department again expanded.

In 1951, when J.R. Partington retired, he was replaced by Michael Dewar, FRS who had established a reputation for his formulation of the tropolone series and his application of molecular orbital theory to organic chemistry. He left the department in 1958 to join the "brain drain" to the U.S.A. Keble Sykes was appointed to the newly created Chair in Physical Chemistry in 1956 and when Dewar resigned took over as Head of Department.

Still the department continued to expand and during the 1960s a Chair of Organic Chemistry was established for Basil Weedon. He made major contributions to the chemistry of carotenoids, and in 1971 was elected a Fellow of the Royal Society. Weedon resigned the Chair in 1976 when he was appointed Vice Chancellor of Nottingham University. The Chair then passed to Raymond Bonnett whose current interests include porphyrins and their application to medicine.

1960 was also the year in which a Chair was created for W.J.Hickinbottom, who had first joined the department in 1947. Hickinbottom, who retired in 1963 to the University of Khartoum, left a considerable sum to the Royal Society of Chemistry to set up the Hickinbottom Research Fellowships, awarded annually.

In 1964 a Chair was created in Inorganic Chemistry for Joseph Chatt, FRS. Later that year he moved to the University of Sussex and the Chair passed to Donald Bradley in 1965. Personal Chairs have also been given to Edward Randall for his studies in nuclear magnetic resonance, John Pritchard for surface chemistry, Michael Hursthouse for X-ray crystallography and James Utley for organic electrochemistry. The union with the Chemistry Department at Westfield College brought in Professor Bernard Aylett (silicon chemistry) and David Kirk (steroids), other colleagues from Westfield and also from the former Chelsea College. It is most appropriate to mention here the name of Michael Clyne. He made major advances in gas phase chemistry and at his untimely death in 1979 at the age of 41 was probably the most distinguished chemist to have worked in the department.

Over the years the Chemistry Department at Q.M.W. has produced many eminent chemists and has often received the Neill Arnott Award for the best graduating chemist. On the research side it continues to maintain an international reputation, contributing over 200 publications to the scientific literature each year on a wide range of topics.

Chemistry at Essex University.

The foundation Professor of Chemistry at Essex University was the late John N.Bradley, then a young physical chemist previously at Liverpool University. His early promise was indicated by the award of a Harkness Fellowship at Harvard (with G.B.Kistiakowsky), following his research studentship at Birmingham (H.W.Melville), and confirmed by the award of the RSC Meldola Medal, in 1960. The physico-chemical stamp of the early department has been continued despite modifications and innovations - studies of chemical structure and mechanisms were its main interest. In organic chemistry J.G.Tillett, from Bedford College, started both the mechanistic approach to undergraduate teaching and a school of physical organic research. G.J.Bullen joined the department from the crystallography department at Birkbeck College to start inorganic and structural chemistry, and J.R.Gilbert, from J.W.Linnett's group at Oxford, assisted with setting up both research and teaching in physical chemistry. Initially students studied a 'common first year', containing for example, potential chemists, mathematicians and physicists, and from the initial entry, ten chemistry honours graduates emerged. An active research school was rapidly built up.

Over the next few years a polymer research group was formed under the direction of Professor Manfred Gordon, with A.J.Matheson and J.M.G.Cowie, and the Department became one of the first in the U.K. to offer a biological chemistry degree course. Current professors in the department are Jon Dilworth (Inorganic), Richard Cherry (Biological) and Alfred Tseung (Physical). Despite the difficulties of undergraduate recruitment which plague most chemistry departments nowadays, the department has always had its successes. Many of its graduates have achieved distinction in industry, commerce and academia. Its research output has been substantial. Some of its staff have moved to senior positions elsewhere, for example Hathaway, Cowie, Hider, Douglas and Harrison to U.K. Chairs. A string of distinguished visitors have lectured in the department. These include Flory, Ingold, Stockmayer, Porter, Fischer, H.C. Brown and Lehn. Past Visiting Professors in residence have included the late Julian Gibbs (Brown University, USA), Wendel Forst (Universite Laval, Quebec), Ron Koningsveld (DSM, Holland), and John Beynon (Swansea).

In the difficult times for academia generally, and science departments in particular, the efforts of past and present members have been recognised by the decision of the Universities Funding Council to encourage expansion to twenty two staff and an intake of sixty undergraduates per annum - a dramatic evolution for a department which started twenty five years previously with ten undergraduates and four members of staff.

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