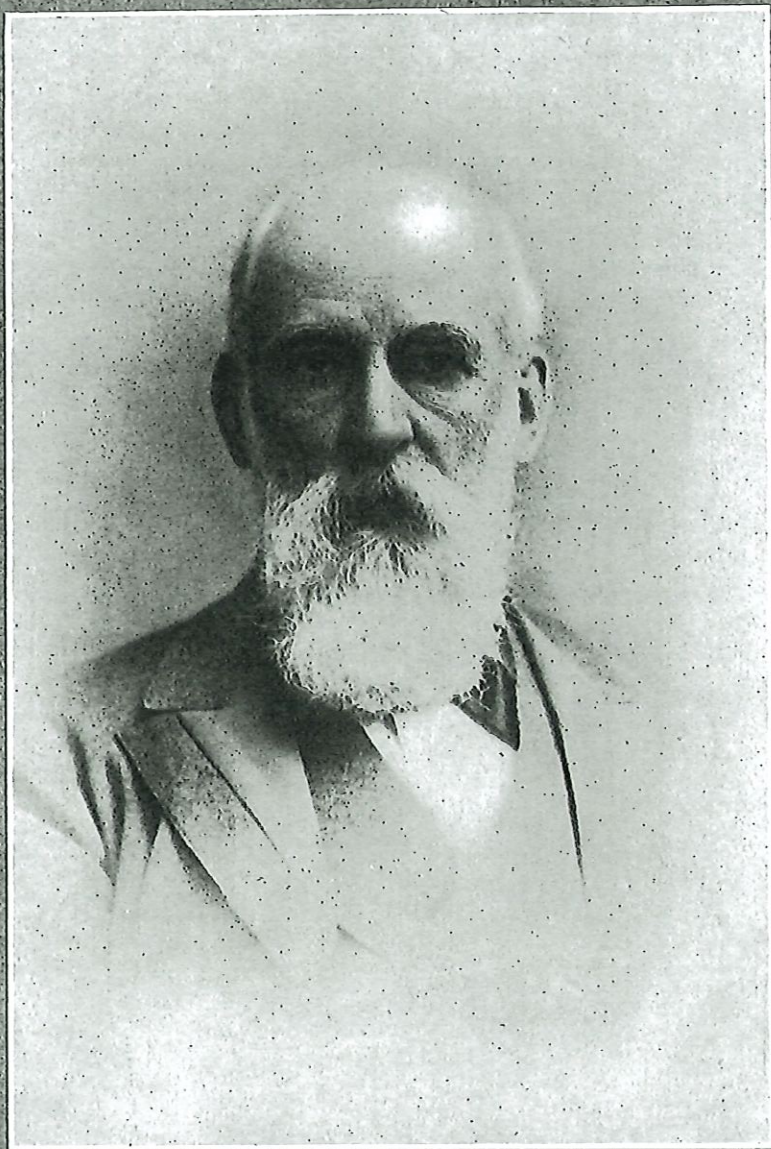


The 50th
Anniversary

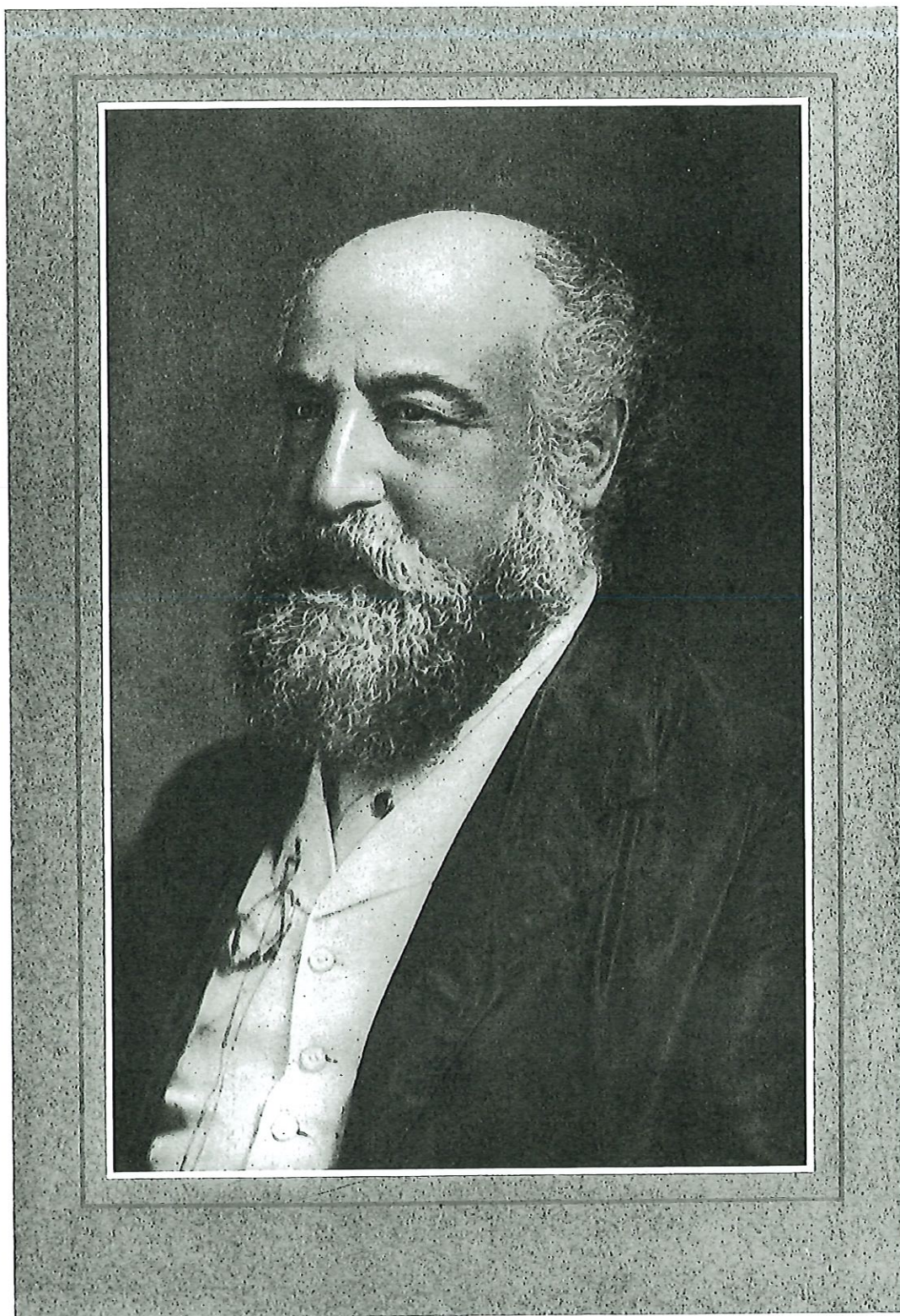


1873-1923

The first fifty years of
Brunner, Mond & Co.
1873 1923



RT. HON. SIR JOHN T. BRUNNER, BART.



DR. LUDWIG MOND, F.R.S.

The first fifty years
of
Brunner, Mond & Co.

1873



1923



ROScoe BRUNNER, ESQ.
CHAIRMAN SINCE 1918.

PREFACE

 HIS book has been written to interest the past and present staff of Brunner, Mond & Co., and therefore contains much matter which is not interesting to the general public. For this reason it has been thought fit to include a short history of the Ammonia-soda process, as many of the readers will be unfamiliar with such accounts of it as have been already published. I wish to acknowledge my indebtedness to Mr. J. G. Nicholson for the Chapter on "Commercial Development," and to Mr. H. M. Ross for his valuable assistance in rearranging, improving and finally editing my manuscript.

JOHN I. WATTS.

*Winnington, Northwich,
June, 1923.*

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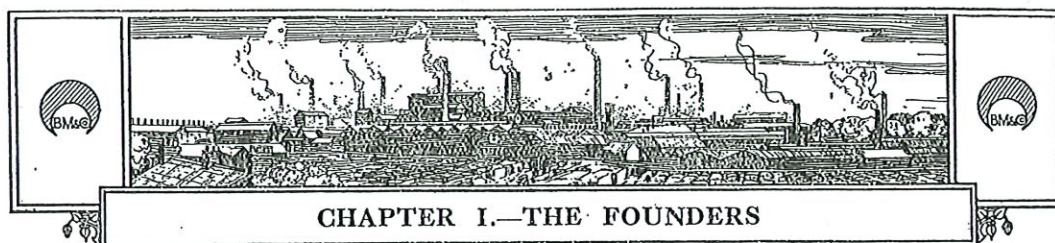
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It is impossible to write any history of the first fifty years of Brunner, Mond & Co. without first of all giving some short account of the lives of the three great men whose labours made it possible for such a gigantic organisation to be built up. Their names are :—

John T. Brunner.

Ludwig Mond.

Ernest Solvay, the founder of the process.

It is much to be regretted that, although Solvay was permitted to celebrate the fiftieth anniversary of the foundation of his Couillet works, no one of the three has lived to see our jubilee.

At present their deaths are of too recent date for the world to realise what great men they were and what it owes to their strenuous lives. The statement that they provided mankind with cheap soda, and thereby contributed in no small degree to the welfare of the human race, is of little significance until it is realised that this has meant lowering the cost of soap, glass, paper, woollens, textiles, and numbers of other necessities that make up the cost of living. Each of them, too, started life with very little money; and each, when he became rich, devoted enormous sums to promoting the enlightenment and comfort of his fellow men.

JOHN TOMLINSON BRUNNER was the second son of the Rev. John Brunner, and was born at Everton, near Liverpool, on February 8th, 1842. After attending his father's school at Everton, he began his commercial career at the age of 15, and later, while still young, he entered the office of John Hutchinson & Sons, chemical manufacturers, of Widnes. There his natural capacity for business methods rapidly developed, and he rose to the position of head of the office.

While at Hutchinson's he became acquainted with Ludwig Mond, and, after many years of friendship, they agreed to start in business on their own account. How they arranged with Ernest Solvay to work his process for the manufacture

of soda is told elsewhere in Sir John Brunner's own words, and repeated allusion is made later to the genius shown by Ludwig Mond in transforming and perfecting the process; but here it is necessary to chronicle the fact that but for the commercial foresight and financial skill of Sir John Brunner it would have been impossible to carry on the works in those early days, or tide over the years of trading losses.

At the outset he did most of the office work, acting himself as book-keeper and cashier, and later he built up the commercial staff, trained to his methods and imbued with his own principles of absolute probity and straightforwardness in business. He was always insistent that all the Company's products should reach the highest degree of purity, and that nothing should be sold that did not give the customer the full value he was entitled to expect. In his dealings with the employees he was generous and considerate, ready to listen to appeals or to receive complaints, and the men felt that they could always rely upon his word when he made any promise. It was his constant practice to consult the trade unions, and he maintained the best of relations with them, though he never scrupled to tell them when he thought they were wrong.

Taking a keen interest in education, he served on the local Education Committee before the control was taken over by the County Council, and he was a member of the local Science and Art Committee until the work devolved upon the Technical School. He induced Brunner, Mond & Co. to build schools at Winnington in 1885, and at his own expense built schools for Barnton; and he was instrumental in founding the Northwich High School for Girls, and secured its amalgamation with the Grammar School, to which he gave a new building and a playground, obtaining also a reorganisation of Sir John Deane's Trust. For many years he provided scholarships for pupils from the elementary schools tenable at the Grammar School, discontinuing them only when the County Council instituted similar ones. He presented a Free Library to Northwich, a Village Hall to Halton, and Guildhalls to Winsford and Runcorn.

He was a generous donor to the University of Liverpool, in which he endowed the professorial chairs of Economics, Physical Chemistry, and Egyptology. The University conferred the honorary degree of LL.D. upon him, and he was its Pro-Chancellor for six years.

In public affairs he took an active part. He served for a time on the Northwich Local Board and on the Northwich Union Board of Guardians,



UNVEILING STATUE OF SIR JOHN BRUNNER, 1922



STATUE OF DR. LUDWIG MOND, F.R.S., IN WINNINGTON PARK

and he was a Justice of the Peace for the County of Cheshire, and a Deputy Lieutenant for the County of Lancashire. In 1885 he was elected as first Member of Parliament for the newly-formed Northwich Division of Cheshire, but in 1886, in the great secession over Mr. Gladstone's first Home Rule Bill, he lost his seat, though at the bye-election caused by the death of Mr. Robert Verdin, in 1887, he was re-elected, and continued to represent the constituency until his retirement from Parliament in 1910. During his distinguished Parliamentary career he introduced, and succeeded in getting passed, the Brine Pumping Compensation for Subsidence Act, which gave redress to property owners who suffer damage through subsidence of the land caused by the pumping of brine, the money being provided by a rate levied on the volume of brine pumped. He was created a Baronet in 1895, and a Privy Councillor in 1906.

In 1864 he married Salome, daughter of the late James Davies, of Liverpool. She died in 1874; and in 1875 he married Jane, daughter of the late Dr. W. S. Wyman, of Kettering. He lived at Winnington Old Hall from 1874, until he removed to Druids' Cross, Liverpool, in 1891, when, on the retirement of Mr. John Crosfield, he was elected Chairman of Brunner, Mond & Co. This office he held until 1918. When he entered Parliament he took a house in Ennismore Gardens, London. In 1908, on account of his wife's health, he bought an estate at Chertsey, Surrey, known as "Silverlands," and gave up his house at Liverpool. He died at the age of seventy-seven, at "Silverlands," on July 1st, 1919, and was buried, on July 4th, in Lyne churchyard, adjoining his own grounds.

On Saturday, June 10th, 1922, in the presence of a large assembly, comprising members of the Brunner and Mond families, Mr. Louis Solvay, Mr. Ernest John Solvay, Lord and Lady Sheffield, Lord Leverhulme, Sir Max Muspratt, the Directors of the Company, representatives from all the Works, and a host of personal and political friends, Sir Alfred Mond unveiled a statue of Sir John that had been erected at Winnington, adjacent to the new road between Winnington and Wallerscote Works. The statue, which is in bronze, stands on a pedestal of Portland stone, and is the work of Sir William Goscombe John, R.A. It represents Sir John in the attitude he was wont to assume when addressing a public meeting, as if he were

still exhorting those who follow him in the works he helped to create, and counselling them to devote their lives not only to the service of the Company, but also to the welfare of their fellow men.

LUDWIG MOND was born at Cassel, on March 7th, 1839. His father, Moritz B. Mond, was a merchant of that city. His mother's maiden name was Henriette Levinsohn. He was educated at the Realschule and the Polytechnic School at Cassel, and then went, in 1855, to study chemistry under Hermann Kolbe at Marburg. In the following year he proceeded to Heidelberg, and so, having followed that great teacher through two institutions, still marked by his influence, he came under the actual control of Robert Wilhelm Bunsen. From him, during a three years' course, Mond undoubtedly acquired that absorbing love of pure chemical science that characterised him in after life.

His introduction to industrial activity took place at a small Leblanc soda works at Ringenkuhl, near Cassel. He next became manager of a factory at Mainz for producing acetic acid by the distillation of wood, and thence he went to Cologne to engage in the manufacture of ammonia from waste organic matter, especially leather.

After spending some time in several other factories, in both Germany and Holland, he came to England in September, 1862.

His experience at Ringenkuhl had led him to devise a process (patented in France in December, 1861, and in England in August, 1862) for the recovery of sulphur from Leblanc alkali waste by atmospheric oxidation, lixiviation, and subsequent separation of sulphur by treatment of the liquors with hydrochloric acid, and he entered into partnership with John Hutchinson at Widnes in order to demonstrate its working, with the hope of inducing other manufacturers to take out licences. In working this demonstration plant he invented several improvements, which he patented in September, 1863.

In 1864 he undertook the construction and management of a Leblanc soda works at Utrecht. During the three years he remained there he practically lost the sight of one eye through an accident with caustic soda, and he also had to cope with an outbreak of cholera in the works, which he succeeded in stopping by the use of bleaching powder. Returning to England, he became a naturalized British subject, and rejoined Messrs. Hutchinson,

in whose works he perfected his sulphur recovery process. The use of the process increased, both at home and abroad, until finally it was adopted by sixty licensees, and it and the Schaffner process continued to be worked until both were displaced by the Chance process.

Shortly before his return to Widnes, in 1867, Mond married his cousin, Frida Löwenthal, daughter of Adolf Löwenthal, who was one of the pioneers of the German electro-plating and electro-chemical industry. Lifelong familiarity with scientific problems eminently fitted Mrs. Mond to be the companion of such a man as her husband, and to the end of his life she never failed to take the most intense interest in all his work. She survived him for fourteen years, and died on May 16th, 1923, at the age of 75.

In 1872 Mond made the acquaintance of Ernest Solvay, a Belgian chemist, who was interested in the process of making carbonate of soda invented by Harrison Gray Dyar and John Hemming in 1838, and who, in association with his brother, Alfred, had built and was running a small factory at Couillet, near Charleroi.

While at Widnes, in 1862, Mond had become the friend of John Tomlinson Brunner, who was in the commercial department of Messrs. Hutchinson, and when, from a study of Solvay's works, he was convinced that there were chances of a brilliant future for an ammonia-soda process, he entered into partnership with Brunner, and obtained a licence to work Solvay's process in England. The story of the establishment of Brunner, Mond & Co. is told in a later chapter of this volume in Brunner's own words, but here it will be interesting to print some extracts from letters written by Mond about this period:—

FROM LUDWIG MOND TO HIS FATHER.

About February, 1872.

There is not much prospect for new business, as all the soda works are excessively busy, and earn so much money that they pay no attention to matters of minor importance in proportion to their own business. Consequently I am trying if possible to create an independent undertaking for the manufacture of sulphur, and if I can succeed with this I shall participate in it. But there are considerable difficulties to be overcome, especially the securing of the raw material for many years to come without paying for it and the acquisition of suitable land to

deposit the lime residues; the negotiations therefore require time and patience. I have in the meantime postponed my plan for the erection of a soda works (Leblanc) in order to wait for the results of several new processes, which, in all probability, will much simplify this manufacture, and especially the plant required, but which have not yet been sufficiently exploited so that I could have dared up to now to adopt them. I have lost much time in consequence, and also missed especially lucky business fees, but, on the whole, I believe I have finally done better by waiting. Should the sulphur works be realised the building of a soda works would fall into the background.

It is not improbable that within the next few days I shall make a short journey to Belgium, and in that case would come for a few hours to Stolberg, and also, once as far as that, on to Cologne.

FROM LUDWIG MOND TO HIS PARENTS.

Farnworth, April 29th, 1872.

I returned on Friday to London, and arrived here late yesterday evening. I had a good passage. I have worked a good deal during the short time I was in London, and yesterday I spent going through the extremely good results of my journey with John Brunner in order to prepare for the further steps. In Brussels, after a very careful examination of the works and the books of the company, I have closed the business under very favourable conditions, and have drawn up and signed a legal agreement. A closer examination of the project shows the thing in every relation extremely favourable, even more favourable than I had expected, and I really have great hopes about it. In the meantime I have undertaken no responsibilities, except to make no communications to others, but my contract ceases if I am not working in two years.

FROM LUDWIG MOND TO HIS PARENTS.

Farnworth, December 5th, 1872.

The process which we wished to introduce has been patented in England, and I have made a very favourable contract with the Belgian Society for its use, which for many years grants me several important advantages over possible competitors, which in the meantime are not to be feared. The process itself is very profitable, and even in the case of the existing works not making any profit, the process gives a net profit of 50 per cent., and with the existing soda prices it will probably amount to more than 100 per cent. It is really the most lucrative and extensible invention which has been discovered by chemical manufacturers

for the last 80 years, and I consider it to be a great fortune for it to have come into my hands. I have many times thought of forming a company with important capital in order to take the thing in hand on a large scale, but I have always come to the conclusion that, in the most favourable case, with very much increased work for myself, I could not obtain an income which would be in the least comparable with my expectations as an individual manufacturer. To obtain in Germany a sleeping partner for a works to be put up in England is absolutely impossible, and I find the idea ridiculous.

FROM LUDWIG MOND TO HIS PARENTS.

December 26th, 1872.

Brunner and I have at last succeeded in finding a third partner, under very favourable conditions, and just as we desired. He is an old acquaintance of Brunner, of wealthy family, and partner of a firm in Manchester, being a Civil Engineer. He has joined us as a sleeping partner with a capital of £5,000, which we were trying to get. He receives 5 per cent. interest and a third of our profits, but with a maximum of 25 per cent. of his capital, so that everything that we earn above 25 per cent. will go into our own pockets. He has, of course, no voice at all in the direction of the business, and has no right to enter into any contract in the name of the business, but I think his opinion promises, in some respects, to be useful to me. We have made a temporary agreement which we have signed, but the formal agreement is in the hands of the lawyers. Having concluded this I have got over the greatest difficulty about the new undertaking, and now I am very busy in order to get over the second great difficulty, the acquisition of the necessary site. It seems that I shall have more difficulties to find it than I anticipated. No one wishes to give a site for soda works, as they do not believe that the new method will not have as many drawbacks as those experienced with the old method, but also in this respect I have made progress. Last week when I was in London I obtained some information on the matter, and I hope very soon to arrive at a favourable solution. I am also pleased with my sulphur business, and I have better prospects here, and quite favourable news from France.

The problem of converting an interesting chemical experiment into a lucrative commercial process had baffled all the earlier manufacturers, and although Solvay had achieved quite an appreciable measure of success, the gigantic task of evolving an economical continuous process was materially advanced by collaboration with Mond. For seven arduous years he struggled

with the problems which the process presented ; but gradually, by successive inventions, the methods of manufacture were so transformed that by the year 1880 he was able to claim that the ammonia-soda process was a commercial success.

In his endeavour to produce soda more economically by the ammonia process than it could be manufactured by that of Leblanc, Mond was naturally anxious to obtain cheap ammonia. He saw that if coal could be burned in gas producers with a mixture of air and steam, the plant would be simple, and the gas obtained could be utilised in the same way as ordinary producer gas. He, therefore, constructed gas producers and ammonia-absorbing plant at Winnington, and experimented with different classes of fuels for a number of years. These experiments showed that the lower the temperature at which the producer was worked, the higher the yield of ammonia, and that the temperature could be controlled by regulating the amount of steam admitted with the blast.

Having satisfied himself that his process could yield a cheap gas suitable for almost every manufacturing operation, Mond sought to extend its use throughout the world. He formed the Power Gas Corporation to grant licences under his patents and act as technical advisers to and erect plants for such manufacturers as desired to employ the gas. Recognising that the gas was eminently suitable for small furnace and foundry work, and that it ensured smokeless combustion, Mond was instrumental in founding the South Staffordshire Mond Gas Company, in the heart of the Black Country, at Tipton, near Dudley Port. There fuel is gasified in Mond producers, and, after purification, the gas is compressed and delivered into mains that convey it to consumers in about 160 works.

In 1886 Mond invented a process for obtaining chlorine by passing the vapour of ammonium chloride over nickel or a similar active oxide to form the corresponding chloride with liberation of ammonia, the chloride being subsequently treated with hot dry air to liberate chlorine and regenerate the oxide.

In the course of experiments carried on with Dr. Carl Langer he discovered nickel carbonyl, and this led to the invention of a process for extracting pure nickel from its ores, and the formation of the Mond Nickel

Company to work it. Pursuing his researches further in conjunction with H. Hirtz and M. D. Cowap, he prepared carbonyls of iron, cobalt, molybdenum and ruthenium. The account of this work was his last publication.

In 1884, Mond made London his regular place of residence, in order to live in closer association with scientific societies. He first resided in Park Crescent, but later acquired "The Poplars," 20, Avenue Road, Regent's Park. This house formed his headquarters all the rest of his life, and he made it a centre for scientific and artistic friends. There he started a research laboratory, one of the first products of which was a gas battery, and there, as a great admirer of the early Italian painters, he formed one of the finest collections of their pictures in England, which, at his death, he bequeathed to the nation. There, too, he died on December 17th, 1909, in his seventy-first year. He was laid to rest in the mausoleum which he had built at Finchley for himself and his family.

During his absence in Rome, in 1903, a report of his death had reached England, and obituary notices appeared in some of the newspapers. The news was quickly shown to be false, and on his next visit to Warrington the workpeople met him in torchlight procession, presenting him with an illuminated address of welcome, and making Warrington Park bright with fireworks.

To foster scientific research, Mond, in 1896, purchased a house next door to the Royal Institution, in Albemarle Street, London, and after converting it into a laboratory, fully equipped with apparatus, at a cost of £45,000, presented it to the Royal Institution along with a sum of £62,000 as endowment, requesting that the building should be called the Davy-Faraday Laboratory. His idea was to provide a place where investigators could secure the means of pursuing their researches under the best possible conditions without incurring the expenditure of large sums of money.

All through his life Mond never failed to point out to his assistants that, in order to avoid waste of time, and for the purpose of securing a favourable start, they should read all that had been published on the subject before they started any new investigation. In his later years he recognised that, in the face of the multiplication of scientific publications, it became year by year more difficult to ascertain what had been written. In order,

therefore, to facilitate the consultation of the world's publications he presented to the Royal Society a sum of £14,000 to defray the cost of the regular compilation of a catalogue of international scientific literature.

Mond was chosen a Fellow of the Royal Society in 1891, and he was elected Foreign Secretary in 1881, and President in 1889, of the Society of Chemical Industry, which he was instrumental in founding. He received the honorary degree of D.Sc. from the Universities of Padua (1892), Heidelberg (1894), and Manchester (1904), and of D.C.L. from Oxford in 1907; and he was Foreign Member of the Accademia dei Lincei of Rome (1899) and the Prussian Academy of Science (1909), Honorary Foreign Member of the Royal Society of Naples (1908), and Honorary Member of the German Chemical Society (1908). The Grand Cordon of the Crown of Italy was awarded him in 1908.

In Winnington Park there stands a life-like statue in bronze, by E. Lanteri, unveiled by Sir John Brunner in 1913 amid a remarkable concourse of Mond's old friends. Here, from his granite pedestal, wearing his well-known dust coat and patriarchal soft felt hat, holding a bundle of plans in his hand, the "Old Man" (as he was always called) looks out upon the works he loved so well. To one who sees this effigy daily, the thought often occurs: What would he think of them now, grown even beyond his plans? and some satisfaction is derived from the fact that over all this remarkable development the statue seems to keep its constant watch.

Although some years have now elapsed since his death, it is not possible to gauge the value of his work by noting the size or number of the factories which he was instrumental in creating. The full benefit accruing from it cannot be assessed separately from national industrial progress; but for a generation to come England will have reason to remember Ludwig Mond, the great pioneer chemical manufacturer.

ERNEST SOLVAY was born at Rebecq, in Brabant, Belgium, on April 16th, 1838. He was the son of Alexandre Solvay, a quarry proprietor and salt refiner. When he was nearing the age of twenty-one he went as assistant to an uncle who was manager of a gasworks, and in that capacity he was employed in studying the utilisation of ammoniacal liquors and especially their distillation and concentration. While experimenting with

the manufacture of sesquicarbonate of ammonia, he noticed that this substance reacted with sodium chloride to form bicarbonate of soda. Although he found out later that he was not the first discoverer of the reaction, he became fascinated with it, and after spending two years in experimenting and designing, he patented apparatus for utilising it in manufacture, and in partnership with his brother Alfred started business as Solvay & Co., with a capital of £5,440. The works which they built at Couillet, near Charleroi, in Belgium, began operations in 1864.

In 1873 they granted a licence to Brunner, Mond & Co. to manufacture in Winnington, and also began to build their own large works at Dombasle, in France. From this time onwards to 1914 very few years passed without some new works being erected to carry on the manufacture—in the United States and in Russia in 1881, in Germany and Austria in 1885, and later in Hungary, Spain, Italy, and Canada—until in 1914 there were twenty-three separate works engaged in working the Solvay process, and capable of producing 2,000,000 tons of soda ash a year. In 1922 the amount made by the Solvay process was 2,354,000 tons.

In seeking for a cheap and plentiful supply of ammonia Solvay was led to study the production of coke, and, eventually, in conjunction with Semet, he designed a bye-product coke oven which yielded ammonia through the scrubbing of the gas before its combustion for heating purposes. Many thousands of these ovens have been built in Belgium, France, England, Germany, the United States, Italy, and Japan, and in 1913 they were producing about 10,000,000 tons of coke a year.

In the midst of his immense industrial activities, Solvay was ever mindful of the welfare of his employees. Working a process that must of necessity be continuous, he was one of the first on the Continent to follow the example of Brunner, Mond & Co. and reduce the hours of labour from twelve to eight. He insured his workmen against accidents, provided them with medical attention, built houses for them and remitted the rent in cases of long service or distress, instituted savings banks and retiring allowances, made free grants of land for culture, built schools, and gave scholarships and grants in aid of higher education, both in Belgium and abroad. To commemorate their fiftieth anniversary, in 1913, Solvay & Co. gave generous gifts to their men, and made contributions to the State Superannuation Fund to secure augmentation of their pensions. Again following Brunner, Mond

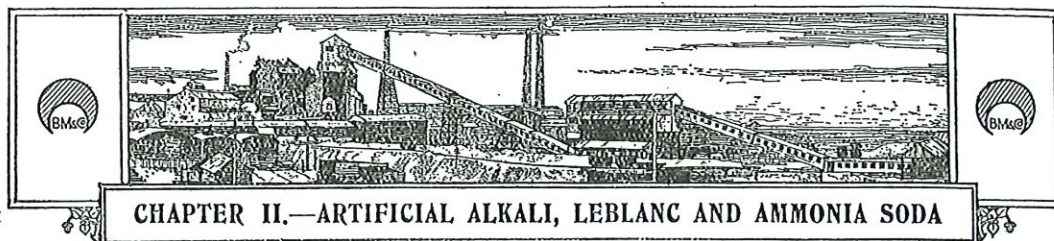
and Co., they granted each workman a holiday of one week each year with double pay. Upon the same occasion, they made grants of very large sums to Belgian, French, and German universities, and also to hospitals and charitable organisations.

Ernest Solvay's sympathies and interests were not confined to his own workpeople, and he was deeply interested in the intellectual and social advancement of mankind in general. He published many treatises on this and kindred subjects, and also from his immense wealth financed or created numerous institutions for their study. He founded the Solvay Society of Brussels, and Institutes of Chemistry, Physics, Physiology and Sociology. To encourage the development of chemical and physical science, by the provision of funds for research workers and the holding of conferences, he inaugurated the Solvay International Institutes of Chemistry and Physics endowing each with a capital of 1,000,000 francs.

During the war, he elected to remain in Brussels, in order that he might alleviate the sufferings which he foresaw would be the lot of the poor. He devoted his energies and his fortune to this object throughout the whole of the German occupation, and the city will never forget his beneficence. Upon his return to the capital, King Albert personally expressed his thanks to him and created him a Minister of State. He was the recipient of many other honours—Grand Commander of the Order of St. Leopold, Chevalier of the Legion of Honour, Doctor of the University of Brussels, Honorary Member of the Royal Institution of London, and of the German, French, American, and Dutch Chemical Societies, and Corresponding Member of the French Academy of Sciences.

At the celebration of the fiftieth anniversary of the formation of his company, he was presented by Professor Haller, in the name of the French Institute, with the gold Lavoisier medal, and by Professor Appell with the medal of the University of Paris.

In private life Ernest Solvay's tastes were simple, and he was happiest in his own family circle. He attracted to his side many men of exceptional ability, and formed lasting friendships. He had a very keen sense of humour and a generally optimistic nature. An ardent mountaineer, he spent his summer holidays regularly amongst the Alps. He could climb vigorously at the age of seventy-five, and did not abandon the sport until a few years before his death, which occurred on May 26th, 1922, at the age of eighty-five.



CHAPTER II.—ARTIFICIAL ALKALI, LEBLANC AND AMMONIA SODA

IN order to realise the importance to the industrial world of the artificial preparation of soda,* it is necessary to remember that until the end of the eighteenth century the only supplies of alkali were obtained from the “natron” lakes that occur in certain tropical parts of the world, or from the ashes of plants, especially those that grow along the seashore. With the exception of the “natron” obtained from Lower Egypt, which is fairly pure sesquicarbonate of soda (Na_2CO_3 , NaHCO_3 , $2\text{H}_2\text{O}$), the ashes variously known as barilla, kelp, varec, blanquette, salicor or soude douce, were very impure, and contained only small quantities of sodium and potassium carbonates.

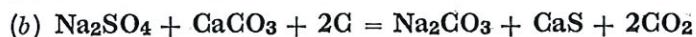
Lunge states that only when Duhamel in 1736 had demonstrated the identity of the base of common salt with that of “mineral alkali,” as the natural soda was then called, was it possible to think of manufacturing soda artificially. But the problem was not actually approached till about 1775, when Scheele discovered that common salt could be partly converted into caustic soda by means of lead oxide.

In the same year, the French Academy of Sciences offered a prize for the solution of the problem of economically converting common salt into

* The following explanation of some of the terms used in this volume may be useful:—

1. Soda Ash (also known in the trade as Pure Alkali, 58 per cent.), is anhydrous monocarbonate of soda, and its formula is Na_2CO_3 .
2. Washing Soda or Soda Crystal is a hydrated monocarbonate of soda, and its formula is Na_2CO_3 , $10\text{H}_2\text{O}$.
3. Soda used for baking, medicinal purposes, etc., is bicarbonate of soda, and its formula is NaHCO_3 .
4. Concentrated Crystal Soda (the “trona” of the Ancients) is sesquicarbonate of soda, and its formula is Na_2CO_3 , NaHCO_3 , $2\text{H}_2\text{O}$.
5. Caustic Soda is sodium hydroxide, NaOH .

soda. After a lapse of years this was ultimately won by Nicholas Leblanc, who devised the following process :—



He obtained a patent in 1791, and began to manufacture at La Franciade, St. Denis ; but the Revolution caused the works to be closed, and he was forced to give up his patent "for the benefit of his country." In 1801 the works were given back to him, but he had no capital to restart them, and, after striving until 1806 to obtain some compensation or help from the Government, he in despair put an end to his life.

Even before Leblanc's death several works employing his process sprang up in France. In 1814, W. S. Losh worked it at Walker, near Newcastle-on-Tyne, and it was started at St. Rollox, near Glasgow, in 1818. James Muspratt, who started near Liverpool in 1823, was the first to manufacture black ash containing as much as 24 per cent. of alkali. This was used by the soap makers in lieu of kelp. It was found that this black ash, when exported, quickly lost strength, and this led to the manufacture of sodium carbonate by lixiviation, evaporation of the liquor, and calcination of the residue, yielding what became known commercially as "soda ash."

During the first half of the nineteenth century, many works were erected in England to manufacture by the Leblanc process, mostly concentrated in the Newcastle and South Lancashire districts, and, though innumerable improvements were made, the process still retained its principal defect, viz., that the costly raw material sulphur was ultimately wasted in the "tank waste," which was left on lixiviation of the black ash.

The problem of how to recover this sulphur engaged the attention of many of the earlier manufacturers. Among the most important of these was William Gossage, who took out a number of patents from 1837 onwards. He was followed by Lee (1844), Losh (1852), Spencer (1859), Mond (1861), Hofmann (1866), Mactear (1878), Pechiney (1882), and Chance (1882). Mond's attention was directed to the subject while he was at the Leblanc soda works at Ringenkuhl, and the sulphur recovery process he worked out was extensively adopted. He was followed by many other inventors, but the method devised by A. M. Chance had the most successful career, and led to great economy

in the manufacture of Leblanc soda, not only by securing the recovery of a large percentage of the sulphur, but also through competition compelling the vendors of pyrites and sulphur to lower their prices.

For some years the Leblanc manufacturers enjoyed very prosperous times, with an ever-expanding trade; but, as will be seen later, they were doomed to meet with a very strong competitor in the ammonia-soda process. A short history of this process, and especially Ernest Solvay's experiences in connection with it, may now be given in Solvay's own words, taken from an address which he delivered at Berlin, in June, 1903, at the Fifth International Congress of Applied Chemistry, under the title: "A Retrospective Glance at the Process for Manufacturing Ammonia-Soda":—

My father was a small refiner of salt. He took rock salt, dissolved it, and then extracted refined salt from the solution by evaporation. My infancy was spent amidst sodium chloride. I had an uncle who was the manager of a gasworks. In 1859, when I was nearly twenty years of age, he asked me to join him as assistant, and I accepted.

Part of my work was connected with the ammoniacal liquors and their utilisation, and I started by arranging for their concentration in order to render the ammonia cheaper to transport, and I also found out a way of making strong caustic liquid ammonia by the distillation of the concentrated liquors with lime.

I was anxious to make sesquicarbonate of ammonia because the sale price was at that time very high. However, I did not succeed in this manufacture, but with the memory of sodium chloride always in my mind, it occurred to me that these two salts might react upon one another. I put some of them into a glass with a little water, and on shaking naturally obtained the now well-known result.

Convinced of the importance of my discovery, I hastened to patent it in Belgium on April 15th, 1861. Having worked alone and having obtained a patent, I believed that I alone knew of the reaction, and that I had the power to claim all rights in connection with it. To-day, such ignorance would be inexcusable, but forty years ago there were neither so many technical publications nor such efficient Patent Offices. Being the possessor of a patent, it became necessary to work it, so I began immediately, with the confidence of an inventor, to secure the industrial application of the new reaction. This was in Brussels itself, in a very small factory, using ammoniacal liquor and carbonic acid from a lime kiln.

As the results proved encouraging, I set about offering the process to various chemical manufacturers. During the course of these proceedings I had to consult a lawyer about the form of contracts (this was M. Endore Pirmez, afterwards Minister of State), and he suggested the advisability of making an exhaustive search of previous processes to ascertain whether the reaction was absolutely new. After a long and tedious search, you may judge of the stupefaction of my brother Alfred and myself when we discovered the patents of Turck, and still more the splendid claims of Dyar and Hemming. I was no longer the inventor of the reaction, and other experimenters had already attempted its industrial application. It was a heavy blow for me.

It seems to me that it would be appropriate now to tell you shortly what we discovered of the efforts of our predecessors. You will doubtless agree with me that never before was the industrial realisation of any process attempted so frequently and for such a long period of time as that for making ammonia-soda.

The true inventor of the chemical reaction is perhaps still unknown, but from extensive search amongst books it appears probable that it ought to be credited to Fresnel, the illustrious French optician. For three years before giving himself up to the study of light, in 1811, this inventive genius busied himself with problems of industrial chemistry, and it appears, from letters of his that have been published, that he asked for advice about his invention from Vauquelin, from the younger Darcet, and from Thénard. This was to some extent like confessing to the devil, because young Darcet was the son of Jean Darcet, who had been instructed by the Institute of France to report upon Leblanc artificial soda; Vauquelin had, with Leblanc, attended the lectures of Jean Darcet, while the younger Darcet was himself continuing to help in the development and improvement of the process, which, in 1811, was still in its infancy.

With the French ports blocked by the War, importation of natural soda became impossible, and the price of Leblanc artificial rose to 2,200 francs, or £88 per ton (from 1,200 to 1,500 francs normal), though the cost of manufacture was only 880 francs, or £35. This naturally stimulated imitation. The sponsors of the first artificial process were not likely to be well disposed to a new-comer. Thénard pronounced the process good, but thought it unworkable on a large scale, and more expensive and more difficult to manage than the other. It should be added that Fresnel had not thought of the possibilities of recovering ammonia by the action of lime on the ammonium chloride, and Thénard was right in pointing out the impossibility of selling the latter. Thus Fresnel gave up his idea, and left the field clear for Leblanc.

A little later, in 1822, the German chemist, Vogel, again called attention to the fundamental reaction of the process, but took no steps to make use of it.

In 1836, John Thom (at one time assistant to Graham) actually manufactured soda on a very small scale at the works of Turnbull and Ramsay, at Camlachie, near Glasgow, but never erected any permanent plant.

On June 30th, 1838, Harrison Gray Dyar and John Hemming took out an English patent (No. 7713, 1838) for improvements in the manufacture of carbonate of soda. This was followed by French patents on May 27th, 1839, and May 18th, 1840, taken out on their behalf by Delaunay. These patents detailed all the principal reactions of the process as now carried on. Dyar and Hemming erected works at Whitechapel, London, and for two years struggled to make the process a practical success, but failed.

James Muspratt and James Young built a factory at Newton, in Lancashire, for the manufacture of ammonia-soda, but were unable to make it a financial success, on account of the high loss of ammonia, and they closed the works after losing about £8,000. The reaction was once more patented by Canning in 1840, then by Waterton. It is said to have been tried at Vilvorde, in Belgium, in 1842, experimented with at Berlin by Kunheim, and at Liesing, near Vienna, by Seybel, but without results. These repeated checks cooled the ardour of inventors, and ammonia-soda ceased to trouble the world for the next ten years.

But from 1852 to 1855 there was quite a crop of patents. In 1852, Grimes, of Marseilles, proposed to use a freezing machine in order to obtain a better yield from the reaction, to put carbonic acid into the absorbers, and to use over again the carbonic acid obtained in calcining the bicarbonate. In England, Gossage took out a patent on February 26th, 1854, for improvements on the process of Dyar and Hemming, and later, on August 28th, 1854, and August 30th, 1855, strengthened his invention; but he met with no better success than his predecessors.

Bowker, although he kept his factory at Leeds going for several years, and actually sold soda in his district, was not made happy by his experience.

Then came Deacon, in 1854, using carbonic acid under pressure, and working an ingenious distiller of his own invention, with well-designed mechanical and continuous apparatus. Nevertheless, when he tried to produce in tons per day he failed, and gave up the struggle.

In the same year Dr. Turck took out a French patent (April 26th), and one for improvements on January 29th, 1855, making use of carbonate

of ammonia; but his attempts to manufacture at Sommervillers, near Nancy, France, did not meet with success.

Schloesing took out a French patent on June 28th, 1854, and one for improvements on September 27th, 1855. In conjunction with Rolland, an engineer, he carried out a series of experiments for four years, and on conclusion of these they secured a new patent (May 12th, 1858), and proceeded to erect works at Puteaux, near Paris. They employed a continuous process; by means of ingenious mechanical contrivances they measured and controlled quantities and temperatures; they checked the loss of ammonia by working at low pressures, and they simplified their distillation by using milk of lime. In fact, the efforts made by Schloesing and Rolland must be considered the most complete and remarkable of all made after Dyar and Hemming and Deacon. Still, with all this, after considerable pecuniary sacrifice, the works had to be closed.

To what must these persistent checks be attributed? Had the new process some constitutional vice? There were times when my faith in the success of my process suffered some shocks; nevertheless I quickly recovered and was sustained by the conviction that in my apparatus for bicarbonatation I had an advantage over my predecessors.

In 1863 we formed the Société Solvay & Cie., with a capital of 136,000 francs (£5,440). We spent the year 1864 in building the works at Couillet. These more than absorbed our capital, and it was only on January 1st, 1865, that operations were started.

Then began the everlasting struggle, the incessant discovery of need for improvements in apparatus, accompanied by the series of accidents inseparable from every new industry. Through all this, however, I was sustained by my faith in the ultimate success of the process, and by the devoted help of my brother, Alfred.

In 1866 we made one-and-a-half tons of soda per day; in 1867 we were able to pay a first dividend of five per cent., and we obtained a bronze medal for our exhibit at the Paris Exhibition. In 1869 we doubled our buildings at Couillet and increased our production three times.

In 1872 I had the first flattering recognition of the value of my invention through the visit of Ludwig Mond, a distinguished industrial chemist. He arrived at my house one day, and addressed me in the following manner:—

“I am working a process which I have invented for utilising the residues arising from the Leblanc process of making soda. It is annoying to have to take such trouble to extract from these

residues the sulphur which one has had so painfully to introduce for the reaction. Now, M. Merle, of Salindres, in whom I have great confidence, has convinced me that the success of your process makes mine no longer necessary. In these circumstances, I prefer to employ myself making soda, and I have come to try to make terms with you."

The ammonia-soda process planted at Northwich under Ludwig Mond was like a cannon threatening the fortresses of Leblanc soda. In fact, it was war.

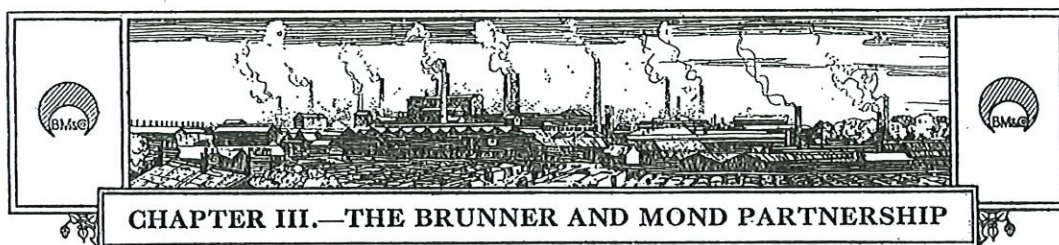
In course of time, as all had gone well at Couillet, we built the Dombasle Works, in 1873, the same year as Northwich. From then onwards the process made rapid strides in all countries, until it may be said that, so far as the production of carbonate is concerned, the Leblanc process, born with the nineteenth century, also died with it.

With the growth of the process, the selling price of soda constantly dropped, and consumption steadily increased. In 1863 the world's total production of soda was 300,000 tons, and the first casks of ash made at Couillet were sold at 325 francs per ton (£13). Ten years later, in 1874, the total world production was 525,000 tons, of which 30,000 tons was ammonia-soda, and the price had fallen to 280 francs (£11 4s.). In 1885, out of a total of 800,000 tons, 365,000 tons was Solvay process soda, and the price had fallen to 120 francs (£4 16s.).

Nowadays,* out of 1,800,000 tons annual production, 1,650,000 tons is ammonia-soda, and the selling price is one-third of what it was when Couillet started.



* 1902



IN a memorandum written a few years before his death, Sir John Brunner gave the following account of his early friendship with Mond and their entry into partnership :—

I was in the service of John Hutchinson & Co., and so was my elder brother Henry. He was technical manager of the works and I was head of the works office, having started there in my twentieth year, October 17th, 1861. I do not know any details of Mond's negotiations with Hutchinson, nor even what royalty was agreed on ; but I understood that on the whole Hutchinson paid him about £10,000. I remember how Mond wrote very well-informed addresses to scientific societies (British Association, Norwich, 1868 ; "Chem. News," 1868) on the subject of his process, because I regularly helped him in their preparation on account of his then deficiency in knowledge of English.

I found him lodgings at the house of Stephen Hunt, the postmaster of Appleton, near Widnes. He had two pleasant rooms on the ground-floor, and a nice garden front and back. It was whilst lodging at Hunt's that Mond was frequently the genial host of the bachelors of the neighbourhood. We founded what we called a Definition Club, and assembled for serious discussion or for whist, and were regularly entertained with eggs and bacon. In addition to Mond, my brother Henry and myself, we had Eustace Carey (then manager of Gaskell, Deacon & Co.'s works, and later secretary of the United Alkali Company) ; James Muspratt (son of Richard Muspratt, of Flint) ; and, for a short spell until his death at an early age, Arthur Field (an engineer in the service of the Widnes local authority), and Walter Angus Watts (chemist at Hutchinson's). Occasionally we had Sydney (brother of James Muspratt), and regularly James Raven (headmaster of the Farnworth Grammar School). Eustace Carey was appointed secretary of the club, and kept the minutes. The

club occupied itself in devising definitions of abstract words such as duty, taste, intelligence, ambition, and so on, and these definitions, in order to be successful, had to be epigrammatic. Each man's definition was discussed, sometimes humorously and at others sarcastically, and the fun was fast and furious.

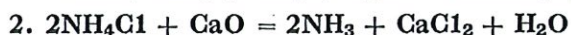
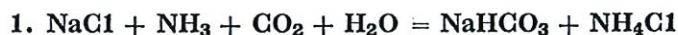
Whilst Mond was an earnest worker, occupied in putting his process into shape at Hutchinson's works, he was a very jovial personage, as we all were, and he enjoyed the cheery evenings we had together to the full. We talked, of course, on all manner of subjects, and we were, on the whole, a well educated lot of men, musical, well up in literature, and naturally, most of us, men of scientific training.

Carey and Mrs. Carey had their musical evenings, and Mond was always ready with a song, as he had then a fairly large repertory. He had an exceedingly powerful bass voice. My brother sang tenor and played the zither.

After spending two years in Widnes, Mond went to Holland for three years, returning to England in 1867 with his wife. I had married in 1864.

Some time later, he and I, discussing our future, after many an intimate talk, came to the conclusion that we would try working together, and, naturally, as manufacturers. At one time the idea was so simple as to be merely the manufacture of soda crystals from soda ash bought for the purpose, and, of course, Mond had his ideas of cheapening the cost of manufacture. Another project that we discussed most intimately was the idea of taking a lease from Messrs. Gamble, of St. Helens, of their heaps of alkali waste, in order to recover sulphur from it.

Finally, Mond came to me one evening to say that he had heard of Ernest Solvay's success in working the ammonia process for the conversion of salt into carbonate of soda at his works at Couillet, near Charleroi, in Belgium. We both knew that Mr. Henry Deacon, of Gaskell, Deacon & Co., of Widnes, had worked a similar process in 1854, and failed to make it pay. The process is based upon the following reactions:



It was agreed that Mond should see Solvay and ask to be shown the works with a view to taking a licence from him. This was done, and after spending several days going carefully through the works, Mond returned to England to tell me that he thought Solvay was at the

beginning of a big success, and saying that he greatly admired Solvay's apparatus, his ability as an engineer, and his great mental power.

When we had decided to adopt the Solvay process, Mond and I went from Widnes to Hartford Station on May 4th, 1872, and thence walked up the Weaver valley as far as Winsford,* to survey the ground with the idea of choosing a site upon which to establish our works. Thereafter, Mond called on Mr. Hermann Falk, the salt manufacturer at Winsford, and explained his ideas to him. Mr. Falk strongly urged taking a lease of land from him, which he had on lease from Lord Delamere. Now I, on my part, was very loth indeed to put any money for which I was responsible on a leasehold plot, and I positively refused to do so then.

After further investigation of the salt field of Cheshire, we hit upon the land at Winnington as being far away the most suitable in the whole district for our purpose.† It was freehold, it had a long frontage to the navigable River Weaver, and, therefore, easy access by water to the Liverpool docks, and it had railway connection with the Cheshire Lines at a convenient level. Mond said no doubt we could get brine there. It belonged to the late Lord Stanley of Alderley, and there was upon it a huge baronial mansion, partly oak framed, with a history going back to the Domesday Book, and partly a handsome Georgian building, erected about 1784 by General Hugh Warburton, of Arley, for his daughter on her marriage with Richard Pennant, afterwards Lord Penrhyn. The mansion was occupied for twenty-two years by Miss Margaret Alexis Bell, who kept a ladies' school there. She became celebrated in her profession, and was patronised by John Ruskin, who lectured there on art, and by Charles Hallé, who used to give musical entertainments.

There were 130 acres of land, a considerable part covered by fine timber, and Mond emphatically declared that a purchase was beyond our hopes. I said on the contrary that we could easily borrow upon it after Hutchinson's fashion, who, as I knew, was an expert borrower.

Mond called on Lord and Lady Stanley, and finally bought it, in 1873, for £16,108, the property being naturally at its lowest value for residential purposes.

* See Appendix A, p. 102, for comparative estimates drawn up by Sir John Brunner, in 1872, of the cost of manufacturing one ton of 56 per cent. soda ash by the Leblanc process at Widnes and the Solvay process at Winsford.

† FROM LUDWIG MOND TO HIS MOTHER.

"Farnworth, April 13th, 1873.

"... The more I see of our site the more I am pleased with it. It is not only a fine property, but it is also in an incomparable position for our works, which offers us most substantial advantages towards any possible future competitors."



SOUTH-WEST VIEW OF WINNINGTON HALL, 1866



SOUTH-EAST VIEW OF WINNINGTON HALL, 1866

Mond set up his household in the modern part of Winnington Hall, and I made efforts in vain to hire a house for myself. Mond and I, therefore, decided that we would restore the old black and white building. I got an estimate from William Leicester, of Northwich, the builder we employed in the construction of the works, for the necessary work of restoration, and that amounted to about £800. We spent £2,500 before the place could be made habitable, as there was, unfortunately, a terrible amount of dry rot in the timber. I turned the house from a three to a two-storied one, as the rooms on the first floor were only seven feet high, and the planks from the ceiling joists above the first floor were used to make good the outside timber exposed through my having stripped off the rough-cast with which the house had been covered.

My friend, Charles Menzies Holland, eldest son of Charles Holland, a Liverpool merchant, a friend of my boyhood, undertook to join us in the purchase. I carefully considered the best method of obtaining money and suggested a lease, which was duly created from the three of us, to Mond and myself, of the small area which was to be occupied by our works at the riverside, pointing out that we could borrow upon that area separately on account of its great commercial value, and we mortgaged it at Parr's Bank as a security for our varying overdraft.

We borrowed through Holland's friends, Messrs. Parker, Rooke and Parker, solicitors, of Bedford Row, £12,000. Through them, we mortgaged all but the works land, and we paid them off on the formation of the limited company, in March, 1881. Mr. Holland's money towards Brunner, Mond & Co.'s capital was paid to us between March 26th, 1873, and August 1st, and amounted in all to £5,000; and on September 2nd, 1874, he lent us £1,500 which we re-paid on January 1st, 1876. We raised £6,000 by means of bills on Holland, and we paid these off in the first three months of 1875.

I borrowed from my father and my mother-in-law, and put into the business £4,000, and Mond put £1,000.

As a consideration for his £5,000, we undertook to pay Holland one-third of our profits, to be limited to a maximum of 25 per cent. per annum, on the money from time to time in our possession, including interest. Our agreement with him was framed at my suggestion under Bovill's Act, and he became a lender of money, and not a partner. Under Bovill's Act he was not liable for the firm's debts beyond the amount he had lent us, whilst Mond and I were fully so. Our bargain with him included the right to pay him off, if and when we became a limited company.

During 1874 we lost money, but in 1875 and 1876 we paid him his one-third share, being about 11 $\frac{1}{4}$ per cent and 19 per cent. We dealt with Parr's Banking Company, and their General Manager, Mr. John Dun, was an exceedingly good friend to us. He had absolute faith in my honesty and frankness, and he allowed us to overdraw all through that time in very generous fashion.

So after experiencing a good deal of pressure for capital, we attained to the position of being able to create a limited company with success at the beginning of 1881. At the time of the beginning of our negotiations with Mr. Solvay, I tried, with Mond's approval, to induce a man named James Richards, a chemist, who had been along with my brother in the service of F. Grace Calvert (public analyst of Manchester and manufacturer of carbolic disinfectants) to join our firm, naturally telling him what we were going to do. These negotiations with Richards fell through, as he could not find the money he had promised, and he then went secretly to Mr. Solvay and obtained a licence to manufacture soda under Solvay's patent, and erected works at Sandbach in 1874 in partnership with Messrs. Kearne & Gasquoine. The royalty which we had agreed to pay to Solvay was 8s. per ton of soda, and he had undertaken not to grant any other licence in England for less than a royalty of 20s. per ton, and this condition was duly imposed upon Richards and his partners. They struggled with the works for over two years, but did not prosper; and, in 1877, Mond arranged with them to take over the management of their works from January 1st, 1878, charging £1,000 a year for our management and 20s. per ton as royalty, keeping the 12s. difference between that and ours as our profit, and bargaining further that when we made ourselves into a limited company, Mond and I should be entitled to take the whole place over at the price of £22,000 in addition to their mortgages for £14,000 and £12,225. This arrangement was eventually carried out, and the Sandbach works were, therefore, a part of the property which we handed over to our limited company.

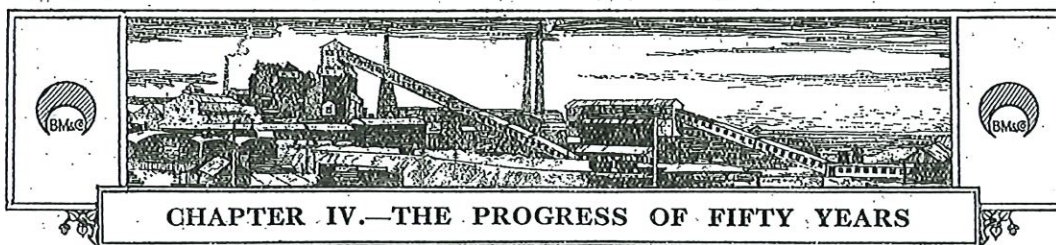
Brunner and Mond signed their deed of partnership on February 28th, 1873. The firm was to be called Brunner, Mond & Co. The Solvay licence to Ludwig Mond, dated September 23rd, 1872, was to become the property of the firm. It was stipulated that J. T. Brunner should forthwith bring into the business £4,000, and L. Mond £1,000. Either partner might bring in additional capital later, but neither could withdraw without the consent of the other. L. Mond was to assign by way of mortgage his interest in his sulphur recovery patents, and insure

his life for £2,500. Each partner was to be allowed to draw £10 per week in anticipation of profits, and no more.

In a supplementary agreement, dated July 1st, 1876, it was recited that each partner had brought in the stipulated amount of money, and that J. T. Brunner was prepared to add £5,000 more, and it was agreed that this sum should receive $7\frac{1}{2}$ per cent. per annum interest from the day when the second set of towers should be set to work until June 30th, 1882. Each partner was to be allowed to draw up to £30 per week in anticipation of profits.

The Solvay licence, dated September 3rd, 1872, was for the term of English Patents No. 3131, December 11th, 1863, and No. 1525, May 18th, 1872. If the building of a factory was not started within one year, and it was not set to work within two years from the date of agreement, the licence was to become void. Payment of a royalty of 8s. per ton of pure soda was to entitle the company to the assistance of Mr. Solvay, to give the right to visit Couillet Works, and make use of all improvements, and, conversely, give Mr. Solvay the right to use all improvements made by Brunner, Mond & Co. Solvay was not to grant any other licences in England for less royalty than 20s. per ton. Solvay was to have the right to erect his own works in England.





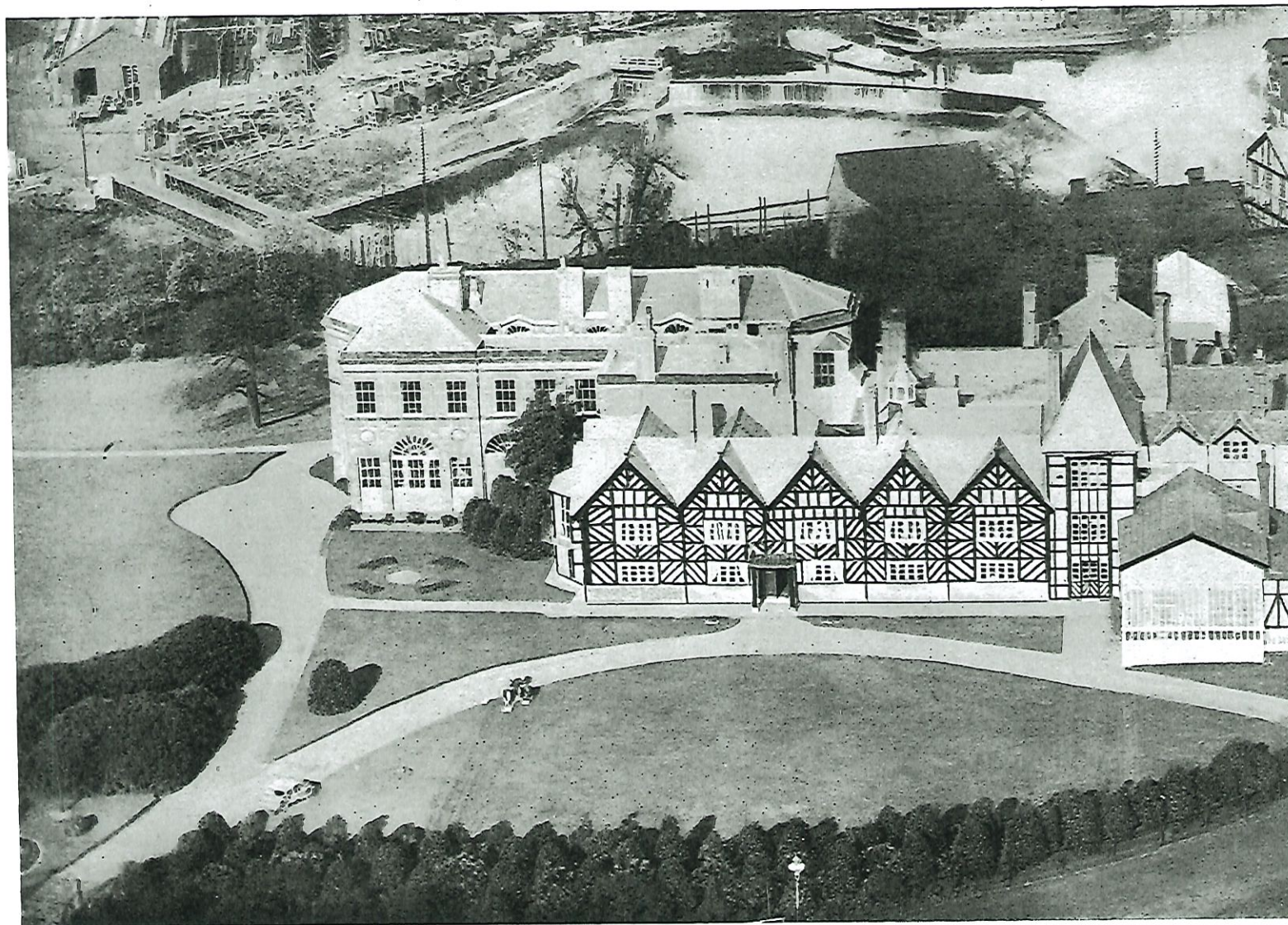
CHAPTER IV.—THE PROGRESS OF FIFTY YEARS

WRITING from Farnworth to his mother, under date April 13th, 1873, Mond said :—"The plans for the erection of the works are now so far advanced that we could begin any day. The principal machinery, apparatus and building materials are ordered, and in all probability we shall cut the first sod in the middle of this week. If my expectations are realised to any extent, we shall be in full swing by the beginning of September."

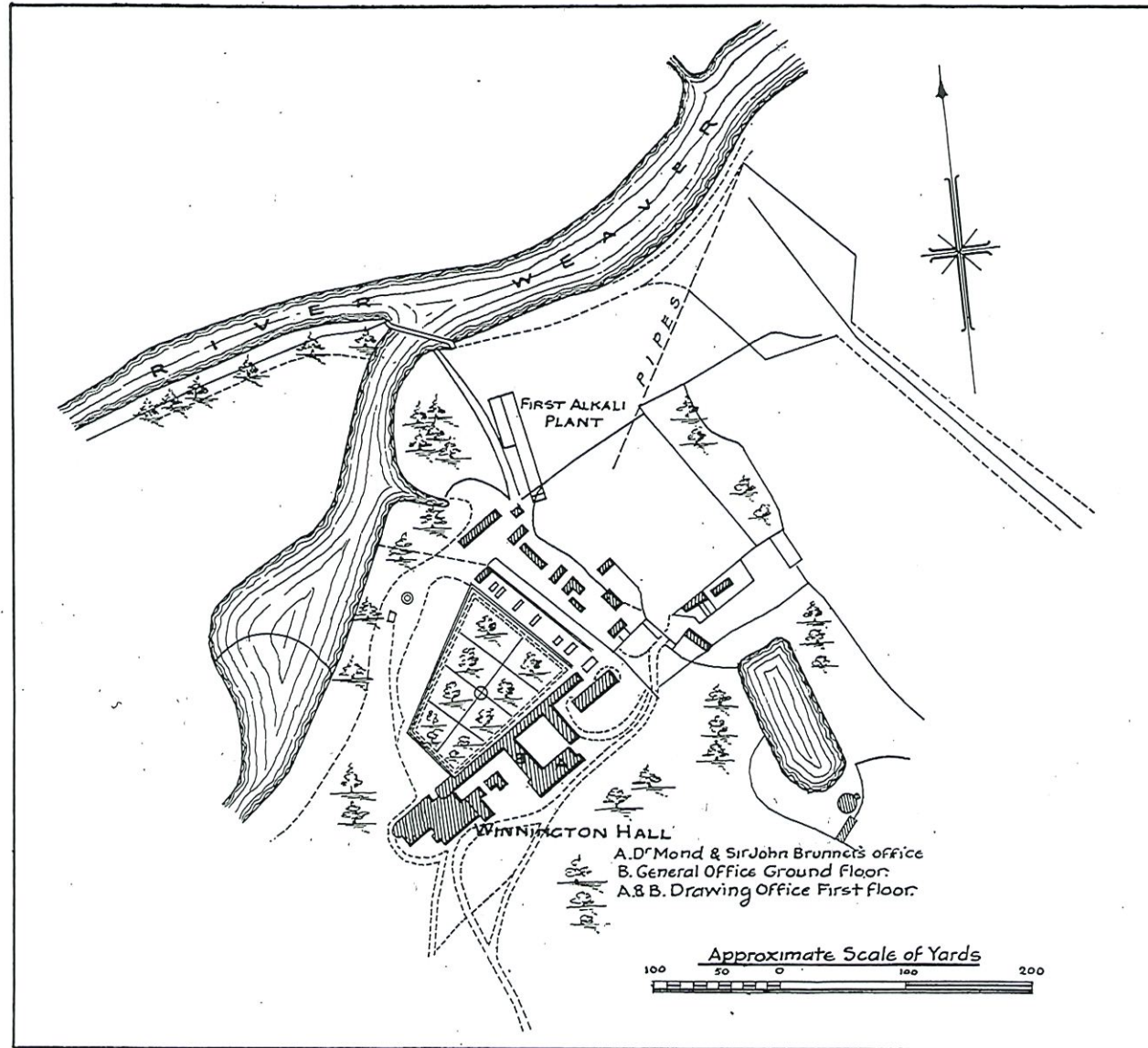
His expectations, however, were not realised, and it was not till October that building operations began at Winnington. There was no "cutting of the first sod," but a start was made by pulling down a long orchard wall and breaking up the bricks for concrete. Eighty men were engaged, the majority of them coming from William Leicester, a builder in Northwich, who contracted for most of the building.

One of the first of these men was James Lowery, who had formerly been employed by the Widnes Foundry Company. He was put in charge of the construction work, and retained the position with ever-increasing responsibility for thirty-one years. Strong and resourceful, endowed with great energy and a faculty for getting the best work from his men, he was invaluable to the firm during the struggling years of its infancy. He retired from active work in 1904, and died on October 4th, 1920.

One man was taken over with the estate, and that was John Done, the park-keeper, who began life in the service of Lord Stanley in 1854, served under Miss Bell during the whole period of her tenancy, and then remained in the employment of Brunner, Mond & Co. until his death in 1918 at the age of eighty-five. Living in the two lodges, one on each side of the entrance gates to Winnington Park, he seemed to feel that he was the Company's guard, always on duty. He took charge of all the Company's horses, and



WINNINGTON HALL



PLAN OF WINNINGTON HALL,
SHOWING POSITION OF ORIGINAL WORKS AND OFFICES, 1873-4

carried out estate repairs to fences, hedges and roads. In his old age he was very proud of having seen the works grow from the time when their founders went to Winnington as young men.

The Original Works

Built almost entirely according to Solvay's plans, the works consisted of what at that time he termed "one element," that is, five small (4 ft. 4 in. diameter) Solvay towers, four stills, one lime kiln, one blowing engine, one driving engine, five filters, four furnaces, a mill and a water pump. Barns and other buildings existing on the estate were utilised for cooperage, joiners' shop and smithy; the time office, stores and laboratory were housed in another building after some extension, while the partners themselves with their office staff took possession of the harness room in the stable yard.

The works were put in operation in the spring of 1874, and immediately demonstrated to the partners that the ammonia-soda process can be carried on only by those who know how to work it. Although the plant had been scrupulously modelled upon that of Solvay, and they had his personal assistance in its operation, it seemed during the first few months, to quote the words of Brunner, that "everything that could break down did break down, and everything that could burst did burst." Still, Mond lived in the works and learnt by every mishap. He had a bed on the platform over the engines where he could get sleep at times. He was equal to all emergencies, and steadily improved each piece of apparatus until it became not only fit to stand the expected strain and yield the calculated output, but capable of producing an even larger amount with better results. For eighteen months the partners worked six days and three nights per week. Both were on duty in the day time and one each night. Needless to say, they slept most of Sunday, when the works were closed.

The position at this period is illustrated by the following extracts from letters written by Dr. and Mrs. Mond:—

FROM LUDWIG MOND TO HIS PARENTS.

April 12th, 1874.

You will be pleased to hear that our large steam engines, which gave us so much trouble, are at last working satisfactorily during the last

few days, and we have started the works again to-night. In a few days I hope the whole of the works will be working, as I have strengthened all the weak points and have able foremen and workmen at my side, so that I expect that I shall now succeed without any great trouble to at last reach our aim.

FROM LUDWIG MOND TO MRS. MOND'S FATHER.

April 26th, 1874.

During the last few days we have succeeded in producing our first soda, and the results are good. I also hope during the course of this week to be able to work regularly half of our works and to earn at least our expenses. I have to fight with a great many obstacles which can never be avoided by the creation of a new works, though I have to go through some things which are really unheard of, like the bad manufacture of the large engines, which are still unsatisfactory; but against these obstacles I have the assurance that when I have once overcome these difficulties I am certain of brilliant results. Solvay has been here for the last few days to help me with the works.

FROM MRS. MOND TO LUDWIG MOND'S MOTHER.

June 6th, 1874.

I did not want to write to you before I was able to tell you that the works are now in full swing. How easy it is to write that, and how much work, trouble and care is included in those few words. You know that Ludwig had the greatest trouble with the large steam engine. They had to take it to pieces because it had not been made sufficiently strong. The weak parts had to be renewed and strengthened, and, from the huge dimensions of the engine, it was not a small job. Now all the difficulties are overcome.

A few days ago the works manager of Mr. Solvay came; on Wednesday all the preparations were made, and since Saturday the works have been fully active. Now it is a question of training the workmen, which is a difficulty; and, as the works have to work day and night, the gentlemen have to take night duty alternately.

The Staff in 1875

At the start the management of the men and the control of manufacture were naturally undertaken by Mond. The first works manager under him was A. Mebus, and the first chief engineer was Forrer.

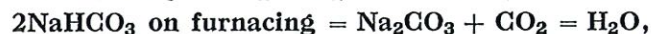
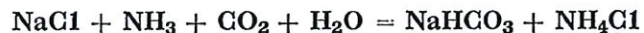
Brunner acted as salesman, accountant, and cashier. In the first few years he had to contend with several difficulties in selling the soda ash. The consumers had been accustomed to use 48 per cent.* ash, and it was hard to convince them that 58 per cent. was any better. In one case, those who tried it reported that it went no further than the soda they had formerly used, and this was difficult to explain until it was found that they were measuring the ash with the bucket their grandfather had bequeathed to them, and so were always taking the same volume whether it was 48 per cent. test or 58 per cent. It took several years to remove the general prejudice against the purer article, and even up to quite recent times some customers have required their ash to be degraded with common salt to 52, 50, and even 48 per cent.

The office staff in 1875 consisted of T. H. Forgan and George Rothwell, and, even with this number, the accommodation in the old harness room was none too ample. The partners shared one room, each taking one side of the same desk (now in the writer's office). A few years after the start, a cowshed was turned into the clerks' office, and a hayloft above was used as the drawing office. The only portion of this building remaining in 1923 is that used as the motor fire-engine house. The position of the office and the first works sheds is shown on the accompanying plan of a portion of Winnington Park as it was purchased.

A list of the names appearing in the wages book for 1875 is given in Appendix B, p. 103.

Improvements and Troubles

The chemical reactions involved in the ammonia soda process look so simple that there is no reason for surprise that it proved attractive to such a large number of eminent men. The decomposition of salt by ammonia and carbonic acid with formation of bicarbonate of soda and ammonium chloride as shown by the following equations:—



* In the early days of the alkali trade, the acid used for testing soda was standardised against a solution of sodium carbonate, the strength of which was calculated upon the assumption that the atomic weight of sodium was 24. Later, when this was ascertained to be 23, and the acid was corrected to show the true strength in percentage of Na_2O , the figure was calculated back to the old standard, and expressed as "English degrees" per cent. This custom still prevails.

and the subsequent recovery of the ammonia in a free state by treatment of the ammonium chloride with lime :—

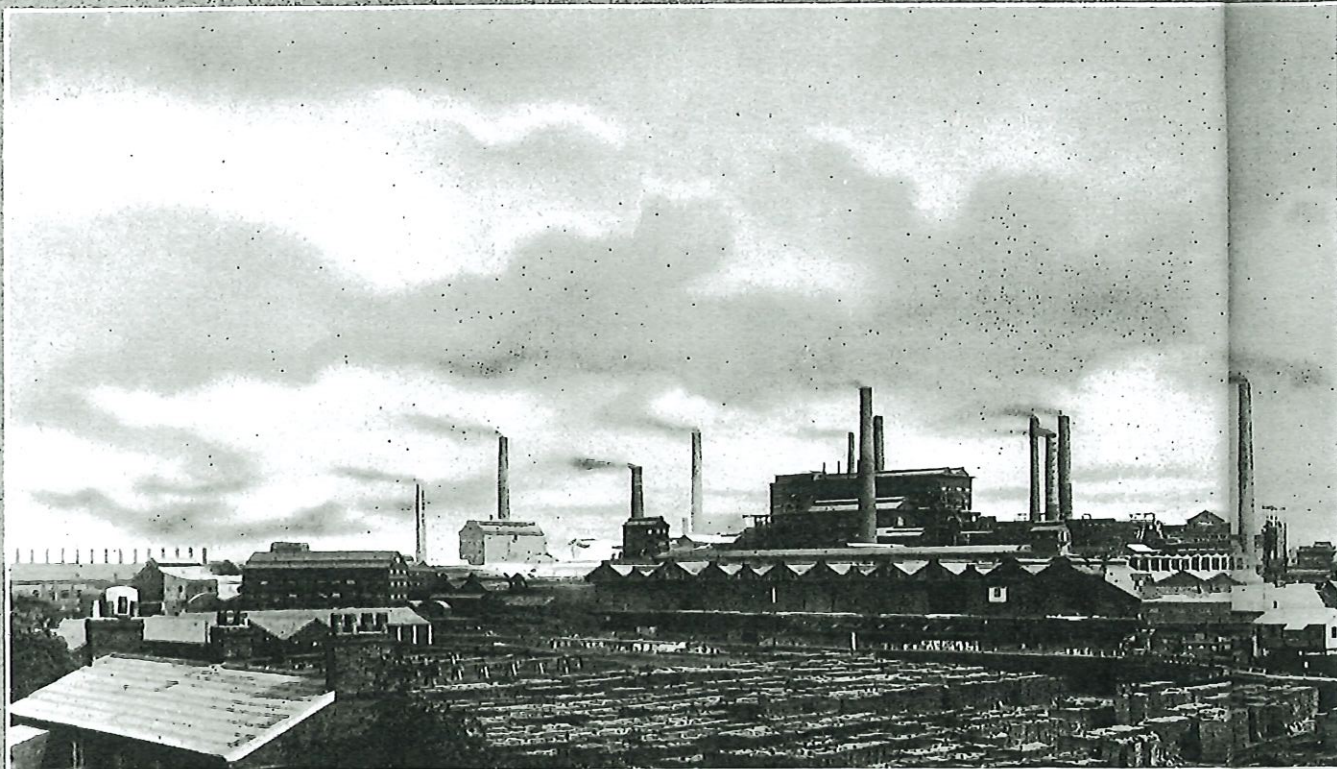


do not appear to be operations that would give any trouble ; but when it is understood that natural brine is not a pure solution of salt, and is apt to form scale throughout the apparatus when treated with ammonia, that lime is not always free from unburnt stone, and when put into stills leaves more or less stone to be blown out with the residue after distillation, and that damp carbonic acid gas attacks and weakens iron vessels, it will be recognised that the process, even as worked by Solvay, was not free from complications.

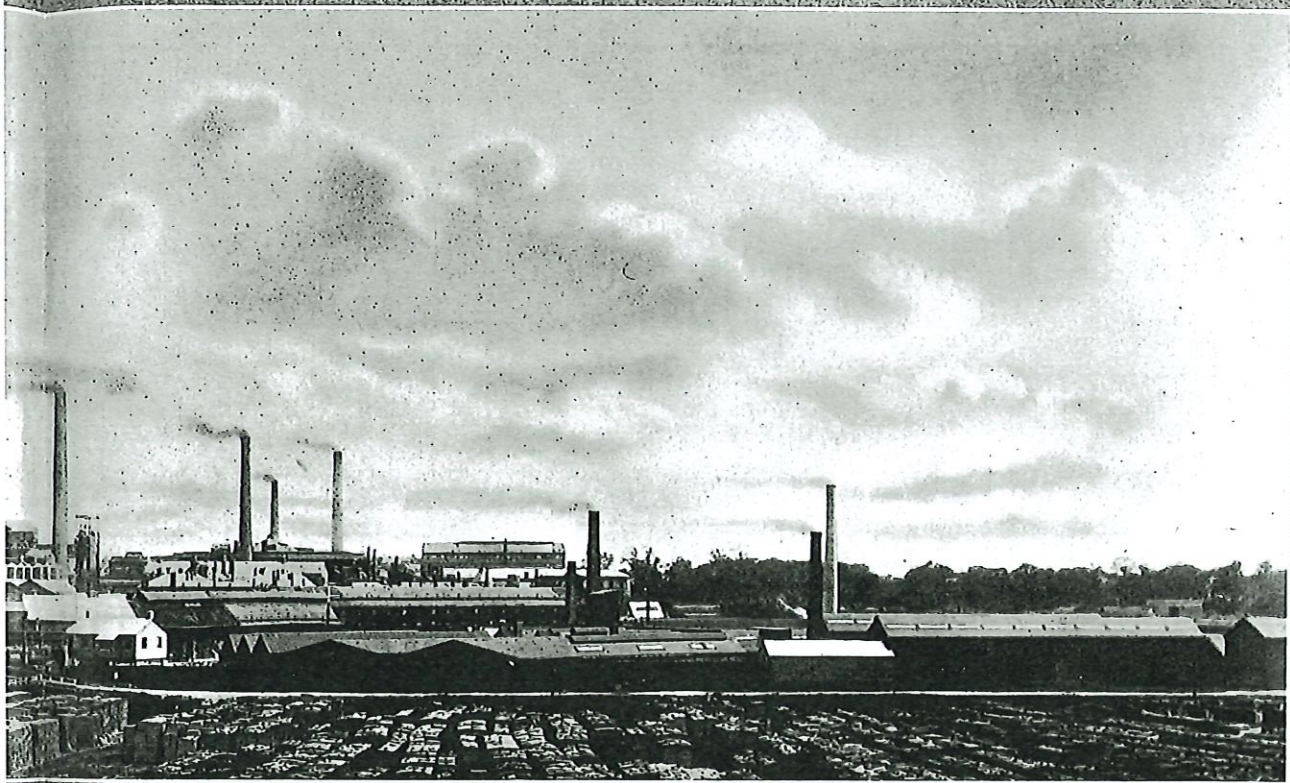
Although he started the Couillet works in 1865, and had, with his nine years' experience, introduced innumerable improvements, progress became much more rapid when Mond came in. Solvay's outstanding invention was his continuous tower, and this, except as regards size, underwent little alteration for twenty years. The intermittent distillation of liquors in groups of stills was, however, wasteful in labour, fuel, lime, and ammonia, and the problem of improving it soon absorbed Mond's attention. The objectionable practice of opening a man-hole at the top of each still, for the purpose of tipping solid lime into it each time it was charged, was got over at the suggestion of Brunner by preparing milk of lime and pumping it in.

In 1880, Mond designed a continuous distiller, consisting of a heater, 4 ft. 4 in. diameter, with four spray compartments, standing on a 6 ft. diameter distiller with seven compartments. The cold liquor that had to be distilled was pumped to the top, and descended from compartment to compartment. Steam was introduced in the bottom, ascended through the compartments, and left at the top as aqueous vapour in a gas consisting of ammonia and carbonic acid. Thus, while in this apparatus the liquors which had to be deprived of their last traces of ammonia were violently boiled at the bottom with fresh steam, the evolved gases (which must be cooled for absorption in fresh brine) were cooled by the incoming liquor.

There were various troubles due to defects in plant and faults in operation. One of these was the explosion of the tubular boilers, owing to the use of impure water from the River Weaver for raising steam. On another



WINNINGTON WORKS, 1



IRON WORKS, 1921

occasion, through the shutting of a valve by mistake, the top of a vessel was blown off through the roof of the shed. One blowing engine gave endless trouble by constantly breaking down, and, as it was only partially paid for, Brunner refused to complete the purchase. A lawsuit ensued, and in the end the partners obtained damages against the makers. At that time their losses were serious, and if the action had gone against them the result would have been most disastrous. Brunner has left on record a statement that in 1874 they made 838 tons of soda and lost £4,300, their cost of production being about £16 per ton and the selling price between £10 and £11. However, in 1875, the tide turned, and they made 2,408 tons and a profit of £2,405.

By 1877 the success of the process was so far assured that the plant at Winnington was doubled by the addition of a second "element," and the management of Sandbach was taken over from January 1st, 1878. At that time Bajou, of Solvay & Co., was acting as manager at Sandbach, and he continued in that office, under the direction of Mond and Jarmay, until relieved by Pick. The manufacture of soda crystals from dirty ash, obtained in the course of manufacture, was started on a small scale at Sandbach in 1880. In the same year, on Mebus leaving Winnington, Jarmay succeeded him as manager there, and Henry Schellhaas entered the Company's service as engineer.

Limited Company Formed

On January 1st, 1881, Brunner and Mond sold the works at Winnington and Sandbach to a limited company with a nominal capital of £600,000, divided into 30,000 ordinary and 30,000 7 per cent. preference shares of £10 each. Of these, 18,000 ordinary and 18,000 preference were issued. The vendors were allotted between them 12,000 ordinary £10 shares. The first directors were John Crosfield (Chairman), Edward Milner, G. M. Holland, J. T. Brunner, L. Mond, with T. H. Forgan (Secretary). It was stipulated in the Articles of Association that J. T. Brunner and L. Mond should each hold the office of managing director for life.

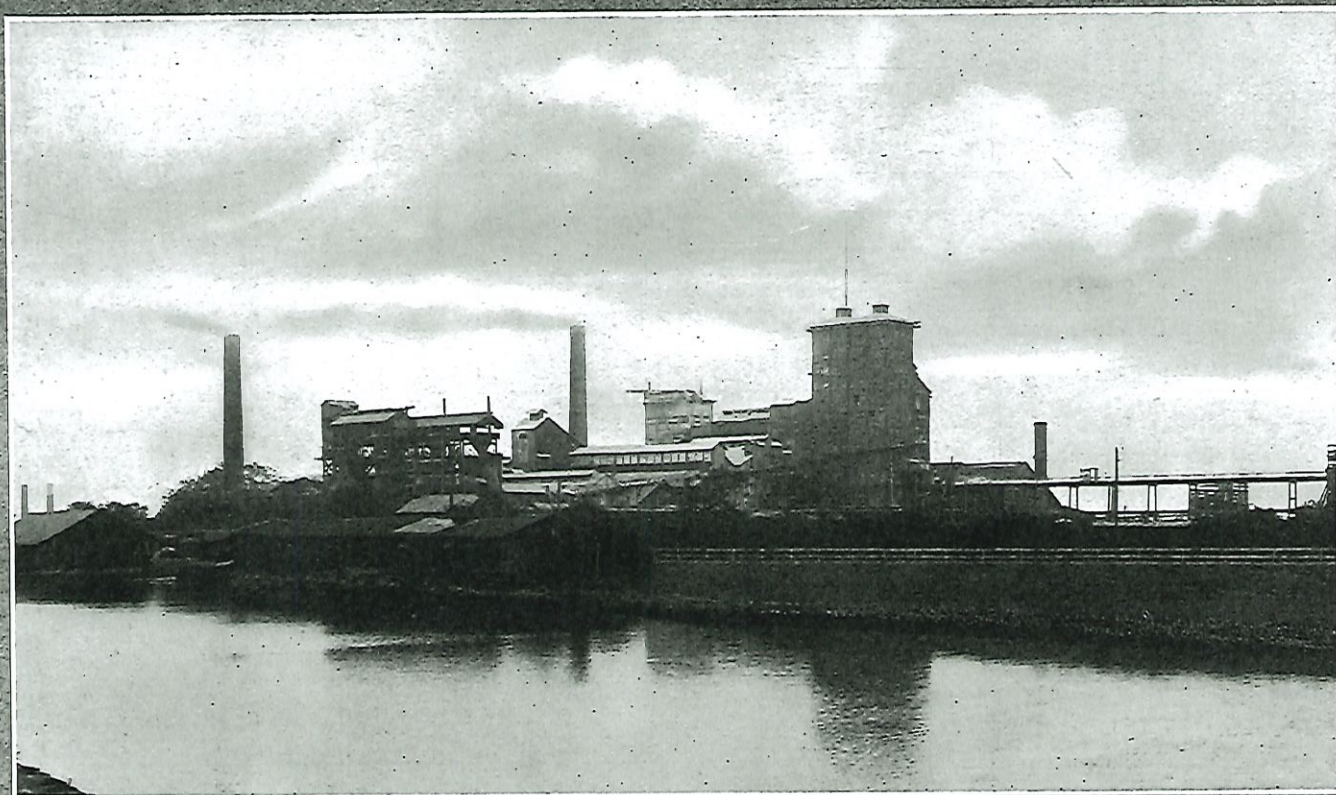
With the acquisition of capital, preparations were made for the immediate enlargement and improvement of the works, and the year 1881 was spent in

constructing a plant of new design and of greater capacity than any that had preceded it. It was placed on the east side of, and parallel with, the old works, a roadway being left in between. It consisted of two distillers, each with its absorber, settler and vats; five large towers; one large beam blowing engine; and "Mond" finishing plant comprising a combined roaster and furnace. At the same time, new lime kilns and milk of lime plant were constructed. In the same year the building of an office block was started. This afforded room for directors' and commercial offices, drawing office, laboratory, stores and managers' offices. The office block was extended in 1887, 1900, and 1905. The first locomotive, called "Solvay," was bought in November, 1881.

By February, 1882, the new plant was finished. Of a new and untried pattern, it developed peculiarities in working that were strange to those accustomed to the old design, and the first few days and nights were very exciting. In the course of a few weeks, however, when various alterations had been made, it settled down to what in those days was considered a steady run for an ammonia-soda plant. Such a "steady run" would probably have seemed like a voyage on a storm-tossed sea to one who was accustomed to an engineering shop or cotton mill. One notorious engine had a habit of breaking down constantly, always selecting a night shift or a holiday. It was ultimately so patched up and strengthened that it ran until quite recent times, and in its retirement it saw the fiftieth anniversary, though no man can say how much of the original engine was there.

Then, too, just as the first distiller was an improvement upon the stills, so the second distillers were far superior to their parent; but, being forced beyond their infantile endurance, they kicked emphatically and frequently, and seldom could the managers get away from the works without receiving a hurried message that there was "liquor up in No. 9." That meant a stoppage of a great part of the plant, a hurried cooling down of the distiller, an opening of the manlids, an examination in the midst of water, steam, ammonia and lime, and a cleaning out of one or two compartments. This performance was frequently repeated several times in a night.

In those days the works were very poorly lighted. The first gas was made by blowing air through a petrol saturator, and the jets were liable



MIDDLEWICH WORKS, 1923



SANDBACH WORKS, 1923

to go out if anybody shut a door violently or made any sudden draught. Later, a small gas retort plant was installed; but gas-light remained very scarce for many years. There were then no such things as electric pilot lamps, and local light could be obtained only by using a "duck lamp."

Well might Sir John and Dr. Mond be proud of the men who worked for them in those early days, for the place was not a bed of roses. The names of many of them will be found in the list of "Mond Pensioners" (pp. 78-80). Herbert Capes, the head foreman, was always "in the thick of it," and one remembers Sam Greenhough, Mat Brown, Frank Marsh, Aaron Owen, William Jones, Jim Morgan, Ernest Starkey, Ralph Bowden, Jim Jones, S. Griffin, J. Lewis, J. Garnett, W. Clarke, J. Norcross and W. Buckley.

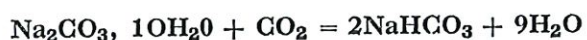
Pick left Sandbach in 1882, and Edward Milner took charge of the works until the appointment of W. A. Richards.

Extensions were continued at Winnington throughout 1882 to 1887, and the output of ash was steadily increased. In 1884, when their nominal capital was increased from £600,000 to £1,500,000, the Company bought from Lord Stanley a large additional area of land situated at Anderton and along the river Weaver. This comprised agricultural land, brine shafts, salt works and the submerged land known as "The Furey," the last providing a much-needed tip for works' cinders and other solid refuse, and also a receptacle for waste lime. Previously, the waste lime had been conveyed from the works in open boats to Witton Brook and discharged upon subsiding land by pumping out of the boats. When the Furey was first acquired, and for a few years afterwards, the loaded boats could enter the large deep lake that existed there and discharge over their sides. About four years later, however, the method of pumping from the works to the Furey was adopted. The lime beds now stand eighty to ninety feet above river level.

Refined Bicarbonate

In 1884 Mond and Jarmay patented a process for purifying the crude bicarbonate obtained in the ammonia-soda process by dissolving it in water and re-crystallising it. Up to this time, nearly all bicarbonate had been

made by exposing soda crystals ($\text{Na}_2\text{CO}_3, 10\text{H}_2\text{O}$) to the action of carbonic acid gas according to the equation



This was a laborious and costly process, and consequently the sale price of bicarbonate was high. The product yielded by the Mond and Jarmay process, which was worked in 1886 and for some years afterwards, commanded a ready sale, and materially lowered the general market price to consumers; but although in other respects it was as pure as any other make obtainable, it still contained minute traces of ammonia. Accordingly, in a few years' time, the process was altered to one that depended on re-precipitation with carbonic acid gas.

In 1885 the Sandbach make was doubled, and No. 2 distiller started.

Finishing Plant

In the original Solvay works and at Sandbach the crude bicarbonate was converted into ash in "pot roasters," shallow cast-iron pots with a wrought-iron cover to prevent loss of ammonia, and a vertical centre shaft carrying horizontal scrapers to keep the charge stirred. These were fed and discharged by hand. In 1884 an experimental machine was started at the Sandbach works on the principle of one invented by Th  len (a foreman at Hasenclever's works). Th  len's machine consisted of a number of curved cast-iron pans (segments of a circle in cross section) supported on brick walls to form the flues through which gases passed along from a furnace at the end. The charge was agitated by ploughs carried from a longitudinal shaft, the ploughs being set to promote traverse of the material.

For evaporating moisture from salts, Th  len's machine was uncovered; but to adapt it for finishing bicarbonate containing ammonia it had to be provided with a gas-tight hood. After many alterations, many breakdowns, and the burning out of many pans during the experimental period, the machine settled down to a fairly steady output of five to six tons per day.

For the Winnington works, Mond always preferred his own pattern of "roaster" to the Solvay type, and considered it better to convert the crude bicarbonate into ash in two stages, viz., by driving off the water, ammonia, and some carbonic acid in one machine and then calcining to soda ash in

an open-hearth furnace. In the extensions of 1881 to 1884, he built roasters having a bed of flat cast-iron plates with a circular wrought-iron hood, centre shaft, and horizontal arms with ploughs, arranged so close to a finishing furnace that the charge, after drying, could be drawn directly on to the hearth. The ash was drawn from the furnaces red hot, and required cooling before it could be ground. In the original works this was done by spreading it out on the floor and allowing it to remain there for some hours, but in the 1883-84 extension overhead cooling bands made of fine wire gauze were installed. The hot ash was roughly crushed in an edgerunner, and elevated to the bands. After travelling slowly along these it was sent to the mills.

When the Sandbach model had been fully tested, larger machines were installed at Winnington in 1885-86, designed to finish ten to fifteen tons of ash per day.

The finishing machines turned out a lighter quality of ash than the hand furnaces, and while this was found quite suitable for most home trades it was not so acceptable or profitable for export, and, as the old hand furnaces were abandoned, Mactear mechanical furnaces were erected. The first started in January, 1886. The cooling bands, being exceedingly dusty and very costly in repairs, were superseded by a rotary tubular conveyor that cooled the rough ground ash as it transported it to the mills.

Concentrated Crystal Soda

The manufacture of sesquicarbonate of soda, christened "Concentrated Crystal Soda," was begun on a small scale at Sandbach in 1887. In the previous year, Watts and Richards had patented a process for this purpose. They showed that the formula of the substance is $\text{Na}_2\text{CO}_3, \text{NaHCO}_3, 2\text{H}_2\text{O}$, which does not agree with any formula given for the native soda known as "natron" or "trona." It was subsequently recognised that the compound is not obtained pure except by artificial preparation, and that the above formula represents the true composition of "trona."

Recovery of Chlorine

The ammonia-soda process as a competitor of that of Leblanc possessed the defect that it wasted all the chlorine of the sodium chloride, and so produced no bleaching powder.

In 1883 Mond patented a process for treating ammonium chloride with sulphuric acid and obtaining hydrochloric acid and ammonium sulphate. In 1886, plant was erected and put to work for evaporating the residual liquors from the tower reaction, until, after the removal of the first crystals of common salt, ammonium chloride crystallised out. In the same year Mond invented a process for obtaining chlorine by passing the vapour of ammonium chloride over nickel or a similar active oxide to form the corresponding chloride with liberation of ammonia, the chloride being subsequently treated with hot dry air to liberate chlorine and regenerate the oxide. This process was installed at Winnington, and bleaching powder was made by it for several years. The old concentration process for obtaining ammonium chloride was superseded by a cold one, wherein the liquors were reduced in temperature by freezing machines until the ammonium salts separated. The dried ammonium chloride was volatilised by heat, and the vapours were passed over nickel oxide. This yielded nickel chloride, and allowed free ammonia to pass forward for absorption in water and eventual return to the soda process.

In order to secure the exposure of a large surface to the action of the gases, Mond made up the nickel oxide into pills by mixing it with china clay and pressing it between rollers with hemispherical cavities. He found that when these pills had been in use for some weeks they became black, swelled up, and ultimately fell into powder. Investigation showed that, in this condition, they contained a considerable quantity of carbon. This was found to owe its origin to the constituents of the so-called "inert gas" which was employed to sweep out the last trace of ammonia from the apparatus before proceeding to evolve chlorine. This gas was obtained from the exits of the ammonia-soda precipitation towers, and consisted of nitrogen mixed with some carbon dioxide and carbon monoxide.

A study of the behaviour of these gases in the presence of nickel oxide and their action on metallic nickel led Mond and Langer not only to devise a method of removing carbon monoxide from producer gas, but also to the discovery of nickel carbonyl. The plant employed for the volatilisation of ammonium chloride had to be of special construction on account of the violent attack of the vapour on most metals. The valves which were required

for effecting the changes of current were made of nickel. Although laboratory experiments had shown this metal to be proof against attack by ammonium chloride vapour, the valves in the manufacturing process soon became leaky, and were found to be coated with carbon.

Mond and Langer were thus led to make a careful study of the action of carbon monoxide on nickel, with the view of ascertaining whether a definite compound of nickel and carbon was formed. In the course of experiments, finely divided nickel was treated with pure carbon monoxide in a glass tube at varying temperatures for a number of days, and was then cooled in a current of carbon monoxide before it was removed from the tube. In order to keep the poisonous monoxide out of the atmosphere of the laboratory, the gas escaping from the apparatus was led to a Bunsen burner and lighted. To their surprise, they found that, while the tube was cooling, the flame became luminous and the luminosity increased as the temperature fell below 100° Centigrade. The flame gave a mirror on a cold porcelain plate, and when the glass exit tube of the apparatus was heated, a metallic mirror was obtained inside, whilst the Bunsen flame lost its luminosity. The mirror was found to consist of pure nickel. Eventually they were successful in discovering that, at a temperature below 100° , nickel combines with carbon monoxide to form a tetracarbonyl, which is a colourless liquid boiling at 43° and solidifying at 25° to form needle-shaped crystals.

Owing to the disintegration of the nickel pills, Mond substituted magnesia and obtained satisfactory results. The chlorine process was carried on for several years; but the plant proved costly in repairs, and the heat losses were considerable. Although the raw material, ammonium chloride, was ready to hand in solution with other compounds, the separation and drying of the pure salt could not be effected cheaply, and proved a serious handicap to a process which had to compete with those that started with common salt. The process was, therefore, abandoned in favour of one patented by Carl Hoepfner, by which zinc oxide and calcium chloride under treatment with carbon dioxide yield zinc chloride and calcium carbonate. The zinc chloride on electrolysis gives chlorine and pure zinc. Thus the residual liquors from the ammonia-soda process were made to yield their chlorine,

and the zinc was obtained in such a state of purity as to command a high price. Owing to imperfect decomposition of the zinc oxide, and other losses in manufacture, the Hoepfner process was ultimately abandoned for one consisting of the solution of zinc oxide in hydrochloric acid. In 1919 the manufacture of bleaching powder at Winnington was entirely abandoned.

Many of the grades of zinc blende that were used in the process contained cadmium. During the purification of the zinc chloride solution this was separated, and after further treatment to remove impurities was distilled and put on the market in the form of rods.

Ammonia Supply

With experience and improvements in plant, the loss of ammonia in working—one of the great difficulties encountered by the earlier exponents of the ammonia-soda process—was steadily reduced, but the need for diminishing the prime cost of this necessary raw material was never lost sight of, and the Company spared no effort to find cheaper sources of supply. For many years they had to buy it in the form of gas-water containing 2 or 3 per cent., and when they concluded a long-term contract to take the Liverpool Gas Company's ammoniacal liquor, they erected close to the gas-works at Linacre plant for concentrating it to 15 or 16 per cent., in order that they might reduce the expense of transportation by boat to Winnington. This plant was started in 1885 and worked during the period of the contract until 1919, when the works were sold to the Gas Company.

About the same time as this plant was established, the Company, in their anxiety to obtain cheap ammonia, turned their attention to bye-product coke ovens, and as coke is a raw material required for burning limestone, they started the first English battery of Semet-Solvay ovens at Winnington in June, 1886. There were 30 ovens capable of producing 30,000 tons of coke per annum.

As early as 1879, again in pursuit of cheap ammonia, Mond had begun to test the known processes of obtaining it from the nitrogen of the air. None gave satisfactory results, except the barium cyanide process of Margueritte and Sourdeval, which consists in heating a mixture of barium



WINNINGTON WORKS STAFF, AUGUST, 1888

W. Wilkinson.	S. Molyneux.	H. Bright.	W. Buckley.	J. Patten.	W. Oakes.	A. Kirkham.	A. E. Starkey.	J. R. Watson.	W. Hodgkinson.	G. Evans.	A. McKenzie.	G. Ellis.	F. Marsh.
A. Owen.	S. Bradshaw.	J. Randle.	J. Allman.	W. Hankey.	F. Bonnell.	C. White.	J. Done.	W. Bryden.	F. W. Brock.	J. Astbury.	J. J. Melville.	T. Winstanley.	W. Hughes.
J. Garnett.		J. Cook.	J. Warburton.	T. Musgrave.	W. H. Baker.	R. Bowden.	J. Green.	C. T. Bickerton.	J. Naylor.	W. Sutherst.	J. Thompson.		
J. Moore.	R. Stringfellow.	K. Markel.	J. I. Watts.	C. Humfrey.	H. Capes.	C. C. Moore.	J. Lowery.						
T. A. Johnson.	T. H. Forgan.	G. S. Rothwell.	D. B. Hewitt.	L. Mond.	J. T. Brunner.	E. Milner.	J. F. L. Brunner.	H. Schellhaas.	W. Field.	M. Brown.			
G. Johnson.							A. W. Tangye.						



SANDBACH WORKS-STAFF, 1888

Back row.—M. Dale, J. Knibbs, W. Yarwood, G. Scragg, J. Gorst, J. Minshull, J. Barker.

Third row.—L. Hancock, D. Stead, J. Burns, D. Handcock, C. Condliffe, A. Ryder, G. Byrne, E. Lynes.

Second row.—H. Chesters, W. Sherratt, G. Huebanks, J. I. Watts, W. A. Richards, S. Sherratt, A. Chapman, J. Latham, G. H. Holland.

Front row.—H. Flockton, F. Fortune.



WINNINGTON WORKS STAFF, AUGUST, 1888

carbonate with carbon in the presence of nitrogen and then treating the resulting barium cyanide with steam, thus producing ammonia and regenerating the barium carbonate. He designed apparatus for carrying out this manufacture on a fairly large scale at Winnington, but finding that on account of the high temperature required the special vertical clay retorts would not stand, he was compelled reluctantly to abandon it.

Mond Gas

In investigating the process patented by Rickman and Thompson, which consisted in passing air and steam through a deep coal fire, he came to the conclusion that if coal could be burnt in gas producers with a mixture of air and steam ammonia could be obtained, and the gas could be used in the same way as ordinary producer gas. He, therefore, constructed gas producers and ammonia-absorption plant at Winnington, and succeeded in converting about one-half of the nitrogen existing in the fuel into ammonia. The gas was used for heating furnaces and working gas engines, and ultimately a very large plant was installed. This plant was the forerunner of many that were erected throughout the country for the production of "Mond gas." It is interesting to chronicle here that when the steel makers of the country said that on account of its low calorific power the gas could never be used in their furnaces, Mond, with characteristic energy, built a Siemens steel furnace at Winnington, and making steel in it for several weeks invited the steel makers to come and see it in operation.

One of the first applications of producer gas at Winnington was to the Galloway boilers, but the evaporative results were not satisfactory, and after many months of experimenting with different types of burners it was realised that the ordinary furnace of a Lancashire boiler is not adapted for the efficient combustion of such gas, and the boilers were changed back to coal firing. Much better results were obtained with the firing of salt pans provided with large combustion chambers. It was there that experience was gained in lighting up gas fires, for one day there was a violent explosion that blew out the front of the fireplaces and frightened a number of people, fortunately without injuring anybody.

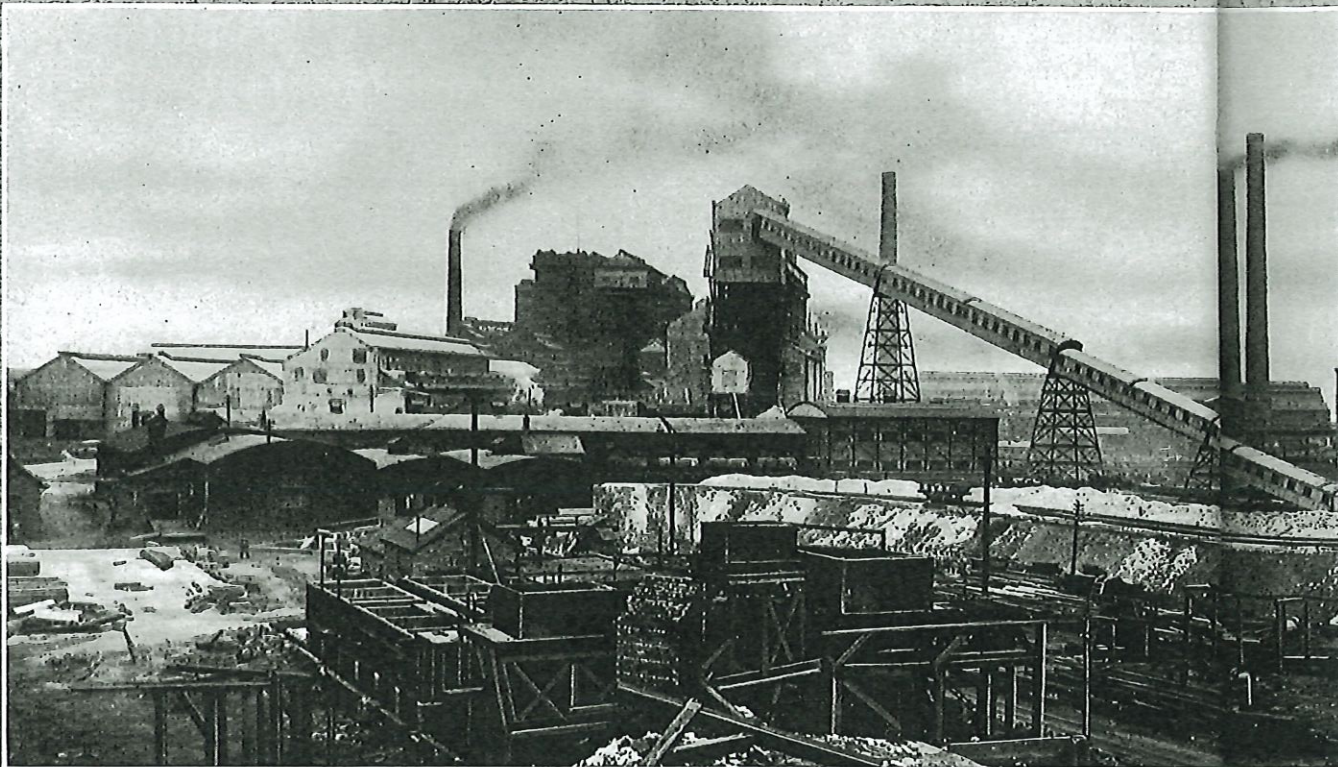
Position of Leblanc Process

In 1888 Solvay & Co. celebrated their twenty-fifth anniversary, and published a souvenir volume containing photographs of groups of the principal men engaged in all the works carrying on the Solvay process, including those at Winnington and Sandbach. By this time the increased output of ammonia-soda (already six times that of 1881) was having a decided effect upon the Leblanc trade, and in the face of ever-falling prices many of the manufacturers were finding it hard to carry on. They began to realise that their process could not hope to compete with Solvay's in the production of soda ash, and that in future they must look to their acid and bleaching powder products for their profits. They had also to reckon with soda crystals produced from ammonia-soda, as a new installation capable of turning out that product in large quantities was started at Winnington in 1888, and the same manufacture was initiated at Silvertown six years later to supply the south of England. They were, however, as yet free from competition in caustic soda, the manufacture of which was not begun at Winnington till 1895. The process then adopted was the "Loewig," which consisted in furnacing soda ash with ferric oxide and then lixiviating the ferrite of soda to obtain a solution of caustic soda and recover the iron as ferric oxide. Shortly afterwards the same process was installed at Silvertown, from which the caustic was sold in solution, whereas from Winnington it was sold in solid form.

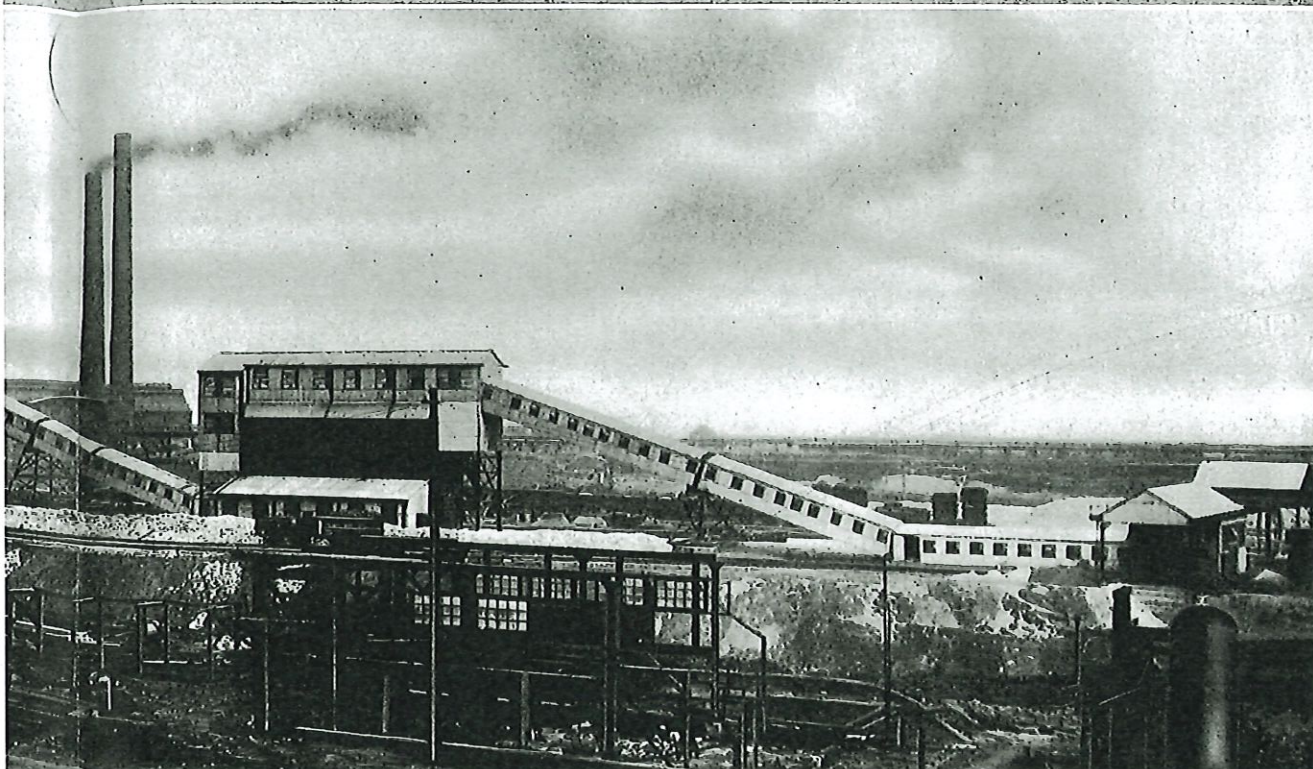
In these circumstances the Leblanc manufacturers took the wise course, in 1890, of forming the United Alkali Company, Limited, which bought up most of the existing Leblanc works, closed the least profitable, concentrated the manufacture in the most up-to-date establishments, and economized management. Some years later they built ammonia-soda works at Fleetwood.

Ammonia-Soda Competition

Meantime the success of Brunner, Mond & Co. was attracting attention, and sundry attempts were made by others to work the Solvay process or variants of it. At Middlewich the Cheshire Alkali Company, in 1887, built works in which a combination of the ammonia-soda and Leblanc processes was employed. They had, however, a chequered career, never making much



LOSTOCK ORKS, 1923



rock Works, 1923

profit for their shareholders, and, in 1897, they were glad to stop and allow their works to be dismantled, by arrangement with Brunner, Mond & Co.

At Middlewich, also, Messrs. Murgatroyd & Co. erected ammonia-soda works in 1893, modelled more upon the design of Daguin of Varangeville than that of Solvay, and, by careful management, were able to carry on for some years. But in 1895 the works were taken over by Brunner, Mond & Co., who rebuilt them and started them again in 1897, with E. B. Harlock as manager, and R. L. Allen as his assistant. They form the present Middlewich works of the Company.

For some years the manufacture of alkali was carried out on a small scale by Messrs. Bell Brothers, at Port Clarence, near Middlesbrough, by Schloesing's process, in which ammonium bicarbonate is prepared in the solid form, and by treatment with brine is converted into sodium bicarbonate; but in 1900 the works were sold to Brunner, Mond & Co., and eventually dismantled.

In 1891 Messrs. Bowman, Thompson & Co., Limited, built works at Lostock Gralam, near Northwich, for the production of ammonia-soda, salt, sulphuric acid, saltcake, and bleaching powder. Essentially the process employed for making ammonia-soda was the same as Solvay's, but the plant employed was of different design. These works attained a considerable output, but the financial result was not encouraging to the shareholders, and in 1900 they were sold to Brunner, Mond & Co. The ammonia-soda plant was immediately stopped for remodelling, but the bleaching powder and acid works were carried on for some years. T. A. Johnson, with A. W. Tangye as assistant, was appointed manager, being transferred from Winnington, where he was succeeded as manager by John I. Watts. Soda manufacture was resumed in 1907, after reconstruction of the works.

The Twenty-fifth Anniversary

In 1898 Messrs. Brunner, Mond & Co. celebrated the twenty-fifth anniversary of the foundation of the Winnington works. From the first radical transformation of the plant in 1882 and following years the Company had never ceased to remodel parts of the apparatus, with the object of improving its efficiency and enhancing its output with the same or less

supervision, and, in consequence, the figures of production showed a continuous increase. The growth of the undertaking may be gauged from the fact that in 1898 the output of all soda products, stated as 58 per cent. ash, was nine times that of 1881.

The celebration began on June 7th, when the Directors entertained representative members of the staff and certain other guests to dinner at Winnington Hall. The guests included MM. Ernest and Alfred Solvay, M. Frey, M. Famerie, and M. Hulin (representatives of Solvay & Co.). Mr. John Crosfield presided, supported by the following Directors:—Sir John Brunner, Dr. Mond, Mr. (now Sir) Alfred Mond, Mr. Henry Brunner, Mr. C. J. Galloway, Dr. D. B. Hewitt, Mr. C. M. Holland, Mr. E. Milner, Mr. (now Sir) John Jarmay, Mr. (now Sir) J. F. L. Brunner.

On July 8th a dinner was given in the Central Hall, Northwich, when 200 guests were present, consisting of members of the staff, foremen, and men with long service.

A monster fête was held in Winnington Park on July 9th, for the entertainment of all the workmen, with their wives and children, 12,000 persons being present in all. Each child was given a bag of sweets and a specially made souvenir mug bearing portraits of Sir John Brunner and Dr. Mond. The proceedings opened with the cutting, by Sir John Brunner and Dr. Mond, of the first sods for the new pavilion which they presented, as their personal gift on the occasion of the celebration, to the Winnington Park Recreation Club. The ceremony was performed with special spades presented by the Committee.

A Disastrous Fire

Two years later the works at Winnington were seriously crippled by a fire which originated in the gas producer plant on August 27th, 1900. The plant consisted of three units, each with its mechanical washer, acid absorption tower, gas-cooling tower, and air-heating tower. Two of the acid towers were built of stone slabs and one of lead sheets, and all were filled with ring tiles. On the date in question, in changing over from one unit to another, there was an escape of gas from the bottom of No. 3 (lead) acid tower, and this was ignited by an adjacent illuminating gas flame. The

Key to illustration of Hosts and Guests at Banquet given at the Central Hall, Northwich,
on the 25th Anniversary of the commencement of Winnington Alkali Works, July 8th, 1898

1	*P. Moran	W	37	†T. A. Johnson	W	73	†G. Huebanks	S	109	†Chris. Brown	S
2	*J. Burgess	W	38	J. F. L. Brunner	W	74	*S. Buckley	L	110	John Bloor	M
3	†J. Poole	W	39	A. Mond	W	75	*J. Lewis	W	111	W. Baddeley	S'n
4	*T. Berry	W	40	†H. Schellhaas	W	76	*W. Darlington	W	112	F. Ryder	S
5	*J. Jones	W	41	G. Jarmay	W	77	*A. Mackenzie	W	113	†W. Lindop	W
6	†H. Hertz	W	42	*T. H. Forgan	W	78	*W. Hodgkinson	W	114	*W. Gascoyne	S
7	*H. B. Brunner	W	43	*Sir John Brunner	W	79	†W. Hankey	W	115	*E. Birchall	M
8	*H. Capes	W	44	*Dr. Mond	W	80	*W. Nutter	W	116	W. Oakes	W
9	T. Alcock	W	45	*E. Milner	W	81	*G. Holdridge	W	117	J. Astbury	W
10	T. Winstanley	W	46	L. P. Acheroy	SPCo	82	J. Bowyer	W	118	W. Wilcox	W
11	J. Burton	W	47	*J. Lowery	W	83	†S. Aston	W	119	*J. Griffiths	W
12	C. Mills	W	48	*W. A. Richards	S	84	†H. Sattler	W	120	†S. Molyneux	W
13	*H. Pickering	W	49	E. B. Harlock	M	85	R. Stephenson	W	121	C. Denning	W
14	*T. Eyes	W	50	*J. Norcross	W	86	†M. Brown	W	122	G. Skeath	W
15	J. W. Mills	W	51	†J. Robinson	W	87	*W. Gorst	W	123	*W. Whitby	W
16	†W. Beech	W	52	*J. Bradshaw	W	88	*W. Brodie	W	124	H. Brown	W
17	†R. Bowden	W	53	†C. Rowe	W	89	B. Dobell	W	125	†W. Warburton	W
18	*W. Yarwood	W	54	*G. Hardley	W	90	*F. Marsh	W	126	J. Coombs	W
19	*W. H. Baker	W	55	†G. Beckett	W	91	E. Litler	W	127	*T. Holbrook	W
20	J. W. Deakin	W	56	A. E. Starkey	W	92	†G. Haddock	W	128	†W. Edwards	W
21	*G. Wilkinson	W	57	*C. Patten	W	93	†J. Cashmore	W	129	J. P. Westwood	W
22	*J. Proudfoot	W	58	†H. Bright	W	94	*J. H. Buckley	W	130	M. Dale	S
23	*J. Taylor	S	59	*J. Done	W	95	*J. Smith	W	131	*G. Meers	W
24	†J. Flude	W	60	†James Cooke	S	96	*John Hough	W	132	*T. Prest	W
25	J. I. Watts	W	61	†L. Hancock	S	97	Jas. Marsh	W	133	†W. Jones	W
26	B. R. Lucas	W	62	*D. Hancock	S	98	*H. Stubbs	W	134	T. Ross	W
27	†C. Humfrey	W	63	*W. Sherratt	S	99	*John Patten	W	135	J. Spilsbury	W
28	P. Shard	W	64	*S. Sherratt	S	100	*S. Griffin	W	136	*J. Mottershead	W
29	A. W. Tangye	W	65	†F. Hall	S	101	*Jas. Hough	M	137	*G. Alcock	W
30	*O. Brock	W	66	†J. Capper	W	102	C. Baker	M	138	*H. Gresty	W
31	*R. Brown	W	67	C. Mason	W	103	T. Bloor	M	139	*S. Gerrard	W
32	*J. Garnett	W	68	†F. Wakefield	S	104	*W. Wilkinson	W	140	J. Thompson	W
33	†J. Pearson	W	69	†D. Stead	S	105	*F. Fortune	S	141	*H. Johnson	W
34	R. L. Allen	S	70	*J. Gorst	S	106	†G. Boote	S	142	*W. Buckley	W
35	R. Brunner	W	71	†J. Knibbs	S	107	F. Dodd	W	143	*John Byrne	S
36	R. Mond	W	72	†A. Chapman	S	108	*H. Allen	W	144	†T. Starkey	W
									145	John Cook	W

1923.

Those marked * now Deceased.

Those marked † now left the employ.

Those marked ‡ now Retired List.



GUESTS AT THE BANQUET, NORTHWICH



GROUND FLOOR OF THE GAS PRODUCER PLANT AFTER THE FIRE

whole building, the framework of which was of timber, as were the platforms and the roof, was quickly ablaze, and in spite of the valiant efforts of the fire brigade, the roof, stages, and platforms were destroyed, while the pipes, which were slung from the cross timbers, crashed down in a shapeless heap. All the lead sheeting of the acid tower was melted off, leaving the ring tiles standing like a pillar of honeycomb.

The gravity of the accident lay in the fact that at that time all the finishing machines were gas-fired. The calamity was so great and so obvious that it had a magical effect upon the whole of the employees, and they set to work with tireless energy to get things straight, determined to show what Brunner, Mond's men can do when called on by the Company. While gangs of men under Lowery's direction tackled the producer plant, working day and night (fortunately it was summer-time), others built coal fireplaces to the finishing machines, and in the course of a few days ash was being finished again. The producers themselves were making gas at the end of fourteen days. Eventually a new building of steel arose from the ashes of the old one.

Later Development

Since the beginning of this century the record of the Company has been one of steady development and expansion. There have been temporary checks, as, for instance, by the railway strikes of 1911 and 1919, and the coal strikes of 1912 and 1921; but the output, which in 1898 was nine times that of 1881, had grown to twelve times in 1903, to fourteen times in 1908, to twenty times in 1913, to twenty-five times in 1918, and to twenty-eight times in 1922. Concomitantly a policy has been pursued of enlargement and broadening of interests, and of strengthening of resources for the supply of essential raw materials. In the provision of munitions during the Great War, Brunner, Mond & Co. took a leading if unobtrusive part, some details of which are given in a subsequent chapter.

In 1911 they bought a controlling interest in the soap-making businesses of Joseph Crosfield & Sons and William Gossage & Sons, but sold it to Lever Brothers in 1920. In 1912 they acquired from Lord Barrymore a plot of land containing 241 acres situated in the valley near Winnington, and

including the ancient manor house of Wallerscote and a farm of the same name. The intention was to erect soda works, but on account of the scarcity and high price of materials during the war, building was deferred for a few years. In order to connect the land with the railway lines at Winnington, it was necessary to divert the road leading to Barnton and Runcorn and construct a new portion passing over bridges. This work was begun before the war, but was not finished till 1923.

In 1916 they bought a majority of the ordinary shares in the Ammonia-Soda Company, Limited. About 1907, prospectors for brine had discovered the existence of a supply on the rock head at Plumbley, near Northwich, and subsequent borings showed this to be of unprecedented thickness. The land was sold by Mr. J. H. Davis to the Ammonia-Soda Company, who proceeded to erect works on the spot, though the site was ill-suited to the purpose because it had no adequate water supply and no facilities for the disposal of effluent liquors. The process employed was somewhat similar to Solvay's, but the plant was of poor and antiquated design. Started in 1909, the works were carried on for ten years and produced considerable quantities of ash, but the profits were not commensurate. The Company went into voluntary liquidation in 1919, and ultimately Brunner, Mond & Co. acquired the land and works.

In 1917 they bought an interest in the old-established chemical manufacturing firm of Chance & Hunt, of Oldbury, near Birmingham, and in 1920 a majority of the ordinary shares of Castner-Kellner, Limited, chemical manufacturers, of Weston Point, near Runcorn, and of the Electro-Bleach and Bye-Products Company, Limited, of Middlewich. In 1919 a controlling interest was purchased in the Buxton Lime Firms, Limited. In the manufacture of ammonia-soda, limestone is required as a source of carbonic acid gas, and of lime for the decomposition of ammonium chloride. Ever since their formation the Company had relied almost entirely on Derbyshire for this limestone, and with the ever-increasing demand they were naturally glad to take advantage of the opportunity that was offered them of assuring their supplies.



WINNINGTON WORKS STAFF, 1913

Seventh row.—W. Buckley, S. Pickering, A. Hickson.

Sixth row.—A. Cross, J. Burrows, S. Molyneux.

Fifth row.—P. Coombs, D. Nicholas, H. Flude, H. Sattler, H. Brown, A. Dale, M. Brown, A. Hignett, G. Postles, A. Gibson, H. Bright, H. Walkden, B. Dobell, J. Marsh, H. Marsh, G. Hilditch, J. Moore, F. Dodd.

Fourth row.—J. Tomlinson, T. Woodward, F. McCormack, J. Stubbs, W. Topping, W. Oakes, W. Darlington, G. Haddock, R. Stephenson, G. Holdridge, J. Astbury, J. Woodward, T. Ross, W. Lindop, W. Woodward, E. Litler, A. Ryder, A. H. Cowap, F. Capper, J. G. Barker, J. Cook, Jun.

Third row.—F. Kirkham, G. Capper, J. Mellor, W. Bostock, L. Hitchinson, W. R. Robins, J. Corker, W. Lang, J. Cook, M. Thomas, G. Lambert.

Second row.—B. Wyman, W. Wilkinson, J. H. Kellett, J. Burton, J. Evans, T. Winstanley, T. Newall, J. Randle, A. E. Starkey, R. Bowden, H. D. Butchart, W. Willcox, G. Plant, W. Deakin, A. Hollows, G. H. Holland, L. H. Swinbank, W. Clegg, J. Hurst, J. Done, H. Yeomans.

Front row.—J. H. Willcox, C. White, C. F. Poole, C. T. Bickerton, E. S. Kitchen, A. M. Sturges, E. S. Grumell, C. Johnson, L. Harper, E. J. Shaw, T. B. Jump, J. I. Watts, A. Kling, W. R. Forgan, J. J. Harper, P. Shard, H. J. Reid, J. Moore, H. B. Brunner, H. Delafield, R. R. Lucas, S. Massey, P. F. Mackarel.



STAFF AT LOSTOCK WORKS, 1913

1—J. Thompson.	9—A. Bassett.	17—W. Towers.	25—R. Williamson.	32—J. Allcock.	39—J. Jolley.	46—T. A. Johnson.	53—T. Faulkner.	60—J. Burgess.
2—W. Hughes.	10—D. Dalton.	18—J. Ryder.	26—W. Roughsedge.	33—E. C. Hilditch.	40—T. Capes.	47—R. L. Allen.	54—T. Forster.	61—M. Marlow.
3—S. Lane.	11—S. Leathwood.	19—J. Lloyd.	27—J. Bowyer.	34—S. B. Potter.	41—J. Capper.	48—A. Wilson.	55—J. Williams.	62—H. Illidge.
4—G. Crawford.	12—F. Forster.	20—J. Kennedy.	28—R. Hall.	35—G. Eccleston.	42—W. Postles.	49—G. Webster.	56—W. H. Morris.	63—L. Smith.
5—H. Booth.	13—B. Jolley.	21—J. Jump.	29—J. Barker.	36—Ellis Perry.	43—C. P. Holland.	50—W. H. Baddeley.	57—G. Starkey.	64—W. F. Perry.
6—H. Platt.	14—W. Wrench.	22—W. H. May.	30—C. Denning.	37—E. Winstanley.	44—R. T. Maudsley.	51—R. Worsley.	58—H. E. Perry.	65—W. Smith.
7—W. Smallwood.	15—J. Hughes.	23—T. Bowden.	31—E. L. Dale.	38—W. Bratt.	45—W. Akers.	52—J. Owens.	59—C. T. Downes.	66—J. T. Turner.
8—A. Foxley.	16—F. Sheen.	24—T. Knight.						

Synthetic Ammonia

During the war, Germany produced ammonia by the Haber process both at Oppau and Merseberg, and by its oxidation supplied herself with the nitric acid required for the manufacture of explosives. England, however, had to depend upon the carbonisation of her coal for supplies of ammonia and upon imports from Chile for her nitrates.

Towards the end of the war, the British Government decided to build synthetic ammonia works at Billingham, near Stockton-on-Tees, and had started to prepare the site before the Armistice was signed in 1918. On the conclusion of peace, it was suggested that Brunner, Mond & Co. should relieve the Government of the undertaking, and after somewhat protracted negotiations the site was sold to them.

Although the Haber process itself was well known to the scientific world, and was the subject of numerous patents, the design of the plant employed had always been a very carefully guarded secret, and consequently the preparation of plans from the scanty information available proved to be a tedious and laborious task that occupied several years. In 1921, however, a small experimental unit was erected at the Castner-Kellner Works, at Weston Point, Cheshire. This place was selected because the Haber process requires a supply of hydrogen, and this was ready to hand there as a by-product in the manufacture of electrolytic caustic soda.

The small plant started in 1922, and apart from the display of a very few infantile disorders, has worked well, doing great credit to all who took part in its design. It has been kept in operation up to the present time, steadily yielding a larger quantity of ammonia than it was expected to turn out. It has shown, as was expected, where trouble was likely to arise in the construction and working of larger units.

Profiting by the experience so gained, the plans for the Billingham works have been so far completed as to admit of the construction being rapidly pushed on, and it is fully anticipated that the first unit will be started during the current year, 1923. The principal product of the works will be ammonium sulphate. The works are under the control of the Synthetic Ammonia and Nitrates Company, Limited, formed in 1920, the shares of which are owned by Brunner, Mond & Co.

American Factories

So far back as 1884 Solvay & Co. became interested in the erection of soda works at Syracuse, New York State, by the Solvay Process Company, and Brunner, Mond & Co. became shareholders. These works were repeatedly enlarged, and additional ones were built at Detroit, Michigan.

Notwithstanding the existence of these works on the American continent, it was always found advantageous to supply Canada from England up to 1914; but on the discovery of rock salt in Ontario the possibility of manufacturing in Canada became worth consideration. In 1916, in conjunction with the Solvay Process Company, Brunner, Mond & Co. therefore formed a new company called Brunner, Mond, Canada, Limited. This company built works at Amherstberg, Ontario, which started in June, 1919.

Brine Supplies

Before the building of the Winnington works was started, Mond arranged with Lord Stanley for a supply of brine, but as this was drawn from a main that served several salt works, it was anything but steady, and many altercations took place between the Brunner Mond officials and neighbouring salt works managers. It is said that on occasion Mond even sat on the valve to prevent Mr. Lockie from taking the whole of the brine for his salt works.

Fortunately a supply was obtained at Winnington itself in 1878 by sinking a shaft in the south-east corner of the park, close to the branch railway of the Cheshire Lines Committee. For the sake of security, a second shaft was sunk close to the first one. The supply from these two shafts sufficed until the purchase of further property from Lord Stanley in 1884 gave the Company possession of the Anderton shafts. These were among the oldest in the district, and the engines with which they were equipped bore the stamp of antiquity, being beam engines with parallel motions.

In 1888 the Company bought Penny's Lane Mine, Northwich, from Mr. John Thompson. The district between Penny's Lane Mine and Wincham was at one time a busy centre of rock salt mining, in both the top and the bottom beds of salt. Owing, however, to neglect in leaving pillars of sufficient strength and making shafts impervious to surface water, the mines



SANDBACH WORKS STAFF, 1913

Back row.—J. J. Swain, C. W. Brookshaw, F. J. Wharton, E. J. Walker, T. Skerratt, W. J. Gaskin, H. Chesters, S. Gibson, F. G. Robinson.

Middle row.—C. H. Mason, G. Huebanks, W. R. Sherratt, E. B. Harran, H. E. Cocksedge, R. Spencer, M. Dale, J. Boulton.

Front row.—H. W. Flockton, J. Breathen, E. H. Lees, F. W. Gorst, A. C. Leadbeater, F. Clough, W. Booth.



MIDDLEWICH WORKS STAFF, 1913

Back row.—G. W. Goodsir, T. Wilton, H. D. Wrench, E. L. Earl.

Middle row.—W. H. Scott, F. H. Walker, J. Egerton, T. W. Bloor, W. H. Swain, A. Garner, J. Hough, C. Baker, W. Davies, H. Johnson, T. F. Bloor.

Front row.—E. B. Sant, T. Johnson, C. Consterdine, J. H. Bloor, A. W. Tangye, E. B. Harran, A. Dolan, W. L. Wakefield, C. Whitehead.

in the top bed began to collapse, and in 1880 Platt's Hill Mine suddenly flooded, causing the inundation of most of its neighbours. Up to this time, brine pumpers had depended upon what was lying on or flowing along the top of the upper bed of rock salt; but when, through the collapse of shafts that pierced the top rock and ran to the bottom stratum, the rockhead brine could find its way to the bottom bed mines, it was discovered that by pumping from these a steadier supply was obtained.

Penny's Lane Mine had been worked by Mr. Thompson for the extraction of rock salt, and was maintained dry. An adjacent mine, however, known as Marshall's Mine, was flooded; but the barrier of rock salt between the two was sufficient to preserve Penny's Lane Mine. By boring through this barrier it was found possible to tap the brine lying in Marshall's Mine. When Brunner, Mond & Co. bought the mine, they erected efficient pumping engines on the surface, and began to raise the brine and force it through pipes to Winnington, where it was used from 1900.

It had always been held that there were no more private rights to underground brine than there were to underground water, because no one could tell whence it came and where the water which made it dissolved the salt. It seemed obvious that if the brine which flowed into a district was saturated when it arrived, it could not dissolve any more salt there afterwards. In 1906, however, the Salt Union, who owned Marshall's Mine, claimed that Brunner, Mond & Co. were dissolving the salt in it by pumping brine and causing fresh brine to flow through it. Accordingly they brought an action against the Company and claimed heavy damages; but after the case had proceeded for some time, a settlement was arrived at, by which Brunner, Mond & Co. agreed to purchase from the Salt Union a large area of land that included the flooded mines in dispute. By this purchase, the Company obtained possession of Dunkirk Brine Shaft, which pumped from the flooded Worthington's Mine. The delivery pipes from this shaft were carried on to the Penny's Lane—Lostock main, and thus it became capable of supplying either Lostock or Winnington.

Recognising that there was always a possibility of Penny's Lane Mine flooding through the rupture of the barrier between it and Marshall's Mine, or by the leakage of its own shafts, the Company sank a new shaft some

hundred yards away from it, and tunnelled through the rock salt towards Penny's Lane, leaving, however, a strong barrier in between. Pumps were installed at the new "Witton" shaft, and the suction pipes were carried along the tunnel, through the barrier, and across the floor of Penny's Lane Mine and coupled to enlarged pipes that pierced the barrier into Marshall's Mine. This gave a very powerful pumping station, available for the supply of both Winnington and Lostock.

Owing to several indications of a shortage of brine in the Northwich area, the Company sank a shaft at Wincham in 1907 down to the top rock head, and found an independent supply of brine, though not a large one.

About 1907 brine was found on the Holford Hall Estate, near Plumbley, and the Ammonia Soda Company, who subsequently bought the land for the erection of works, made three borings, the deepest one going down 2,509 feet from the surface. This showed that in the first 1,000 feet from the surface (plus 96.49 ft. O.D.) there were eight beds of rock salt of varying thickness separated by strata of marl and aggregating as much as 594 feet of salt. In view of the proved existence of this thick bed of rock salt of unknown extent, Brunner, Mond & Co. bought the adjacent Holford Moss Estate in 1912 from Mr. H. M. Wilson, and sank two boreholes thereon, finding brine in both of them. This brine was coupled by a long range of pipes to the Lostock end of the Dunkirk—Penny's Lane—Winnington system. The whole of the Holford Moss Estate is now being developed for the purpose of securing a large supply of brine from a district not already honeycombed with abandoned mines, and far from a residential area.

Water Supply

When the Winnington Works were started, the salt trade in Cheshire was very brisk, and the water of the River Weaver was highly charged with sodium chloride. While this water was quite suitable for cooling purposes, it proved most objectionable for steam-raising, and the first boilers exploded through incrustation with salt and scale. A certain amount of relief was obtained by using water from a well sunk on the premises. In 1891, however, an arrangement was made with Lord Barrymore to pump the overflow water from Marbury Mere to Winnington. This gave a supply of very soft water,

but, with the growth of the works, the volume proved insufficient in summer time, and it was augmented by pumping from a reservoir built at the outlet of Cogshall Brook alongside Uplands farm.

The Company's pumping station at Marbury was situated close to the Trent and Mersey Canal, and very near the edge of an old salt mine. In 1905 the water of the brook flowing from the mere occasionally disappeared through cracks that developed in its course. These were repeatedly stopped with clay, and large pipes were even laid in the bed of the stream to bridge the porous places; but eventually a crisis came, for the canal itself gave way in 1907, and after continuous struggles with the brook, the station was abandoned in 1908.

The premonitory signs had been enough to make the Company look for an alternative supply of boiler water, and this was found at Cranage Brook, near Lostock Gralam. Pumping plant was erected there, and pipes were laid to carry the water to Winnington and Lostock. This station has been enlarged from time to time, but it has now become apparent that the demands of the existing works are becoming equal to the minimum flow of the brook, and that nothing will be left for the supply of the new Wallerscote Works. A few miles down the Weaver, below Winnington, there is a stream called Cliff Brook that flows into the river near Pickering's Lock, and the Company have bought land there for the erection of a pumping station. The water will be conveyed to Wallerscote and Winnington through a long line of pipes now being laid.

River Transport

Before 1880 the Company's products were shipped to Liverpool in hired craft, but in that year a barge christened the "Crescent" was built. This was followed in 1882 by four tank boats for carrying ammoniacal liquor. They were called "Courage," "Patience," "Perseverance" and "Success."

The first steamers were built in 1889 and christened "Rose" and "Shamrock." Three more barges—"Ann Jane," "Paragon" and "Emeline"—followed in 1890, and then another steamer in 1891 bearing the name of another national emblematic flower, "Thistle." Two more barges—"Triumph" and "Mary"—were launched in 1891. The fourth steamer appeared in 1892,

and was christened "Cambria." A steam liquor boat called "Waterwitch" was built in 1895, the same year as the fifth steamer, "Scotia." The sixth steamer, "Hibernia," appeared in 1897, and the barge, "Jane," in 1899. The seventh, eighth and ninth steamers—"Anglia," "Caledonia" and "Britannia"—came in quick succession in 1903, 1904 and 1905. The barge, "Joyce," was built in 1907; the tenth steamer, "Gwalia," in 1908; and the eleventh and largest steamer, "Crescent," in 1910. By this time the original barge, "Crescent," had been rechristened "Harry."

In 1912 an experiment was made with a petroleum motor boat, "Egbert," and three more motor boats were built in 1914, called "Paddy," "Eva" and "Persistence."

The twelfth and thirteenth steamers, "Felix" and "Frida," were added to the fleet in 1912; the fourteenth and fifteenth, "Agnes" and "Madge," in 1913; and the sixteenth, seventeenth and eighteenth steamers—"Eleanor," "Millicent" and "Oswald"—built in 1914, 1915 and 1916, complete the fleet up to date. The totals are: 18 steamers, 4 motor boats, 5 liquor boats and 8 barges.

Retrospect

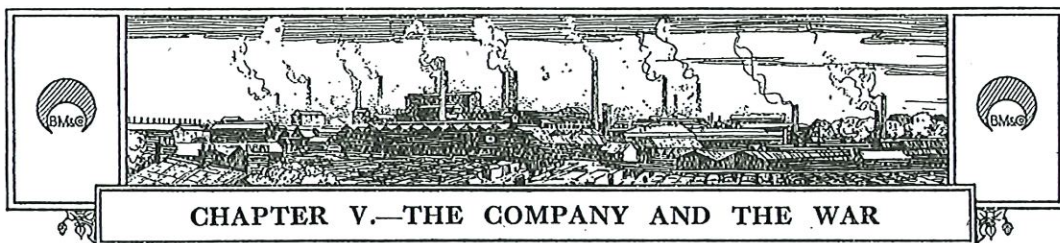
In looking back and comparing the works of 1881 with those of to-day, one is struck by the completeness of the change in the plant employed, and is led to marvel that the ammonia-soda process became a commercial success with the apparatus employed in the early days. That it did so certainly shows what an essentially good process it is, and that the margin for profit between cost and selling price was ample in those first years. When it is realised that the whole of the plant has been remodelled, enlarged or altered not once, but many times, and that every part had to be specially designed, some idea can be obtained of the ceaseless activity that has been required to bring the process up to its present state of a near approach to perfection.

As fuel has always been one of the most costly raw materials, the greatest economy has been effected by constant attention to careful design of the apparatus employed, with the object of avoiding loss of heat. The high loss of ammonia that baffled the early experimenters was soon avoided, after the introduction of the continuous distiller, by good engineering and careful working of the plant.

In the original licence from Solvay it was stipulated that Brunner, Mond & Co. should be entitled to use all improvements made by Solvay, and that he, in turn, should have similar rights to those effected by them. Although the licence expired many years ago, the closest and most friendly relationship has always been maintained between the two Companies. Solvay and Co. were, before the War, proprietors of, or interested in, twenty-three separate factories scattered throughout the world working the Solvay process, and the steady comparison of technical results obtained in the different establishments, together with the friendly rivalry induced, has undoubtedly led to the ammonia-soda manufacture reaching the commanding position that it occupies to-day as a thoroughly scientific process.

Notwithstanding the enormous amount of progress made by the Company in their first fifty years, it seems possible, in view of the rapid advance of science, that when their centenary comes round, most of the existing plant will have been relegated to the museums, and that the steam boilers, engines, distillers and furnaces, if they exist in anything like their present form, will be worked by some new source of energy.





IN the outbreak of the Great War, in 1914, the Company put their resources at the disposal of the nation. Everyone will remember the consternation that was aroused by the statement made after a few months of war that England was short of munitions and practically devoid of high explosive. Lord Moulton was appointed head of the High Explosives Department of the Ministry of Munitions. Although he had arrived at an age when he might naturally have sought an honourable and well-earned retirement, he undertook the task of forming that gigantic organisation which had to secure the supplies so urgently required. No man was better fitted for the work. Quitting his University as Senior Wrangler, he became the most brilliant leader of modern times at the Patent bar, possessing perhaps as wide a general knowledge of physics and chemistry as any man in the country. All who came in contact with him during the War were deeply impressed, not only with his marvellous tact and ability, but also by his unfailing patience and courtesy.

Ammonium Nitrate

The country was notably lacking in ammonium nitrate, the annual production of which before the War had not exceeded 1,000 tons. Lord Moulton asked Brunner, Mond & Co. whether, if he obtained supplies of calcium nitrate from Norway, they could, by treating it with ammonia and carbonic acid, produce nitrate of ammonia. As they had proved some years previously that this process was workable, a portion of the plant at Lostock Works was immediately diverted from the manufacture of soda, and adapted with many additions for this purpose. As the demand for this substance was steadily increasing, and there was an obvious possibility that the Norwegian supply of calcium nitrate might be insufficient, or fail altogether, consideration was given to other possible methods of manufacture. The only other available source of nitrate was clearly from Chile saltpetre, and several processes were suggested.

The first was to use the sodium nitrate in place of sodium chloride in the ordinary ammonia-soda process and, while producing sodium bicarbonate for conversion to soda ash, obtain ammonium nitrate in the filter liquor. This process was started at Lostock, and although it seemed very simple in theory it gave considerable trouble before it could be pronounced successful. Another solution of the difficulty was to make calcium nitrate by treating sodium nitrate with calcium chloride. An experimental plant was started at the works of the Ammonia-Soda Company, at Plumbley, and on the management of the place coming under the control of Brunner, Mond & Co. extensive plant was erected there, on behalf of the Ministry, to manufacture by this process on a large scale. On the basis of the experience gained at Plumbley, Brunner, Mond & Co. designed and erected for the Ministry a much larger plant at the Victoria Works of the Salt Union, near Northwich, and ultimately Lostock was supplied with calcium nitrate from both Plumbley and Victoria.

In face of the enormous consumption of ammonium nitrate for munitions in 1916, the Company transformed their Sandbach soda crystal plant to adapt it for producing ammonium nitrate by another untried process, viz., by crystallisation from a mixture of sodium nitrate and ammonium sulphate. This, by skilful management, proved so successful that the Ministry requested them to design a large plant for erection at Swindon, and this was eventually done. This plant was started in September, 1917, and was operated under their direction. Not only was this process used in England, but the Company made a free grant of it to the United States Government, and it was employed on a large scale in that country.

The accompanying table (see page 54) shows the production of ammonium nitrate in the various works, and by the different processes.

Plumbley started to make calcium nitrate tetrahydrate in April, 1916, and Victoria Works in September of the same year. The following table shows their annual outputs:—

MANUFACTURE OF CALCIUM NITRATE.

Year.	Tons as tetrahydrate.		Tons as calcium nitrate.		Tons per day as calcium nitrate.
	Plumbley.	Victoria.	Plumbley.	Victoria.	Both works.
1916	16,651	2,873	11,281	1,956	62.3
1917	57,852	52,479	39,468	35,683	205.9
1918	16,706	61,962	11,360	42,134	228.1
Total	91,210	117,315	62,110	79,774	

AMMONIUM NITRATE MANUFACTURE.

	1915.		1916.		1917.		1918.		Grand Total.
	Total tons.	Tons per day.	Total tons.	Tons per day.	Total tons.	Tons per day.	Total tons.	Tons per day.	Tons.
(1) By calcium nitrate process	3,575	13.2	18,771	51.3	58,692	160.8	45,889	133.4	126,928
(2) By am. soda process ex soda nitrate	1,188	4.4	15,117	41.3	23,423	64.2	13,566	39.4	53,296
Total at Lostock	4,764	17.6	33,889	92.6	82,115	225.0	59,456	172.8	180,225
(3) Total at Sandbach	—	—	95	0.2	9,187	25.2	2,063	5.9	11,346
Total Brunner, Mond & Co. ...	4,764	17.6	33,985	92.8	91,302	250.2	61,567	178.9	191,619
(4) Swindon	—	—	—	—	670	—	23,831	—	24,501
Grand total, all works	4,764	17.6	33,985	92.8	91,973	—	85,398	—	216,120

(1) Started April 6th, 1915, and stopped December 10th, 1918.

(2) Started August 15th, 1915, and stopped in August, 1918.

(3) Started in November, 1916, and stopped in April, 1918.

(4) Started September 11th, 1917, and stopped in November, 1918.

Highest monthly make, January, 1918 :—Lostock, 8,930 tons + Sandbach, 1,220 tons = 10,150 tons = 327.4 tons per day.

It will be obvious from what has been said already that, failing the supply of calcium nitrate from Norway, all these processes depended upon the importation of nitrate from Chile. In view of the possibility of this being interrupted, Lord Moulton was anxious to gain experience of the oxidation of ammonia to nitric acid, and he therefore arranged that Brunner, Mond & Co. should instal apparatus for this purpose. This was done at Winnington, and a small quantity (forty-eight tons) of ammonium nitrate was made. A larger unit was later installed at Lostock and used for supplying nitrous gases to the sulphuric acid chambers.

T.N.T.

In addition to the urgent demand for ammonium nitrate, there arose an outcry for trinitrotoluene (T.N.T.) for filling shells, and Lord Moulton immediately set to work to satisfy it. Not only had he to secure the supplies of toluene, but he had also to urge manufacturers to provide concentrated sulphuric acid and nitric acid. When he had made sure that T.N.T. could be obtained in quantity, there still remained the problem of how to purify it to render it suitable for filling shells. He came to Brunner, Mond & Co. to ask for help, and, learning that the works at Silvertown, where the manufacture of caustic soda had been discontinued in 1912, were standing idle, he pressed for their transformation to work a process that consisted of melting the crude T.N.T. in hot methylated spirit, and then cooling it to free it from impurities. The Company strongly expressed their reluctance to carry on such a dangerous manufacture in a densely populated district; but the urgency was so great that they eventually consented.

The works were quickly transformed, and started in September, 1915. The process proved satisfactory so far as the product was concerned, but it was laborious on account of the large volume of spirit that had to be distilled, and the demand soon overtook the capacity of the plant, which never exceeded about nine tons per day. Lord Moulton then asked the Company to build new works for T.N.T. purification, and accepted their suggested new process, which effected the purification by grinding the crude material in a mill flooded with warm alcohol, filtering the mixture, and then melting the T.N.T. ready for solidification on a flaking machine. The Company

offered a plot of land in the township of Rudheath, about one mile from Northwich Station, and rapidly built works there, the first unit being put in operation within a few months (in February, 1916). From the name of the stream that flowed through the land, they were christened the "Gadbrook Works." In face of an ever-increasing demand, unit after unit was added, and extensions were carried out up to the end of the war. The output of purified T.N.T. eventually reached nearly sixty tons per day.

The situation of these works had been very carefully chosen, and with the exception of one farm building there was not an inhabited house within half a mile. On account of the extreme liability of T.N.T. to take fire, water tanks were placed in each unit, and pipes were so arranged that any part of the plant could be drenched in an instant. It was recognised that in an atmosphere always charged with the vapour of alcohol a fire once started might spread with alarming rapidity. On one or two occasions fire did occur, but it was immediately extinguished by flooding with water. On one day, however, there was cause for grave anxiety, because while rodding through the choked outlet of a vessel, the T.N.T. took fire under water and burned until it was all decomposed, in spite of the fact that numerous hosepipes from the fire engines were discharging water through it all the time. In recognition of their bravery upon this occasion, resulting in the probable saving of life, the King awarded Leonard Harper the Albert Medal, and made W. R. Storey a member of the Order of the British Empire.

It is much to be regretted that when Gadbrook Works were started the Silvertown plant was not stopped, because its situation was never suitable for the handling of a high explosive, and the only reason for ever starting the manufacture there was the existence of idle plant which could be adapted in a short space of time. Unfortunately, in January, 1917, while a number of men, led by Andrea Angel (an Oxford don who had volunteered for war work) were trying to quell a fire in the plant, a disastrous explosion destroyed not only the whole works but also a large number of dwelling-houses in the vicinity. Angel, fourteen men, and one woman were killed by the explosion.* For his valiant attempt to save life, the King made a posthumous award of the Edward Medal to Angel.

* See page 67.

Synthetic Phenol

A third material for filling shells, of which the country found itself short as the war proceeded, was picric acid or trinitro phenol. In normal times the production of phenol (carbolic acid) from tar distillation was sufficient to satisfy the demand; but owing to the requirements of our Navy and the needs of the French Government it became evident early in 1915 that the supply was going to be totally inadequate. Again Lord Moulton appealed to Brunner, Mond & Co. for help, asking for the preparation of synthetic phenol.

Although there were records in the literature of various chemists having prepared the substance synthetically, there were none of any satisfactory manufacturing process, and the Company's chemists had to set to work and devise one. After a few weeks' work with a hastily constructed small-scale plant, in what was christened the "Devil's Kitchen," the problem was solved. Starting with benzol, two materials were required—sulphuric acid and caustic soda. Lostock had the acid and Winnington the caustic. It was, therefore, arranged to make sulphonate at Lostock and fuse it with caustic at Winnington to convert it into phenol. The plant was put up at both places with the utmost rapidity, and started in July, 1915. To meet Lord Moulton's ever-increasing demands, it was extended time after time until 1918, when the make was reduced, to be finally stopped in January, 1919. The maximum make reached was 130 tons per week. The following table shows the output in the several years:—

MANUFACTURE OF SYNTHETIC PHENOL.

Year.	Days worked.	Tons made.	Tons per day.
1915	120	447	3.72
1916	366	3,370	9.20
1917	365	6,068	16.62
1918-19	381	2,799	7.34
Totals	1,232	12,685	Average 10.3

In January, 1919, the Chairman received the following letter from Lord Moulton :—

The work of this Department is rapidly coming to an end, and I shall soon cease to be occupied with Explosives Supply. Before this occurs, I wish to put on record the great services which have been rendered to the Department by the Company of which you are the Chairman.

I shall not attempt to enumerate the various forms in which these services have been rendered, but on the ground of its scale and its importance one service stands out so remarkably that I must make special reference to it.

The programme of explosives as developed under the exigencies of the war made it necessary to manufacture nitrate of ammonia on a huge scale. Previous to the war it had only been manufactured in this country in small quantities, and by methods inapplicable to wholesale production. So we had to start *de novo*. This great task of production in adequate quantities was undertaken by your Company, and carried through by it with complete success. The processes by which it was produced were novel. They were devised by the Technical Staff of your Company, and were carried out mainly by it or under its direct supervision in factories belonging to it or erected or adapted by it and according to its designs. In this way we have been indebted to your Company for the manufacture of the bulk of the largest component of the high explosives used by this country in the war.

The scale of its help in other directions was also large, but I will not dwell on it further. From the moment when, early in the war, I was assured by your Board that the resources of the Company were at the disposal of the Department, we received all the assistance we sought from your Directors and Technical Staff, and this was given so willingly and so ungrudgingly that it has made the memory of the work done together for the great cause a most pleasant one.

Yours very sincerely,

(Sgd.) MOULTON.

In recognition of valuable services rendered during the war in the manufacture of munitions, the King made the following appointments to the Order of the British Empire :—

J. G. Jarman to be Knight (K.B.E.).

H. Glendinning to be Commander (C.B.E.).

A. W. Tangye to be Officer (O.B.E.).

F. A. Freeth to be Officer (Military Division) (O.B.E.).

Such is the short straightforward tale of what the Company did to help to "win the war." The absence of any allusion to the thousand-and-one things that had to be done to render the manufacture possible, and the difficulties that were experienced, must not be taken to imply that all was plain sailing. The general disorganisation of the works, and the serious interference with the Company's ordinary trade, were looked upon as inevitable, and the conviction that they were doing their duty to the nation satisfied the Company for the absence of profit on the work.

Service with the Forces

While all this was being done in the works by those "who stayed at home," what did the rest of the men do?

At the outbreak of war, the Company made it known that they would pay half wages to all married men who volunteered for active service, and a proportion of their wages to all single men who had dependents to provide for. At this time the Army separation allowance was very low, and it was estimated that the addition of the half wages allowance would be necessary to keep the families in comfort.

When the separation allowance was increased, it was found that the wife's receipts would be higher than when the husband was at home, and so only a proportion of the grant was paid her, the rest being put into the Savings Bank. The result was that the men on their return at the end of the war found considerable sums standing to their credit (in a number of cases over £100).

The men, including the staff, answered the country's call nobly, and the works soon felt the strain. A mass meeting of the men was called and addressed by Sir John Brunner and Sir Alfred Mond, and an agreement was made to give up the 48-hour week and revert to the old 6 a.m. to 5 p.m. day or 53-hour week. This gave relief for a time, but as men continued to go, a definite shortness was felt, and recourse was had to the employment of female labour. Women were employed at all the works, and Gadbrook, from its start, was "manned" almost entirely by women. The highest

number reached was in January, 1918, when the figures of women employed at the various works were as follows :—

Winnington	...	...	...	...	...	345
Lostock	...	...	...	...	...	1,058
Sandbach	...	...	...	...	...	395
Middlewich	...	...	...	...	...	49
Gadbrook	...	...	...	...	...	545
Total						2,392

The following table shows the numbers of men who joined H.M. Forces from the Company's works and offices :—

	Joined H.M. Forces.	Returned.	Paid the Supreme Sacrifice.
Winnington Works...	1,481	1,099	169
Witton Street Saw Mills	7	6	1
Lostock Works	884	435	85
Sandbach Works	129	107	10
Middlewich Works...	116	86	16
Silvertown Works	46	36	7
London Offices	4	4	—
Liverpool Office	8	6	1
China Offices	9	8	1
India Offices	4	3	1
	2,688	1,790	291

It will be noticed that the numbers of those who returned, plus those who died, fall short of those who left the Company's service to enlist by 607. This is partly accounted for by some remaining in the Army after the end of the war, but principally by the fact that numbers of those who joined up from the different works had been in the Company's service only for a very short time as replacement men, and had reverted to their old occupation on leaving the Army.

In March, 1919, the Company offered a welcome to the returned soldiers by entertaining them to supper, and gave each of them an illuminated card signed by the Chairman:—

Brunner, Mond & Co., Limited,
Winnington,
Northwich,

Dear Sir,

March 31st, 1919.

ON BEHALF OF THE DIRECTORS AND THE WHOLE OF THE WORKPEOPLE OF THE COMPANY, I wish to offer to you our heartiest congratulations and best wishes on your release from military service.

The loyal response to the Nation's call made by you and your comrades has been a source of great pride and gratification to the Company and all connected with it.

We rejoice that you have lived to return again to be amongst us, and we fervently hope that the future, the security of which is so greatly due to your efforts and sacrifices, will be worthy of your exertions.

Yours truly,

ROSCOE BRUNNER,

Chairman of Directors.

Although, as stated above, 607 men who might have returned failed to do so, the Company had already engaged 926 other ex-soldiers by the time the suppers were given, and these were invited along with the old employees.

To the relations of those who had fallen, a card was sent expressing sympathy with them in their loss:—

Brunner, Mond & Co., Limited,
Winnington,
Northwich,

Dear Sir,

March 31st, 1919.

ON BEHALF OF THE DIRECTORS AND THE WHOLE OF THE WORKPEOPLE OF THE COMPANY, I wish to offer to you our heartfelt sympathy in the loss of your..... while fighting for his country.

The loyal response to the Nation's call made by him and his comrades has been a source of great pride and gratification to the Company and all connected with it.

We regret that he had not the good fortune to return to you, but we know that you will derive comfort from the thought that he sacrificed his life for the cause of humanity and freedom.

Yours truly,

ROSCOE BRUNNER, Chairman of Directors.

In order to preserve the memory of those who had given their lives for their country, the Company commissioned Mr. Darcy Braddell to design memorials for each of the works and offices, and in due course these were erected and unveiled with solemn ceremony. Those at Lostock, Sandbach, Middlewich, Silvertown, and the various offices bear the names of the men who belonged to those several places; but that at Winnington is inscribed with the names of all, and these are reprinted below. The memorials at Lostock, Middlewich, Sandbach and Silvertown were unveiled by Mr. Roscoe Brunner; and that at Winnington by Lieut.-General Sir Belvoir de Lisle, K.C.B., K.C.M.G., D.S.O.

WINNINGTON.

ROYAL NAVY:

James Burton, H.M.S. "Centaur."
Joshua Stewart Eyes, R.N.V.R.

ARMY:

4th HUSSARS.

Samuel Shaw.

SHROPSHIRE YEOMANRY.

Thomas Lewis Jones.

ROYAL ARTILLERY.

John Hankey.
Thomas Whitehead Sandwell.

ROYAL ENGINEERS.

Albert Emmett.
William Henry Lloyd.
Edward Thomas Pratt.
Harry Watts

ROYAL SCOTS REGT.

George Parkes.

ROYAL WARWICKSHIRE REGT.

Charles Gathercole.
George Gillett.
Leonard Hicklin.
John Edward Holt.
William John Walker.
James Woodward.

ROYAL FUSILIERS.

Albert Stuart Fortnum.

KING'S LIVERPOOL REGT.

Robert Arnold.
James Atherton.
Arthur Wentworth Evanson.
Geoffrey Storrs Sutton, M.C.
John Kennings Thurlow (Scottish).

YORKSHIRE REGT.

George Henry Boulton.

LANCS. FUSILIERS.

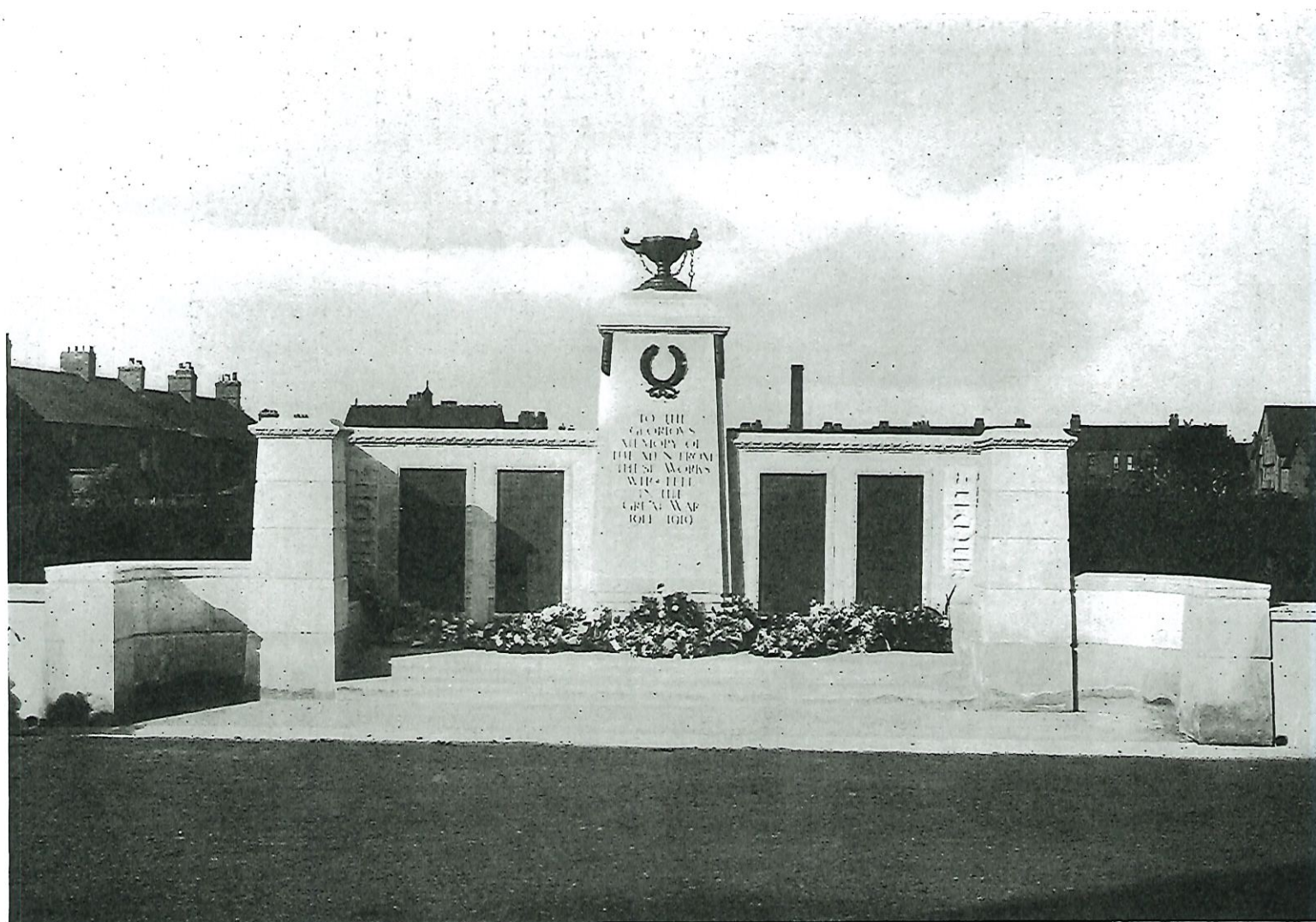
George Riley.
John Edward Wilding.

CHESHIRE REGT.

Frank Allen.
Harry Allman.
Oscar Andrews.
James Astles.
John William Blackhurst
Joseph Boag-Munro.
William James Bostock.
George Rothwell Bradbury.
Thomas Bramhall
Robert Buckley.
Arthur Shaw Burgess.
Richard Chantler.



WINNINGTON WAR MEMORIAL



LOSTOCK WORKS WAR MEMORIAL

WINNINGTON—continued.

Cheshire Regt.—continued.

Robert Clarke.
Ernest Cooke.
Samuel Coombs.
John Dalzell.
Richard Whitlow Davies.
William Henry Deakin.
William Done.
Harry Dunn.
George Fairhurst.
Robert Fallows.
William Gandy.
Samuel Goodier.
George Greatbanks.
Richard Gregory.
John Wilfred Hayes.
Horace Hitchensen.
Harry Hodgkinson.
Joseph Holland.
Robert Holland.
William Holland.
Harry Hornby.
Henry Victor Hubbard, D.C.M.
Harry Hughes.
James Hunt.
William Jones.
James Leicester.
Samuel Lightburn.
Ernest Lightfoot.
Harold Algernon Littler.
Reginald Littler.
Thomas McCabe.
Leonard Lowe.
William Meers.
George Mills.
George Moore, M.M.
Harry Moore.
Thomas Jubilee Moore.
Harold Mottershead.
Joseph Neild.
Oswald Nicholas.
Frank Norcross.
Abraham Phillips.
William Morbon Poole.
Albert Edward Pye.
Robert Redford.
James Regan.

David Paul Riley.
Thomas Riley.
William Roberts.
Charles Frederick Robinson.
Joseph Rustage.
Richard Newton Smith.
John William Stanley Spruce
William Stephenson.
William Sutton.
Frederick Sweeney.
Arthur Tomkinson.
Levi Vernon.
Albert Victor Walker.
Walter Watkin.
Henry Whalley.
Arthur Frederick Wilkinson.
John Thomas Wilkinson.
Harry Wilkinson.
John Williams.
Harry Woodward.
John William Yarwood.
George Yoxall.

ROYAL WELCH FUSILIERS.

William Banks.

ROYAL INNISKILLING FUSILIERS.

James Leicester.
George Wilfred Moore.

EAST LANCs. REGT.

Alfred Ashley.
George Barnes.
Gerald Benson.
Reginald Bowyer.
Arthur Bradbury.
Jervis Clarke.
Leonard Cross.
Harry Fallows.
Peter Allen Gates.
Samuel Grindley.
George Hartley.
Dmitri Jarintzoff, M.C.
Thomas Lamb.
William Parkes.

WINNINGTON—continued.

East Lancs. Regt.—continued.

Herbert Plant.
Harold Preston.
Thomas Smith.
William Henry Southern.
Ernest Wilkinson.

SOUTH LANCs. REGT.

Eric Adams.
William Arthur Clarke.
Josiah Curbishley.
Joseph Lowe.
Edward Molyneux.
William Mellor Shufflebotham.

WELSH REGT.

David Thomas Malcolm.

LOYAL NORTH LANCs. REGT.

Frank Barnes.
Charles William Latham.
Thomas Tomlinson.

ROYAL BERKS. REGT.

Arthur Henshall.
Thomas William Stringer.
Frederick Charles Walker.

KING'S SHROPSHIRE L.I.

Arthur Newton.
Herbert Platt.

KING'S ROYAL RIFLE CORPS.

Thomas Burrows.

6th DRAGOON GUARDS.

Albert Ford.

NOTTS. YEOMANRY.

John Bellamy.

MANCHESTER REGT.

James Ewart Ashton.
Joseph Barker.
Thomas Cotgreave.
Douglas Eachus.
William Foster.
Edward Gerrard.
Frank Herbert Hobson.
Samuel Hughes.
John Lawrence Littler.
Abraham Frederick Mills.
Joseph Phillips.
Arnold Robinson.
Heber Robinson.
Alfred Brown Thornton.

YORK & LANCs. REGT.

Thomas Forster.

SEAFORTH HIGHLANDERS.

Andrew Hamilton MacGregor.

RIFLE BRIGADE.

James Aspey.
Abraham Barker.
William Millington.
Richard Sweeney.

MACHINE GUN CORPS.

Thomas Bell.
Enoch Hatton.
Samuel Buckley Lare.
Harry Leadbeater.
Thomas Lewis.
Sidney Mellor.

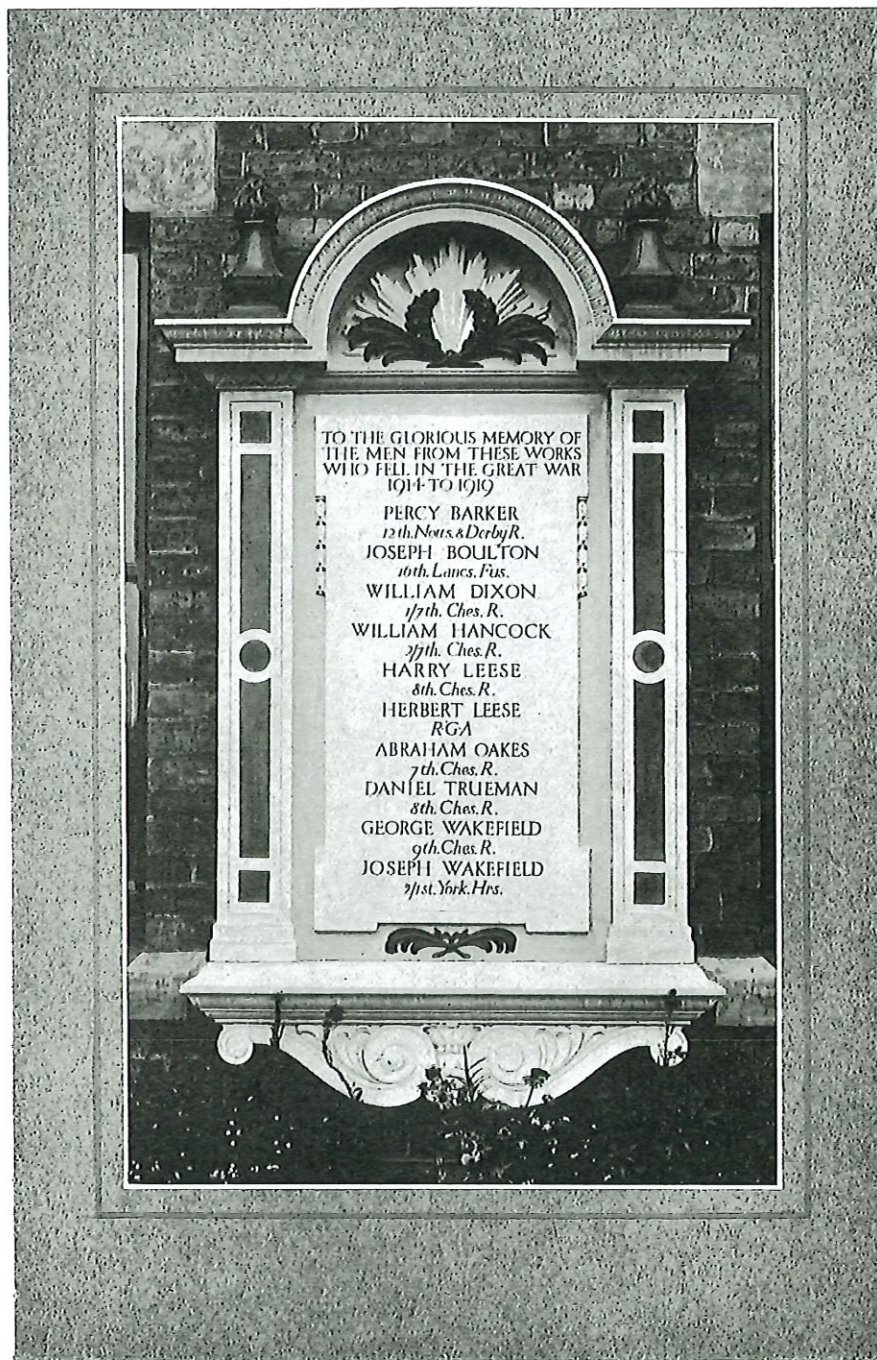
ROYAL ARMY SERVICE CORPS.

Albert Gleave.

LOSTOCK.

ROYAL FIELD ARTILLERY.

Patrick Gahan.
Robert Hitchen.
John Frederick Ince.
Carroll Whitfield Williamson.



SANDBACH WORKS WAR MEMORIAL

LOSTOCK—continued.

ROYAL ENGINEERS.

William Hesketh.

ROYAL WARWICKSHIRE REGT.

Harry Johnson.

KING'S LIVERPOOL REGT.

John Hollas Mathews.

Dan Tomlinson.

CHESHIRE REGT.

Thomas Abbott.

John Adamson.

Frederick William Aimson.

William James Ainsworth.

John William Armitage.

Charles Arnold.

Edward Ashley.

Allen Atkinson.

John Bladon.

Harold Bowyer.

John William Buckley.

Joseph Henry Bunkall.

Charles Henry Carter.

Thomas Carter.

Thomas Howard Connolly.

Gerald Coppock.

William Cox.

Albert Ernest Curbishley.

Frederick Davies.

John William Deakin.

William Arthur Dutton

Ralph Fairhurst.

James Forster.

Peter Fowles.

Joseph Foxley.

Arthur Furnival.

John Henry Gleave.

Robert Heywood.

Thomas Hickson.

William Hitchen.

James Holland.

John Hulme.

Henry Jacks.

John George Kelly.

James Kettle.

James Kinsey.

John Lamb.

Archibald MacDonald.

Peter Maddock.

Charles Albert Moss.

Henry Postles.

George Riley.

William Roughsedge.

Ernest Edward Sherlock.

George William Shore.

Harold Slater.

Patrick Sweeney.

William Edward Thomason.

John Thomas Thompson.

Arthur Tomkinson.

Leonard White.

Samuel Whittaker.

Frederick Wood, M.M.

SOUTH WALES BORDERERS.

Richard Walsh.

EAST LANCs. REGT.

James Egerton.

John Stevens.

SOUTH LANCs. REGT.

Leonard Connolly.

John William Cotterill.

Frank Evans.

WELSH REGT.

William Bramhall.

John James Forster.

LOYAL NORTH LANCs. REGT.

Thomas Barnes.

Abraham Moore.

Albert Thorneycroft.

ROYAL BERKS. REGT.

Frank Robinson.

KING'S SHROPSHIRE L.I.

Albert Elsby.

James Spencer.

LOSTOCK—continued.

MANCHESTER REGT.

John Thomas Faulkner.

DURHAM L.I.

William Hankey.

SEAFORTH HIGHLANDERS.

Edward Bannister.

David Hutchinson.

RIFLE BRIGADE.

Thomas Southern.

TRAINING RESERVE BATTALION.

Samuel Herbert Buckley.

ROYAL ARMY SERVICE CORPS.

Frederick Bowden.

ROYAL ARMY MEDICAL CORPS.

Harry Chesterton.

MIDDLEWICH.

ROYAL ARTILLERY.

George Henry French.

Percy French.

Frank Wilton.

ROYAL ENGINEERS.

Chris Carter.

William Jones.

LANCS. FUSILIERS.

William Duncan.

CHESHIRE REGT.

Bertram Frith.

James Hodgkinson.

Martin Reynolds.

Samuel Spilsbury.

William Harold Swain.

SOUTH LANCS. REGT.

Arthur Harrison.

MIDDLESEX REGT.

Douglas David Dobson.

MANCHESTER REGT.

Harry Lowe.

MACHINE GUN CORPS.

John Willie Maddock.

ROYAL AIR FORCE.

Fred Hough.

SANDBACH.

YORKS. HUSSARS.

Joseph Wakefield.

ROYAL ARTILLERY.

Herbert Leese.

LANCS. FUSILIERS.

Joseph Boulton.

CHESHIRE REGT.

William Dixon.

William Hancock.

Harry Leese.

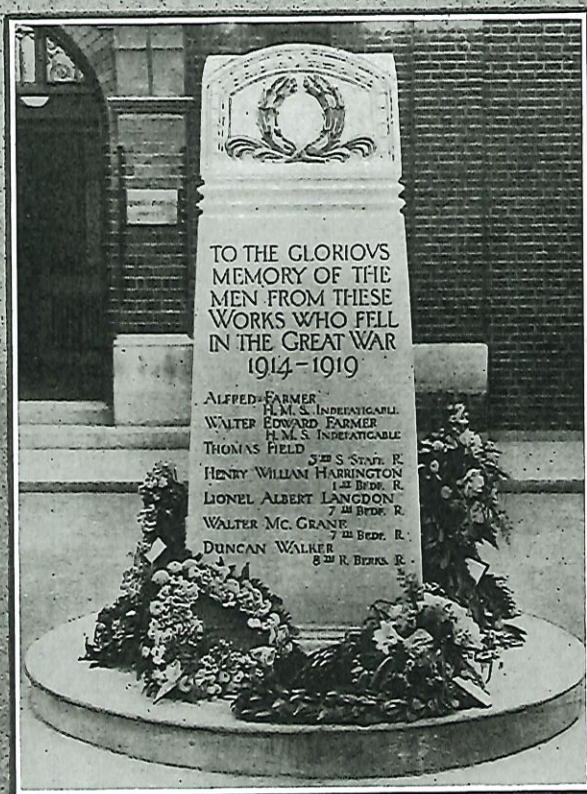
Abraham Oakes.

Daniel Truman.

George Wakefield.

NOTTS. & DERBY REGT.

Percy Barker.



SILVERTOWN WORKS WAR MEMORIAL

SILVERTOWN.

H.M.S. "INDEFATIGABLE."

Alfred Farmer.
Walter Edward Farmer.

SOUTH STAFFORDSHIRE REGT.

Thomas Field.

BEDFORDSHIRE REGT.

Walter McGrane.
Henry William Harrington.
Lionel Albert Langdon.

ROYAL BERKSHIRE REGT.

Duncan Walker.

and the following, whilst serving their country by making T.N.T., perished in the explosion in their works on January 19th, 1917:—

Andrea Angel (Edward Medal).
James Bruce.
Sidney Joseph Benstead.
John George Chandler.
Charles Downing.
Catherine Elizabeth Hodge.
George Henry Hopkins.
William Lambert.

Walter Manger.
Hugh McCoombs.
James Henry Reeve.
Henry Rogers.
Samuel Saunders.
Walter Ernest Sharpe.
David Taylor.
George Edgar Oliver Wenborn.

LIVERPOOL.

ROYAL ARTILLERY - - - James Kenyon Skelhorne.

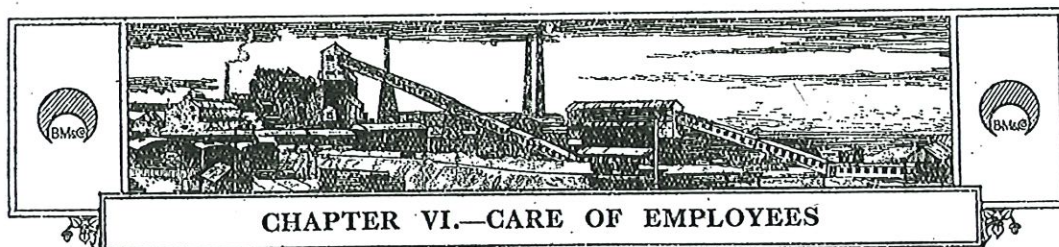
CHINA.

YORKSHIRE REGT. - - - Hubert Arthur Cornaby.

INDIA.

ROYAL ARTILLERY - - - Archibald Andrews.





LETTER written to Dr. Mond by his mother, from Cassel, on June 3rd, 1872, contains the following passage:—

Do you remember, Ludwig, how often we spoke when you were still a student and had no practical experiences and you desired to become the ideal of a captain of industry? How you would prepare and educate workmen, and care for them that they should have a pleasant and comfortable home? What do you think now?

What Dr. Mond did think, and how his ideas were put into practice, will be gathered from the account now to be given of various aspects of the relations existing between Brunner, Mond & Co. and their employees.

I.—HOURS OF LABOUR AND HOLIDAYS.

Many processes of chemical manufacture are bound to be continuous, and none more so than the ammonia-soda process. It is therefore always necessary to keep the plant running day and night, Sundays and weekdays.

When the Winnington Works started in 1874, the regular process men, in accordance with the general custom in the chemical trade, were divided into two groups working shifts, thirteen hours constituting the night shift and eleven hours the day. At the week-end a change was made by the day men working a double shift. Each man, therefore, worked on an average eighty-four hours per week, if he kept good time and turned up for work whenever he was due. Those men who worked in daytime only on six days per week started at 6.0 a.m., and finished at 5.30 p.m., except on Saturdays, when they left off at 1.0 p.m. With half-an-hour for breakfast each day, and one hour for dinner each day except Saturday, this arrangement gave a week of $56\frac{1}{2}$ hours.

In the course of a few years, it became obvious to those in close contact with the men, as all were in those days, that the failure to keep good time, especially on the part of the shift men, was due not so much to unwillingness as to inability, and that they were physically unable to work 84 hours per week for 52 weeks of the year. The Company, therefore, offered in 1884 to give each man a week's holiday with pay each year if he had qualified by keeping reasonable time during the preceding twelve months. It was hoped in this way to induce men, on the one hand, not to stay away from work when they were well, and on the other, by giving them a week of complete rest, to make them less likely to fall ill during the following year. For the first year each man who had lost fewer than ten days or shifts (absence through sickness or on leave not being counted) got the holiday, and 42 per cent. of the men qualified. In the following years the maximum time lost allowed for qualification was steadily reduced, but with each reduction the percentage of men earning the holiday has steadily increased.

From the time when they arranged to give an annual holiday Sir John Brunner and Dr. Mond always regarded the long hours worked by the shift men as objectionable and not conducive to health, and they determined that, whenever a suitable opportunity presented itself, they would make a change. At the end of 1889 they decided that, with certain safeguards, such a step might be taken, and they made the following offer to the men:—

- 1.—To reduce the length of the shift from twelve to eight hours.
- 2.—To reduce the pay per shift by 10 per cent. only, on condition that those engaged in manual labour would work as much harder as would admit of every tenth man being dispensed with.

The creation of a third shift of men by itself would increase the cost of wages by 50 per cent. The reduction of 10 per cent. in rate of pay would reduce the 150 to 135, and the drop in numbers of men, involving another 10 per cent. reduction to $121\frac{1}{2}$, brought the net increase in wages cost to $21\frac{1}{2}$ per cent.

The offer was accepted by the men, and the change took place in November, 1889. Such a change was not only absolutely unheard of in the chemical trade, but was also almost unknown in the country. During a period when the efficiency of the plant was constantly being increased by alterations and additions it was difficult to gauge the effect of the change with accuracy; but it was obvious that the health and ability of the men steadily improved, and although the 10 per cent. reduction in shift pay was cancelled at the end of 1890, and the pay for eight hours made the same as for twelve hours, it was found at the end of four years that the cost of wages per ton of product had come down to the old figure again.

In 1895 the Company took the further step of reducing the working hours for day men from 55½ to 48 for tradesmen and 49½ for labourers, without any alteration in pay. Instead of starting hungry at 6 o'clock, the men were able to come to work after breakfast at 7.40 a.m. and 7.45 a.m.

For several years before the war the hours of day men were shortened for twelve weeks in winter (eight weeks before Christmas and four weeks after) by stopping at 4.30 p.m. instead of 5.30 p.m., forty hours being thus lost. The men were paid wages during this time as though they had worked full time, and the over-payment was cleared off during the remaining forty weeks by shortening the dinner interval by twelve minutes throughout the whole year.

Owing to the pressure of war work it became necessary, in 1914, to revert to the old 6 a.m. start and the long hours, but with overtime pay after forty-eight hours.* In January, 1919, the hours of day men were reduced to forty-seven per week, with the same pay as for forty-eight hours.

Bearing in mind these various changes in hours, it is interesting to follow through the holiday figures, as given in the appended table, and notice how the percentage of men getting holiday has steadily risen while the basis has been altered down to two days or shifts per year.

* A meeting of the workpeople was held at Winnington and addressed by Sir John Brunner and Sir Alfred Mond. Sir John pointed out that the Company had placed their entire resources at the disposal of the Government, and were determined not to make a profit out of any of the work entrusted to them. He called upon the men to work longer and harder to help their country, and met with a hearty response.

PERCENTAGE OF MEN WHO QUALIFIED FOR HOLIDAYS OUT OF
THE TOTAL NUMBER EMPLOYED FOR A FULL YEAR.

Year.	Winning- ton.	Lostock.	Middle- wich.	Sandbach.	Silver- town.	Littler.	Time-lost Basis for Holidays.
							Day Shift men. men.
							days. days. 10 5
1892	72.5	—	—	—	—	—	10 5
1893	83.9	—	—	66.8	—	—	10 5
1894	95.2	—	—	85.1	—	—	10 5
(a) 1895	91.7	—	—	73.3	—	—	10 5
1896	96.7	—	87.0	90.1	—	—	7½ 5
1897	92.9	—	88.8	75.8	—	—	4
1898	94.9	—	88.3	83.5	—	—	3
1899	93.5	—	97.9	100.0	—	—	3
1900	87.9	63.0	96.6	94.8	69.5	—	3 (c)
1901	91.3	70.5	98.5	99.6	74.4	—	3 (c)
(b) 1902	94.2	77.7	98.0	99.2	92.4	—	3 (c)
1903	95.7	86.2	98.6	98.9	88.1	—	2 (c)
1904	97.1	97.2	95.5	99.6	81.4	—	2 (c)
1905	98.6	93.6	99.1	99.3	89.8	—	2
1906	97.7	92.4	98.7	100.0	89.9	—	2
1907	97.5	90.0	99.6	99.7	93.3	—	2
1908	98.4	95.5	98.9	100.0	96.9	—	2
1909	98.6	96.1	100.0	100.0	96.3	—	2
1910	97.8	96.9	100.0	100.0	97.7	—	2
1911	98.0	93.7	99.5	100.0	94.6	—	2
1912	97.5	93.38	100.0	100.0	93.2	—	2
1913	95.8	93.2	98.8	98.8	92.0	—	2
1914	96.7	95.1	99.2	99.4	95.2	—	2

Shiftmen put on 8-hour shifts, 1889.

(a) Daymen put on 8-hour day, 1895.

(b) Extra holiday week's pay given, 1902.

(c) The time-lost basis at Lostock was six days for 1900 and 1901, four days for 1902 and 1903, and three days for 1904.

PERCENTAGE OF MEN WHO QUALIFIED FOR HOLIDAYS OUT OF THE TOTAL
NUMBER EMPLOYED FOR A FULL YEAR—continued.

Year.	Winning- ton.	Lostock.	Middle- wich.	Sandbach.	Silver- town.	Littler.	Time-lost Basis for Holidays.
							Day Shift men. men.
							days. days.
(e) 1915	92.0	78.6	96.3	98.2	85.1	—	2
(e) 1916	87.5	54.0	96.2	96.8	94.1	—	2
(e) 1917	86.66	56.65	98.48	95.22	97.79	—	2
(e) 1918	88.78	80.60	97.56	96.73	77.77	81.25	2
(d) 1919	92.83	93.32	98.41	97.77	94.80	79.48	2
1920	95.62	95.97	98.13	98.35	96.00	91.66	2
1921	98.98	99.15	100.00	99.66	98.75	92.68	2
1922	99.59	99.10	99.09	99.66	93.90	100.00	2

(d) Daymen's week reduced to 47 hours, January, 1919.

(e) War years. Large number of new men and women.

It was always desired that a man should go away from home for his holiday, in order to get a thorough change. Yet it appeared that in very few cases did he do so, and enquiries elicited the statement that he could not afford to go away and take the family, and that if he went away alone he left very little money for housekeeping at home. The Company decided, therefore, in 1902, to give two weeks' pay for the holiday week.

In order to encourage enlistment in the Territorial Force, the Company decided, in 1909, to grant a fortnight's leave of absence to all who were required to attend the annual camp. Those entitled to holidays received the usual two weeks' pay for the first week, and ten shillings pay for the second. Those who were not so entitled through bad time-keeping were paid ten shillings for one week; while those who had not been in the Company's service for the whole of the qualifying year were paid ten shillings for each week, if good timekeepers.

In 1920 further concessions were made, and those entitled to holidays were given their usual two weeks' pay for the first week, and for the second had their army pay, separation allowance, etc., augmented by the payment

of such a sum as raised it to the level of their ordinary wages. Those not entitled to holidays had their army emoluments for both weeks increased by the payment of the difference between their total and the weekly wage.

II.—LONG SERVICE PAY AND AWARDS.

In 1907 the Company desired to establish some scheme to benefit those who remained in their service year after year, so that when they had to give up work altogether they might have a fund of money on which to draw.

With this object in view, a Bonus Scheme was started by which it was arranged that to every man who had been in the Company's employment continuously for two years there should be credited in the Company's books at the end of each year 6d. for every complete pound paid to him in wages, and to every man who had been six years there should be credited a shilling for every pound paid to him in wages. The money received interest at the rate of 3 per cent. per annum, and was withdrawable only on the man leaving the Company's service.

In the course of a few years it became apparent that, on account of their inability to touch the money, the majority of the men did not value the scheme. They were not nearly so anxious to make provision for their old age or for posterity as to get some immediate increase in their weekly income. It was, therefore, decided to abandon the scheme and substitute weekly payments for long service. The accumulated sums standing to the credit of each man were paid out or transferred to an ordinary Savings Bank account, and from July 1st, 1913, the following scheme was put into operation :—

Each man over 21 years of age who had completed 2 years' service received 1s. per week.

Each man over 21 years of age who had completed 4 years' service received 2s. per week.

Each man over 21 years of age who had completed 6 years' service received 3s. per week.

Youths who had completed 5 years' service received 6d. per week up to the age of 23 credited to them in the Bank to receive 5 per cent. interest.

In 1920, the basis was changed to 1, 3 and 5 years' service, with 1s., 2s. and 3s. pay.

Watches

In 1918 several of the oldest employees had to retire on account of age and infirmity, and it was felt, on noting that they had served 25, 30, 35 and even 40 years, that it was a pity there was no recognised method of marking such meritorious service or offering congratulations to the man. It was then decided to present a silver watch and special medal to each man who completed 25 years' continuous service, and a gold watch to each one who completed 35 years.

The promise was made in May, 1918, but owing to the difficulty of obtaining such a large number of watches in and just after war time, the first distribution did not take place until 1920, though it included all who were living in May, 1918.

As the first list included all the men who had served from 25 years upwards and were still living in May, 1918, it was a very long one. The presentations were made by the Chairman of the Company (Mr. Roscoe Brunner) at four smoking concerts held on April 19th, April 29th, May 1st and May 3rd. In 1921, the distribution was made at a concert on May 28th, in 1922 on January 23rd, and in 1923 on February 3rd.

The table on page 75 shows the total number of awards made for service up to December 31st, 1922.

It is interesting to note the ages of the men (excluding foremen and administrative staff) who were in the Company's employment in March, 1923 :—

11.9%	were under 21 years of age.
20.5%	were from 21 to 30 years of age.
24.9%	" " 31 to 40 " "
20.9%	" " 41 to 50 " "
16.5%	" " 51 to 60 " "
4.8%	" " 61 to 70 " "
0.1%	were over 70 years of age.

FOREMEN.

8.0%	were under 41 years of age.
11.2%	were from 41 to 50 years of age.
59.6%	" " 51 to 60 " "
19.1%	" " 61 to 70 " "
1.6%	were over 70 years of age.

LONG SERVICE AWARDS. TO DECEMBER 31st, 1922.

Years.	GOLD WATCHES:							SILVER WATCHES:							Total Awards
	Win- nington	Sand- bach.	Middle- wich.	Los- tock.	Silver- town.	Liver- pool.	Total.	Win- nington.	Sand- bach.	Middle- wich.	Los- tock.	Silver- town.	Liver- pool.	Total.	
May, 1918 to Dec., 1919	176	38	—	6	—	—	220	877	71	60	93	10	7	1,118	1,338
1920	54	9	—	2	—	—	65	71	4	7	16	10	4	112	177
1921	42	5	—	1	—	—	48	33	—	2	18	6	—	59	107
1922	61	1	—	2	—	—	64	28	4	15	13	8	—	68	132
Total presented to date.	333	53	—	11	—	—	397	1,009	79	84	140	34	11	1,357	1,754

Gold Medals

Upon the occasion of the celebration of the fiftieth anniversary, the Company decided to award gold medals to those who have been in their service for over 40 years. One hundred and eight men have received them.

III.—CARE OF THE OLD MEN.

One of the consequences of the prolonged existence of a company that retains the services of its employees is that ultimately the men grow old and become no longer fit for work.

In cases where a man of long service has to give up his employment, and it is found that he has not been able to save enough money to keep him, or where an allowance from the Guardians is not sufficient to enable him to live in comfort, Brunner, Mond & Co. have, since their twenty-fifth anniversary in 1898, made Compassionate Allowances in weekly payments in cases approved by the Board of Directors. These grants are made for twelve months, but are renewable each year if the need continues.

The following table shows the number that have been granted allowances since 1898. It must be remembered that Winnington and Sandbach Works are older than Silvertown, Middlewich and Lostock.

COMPASSIONATE ALLOWANCE CASES FROM 1898 TO
DECEMBER, 1922.

Works.	Number granted.	Number who have died.	Number been stopped.	Number who resumed work.	Number elected Mond Pensioners.	Number remaining on books.
Winnington ...	339	143	29	5	31	131
Lostock ...	60	28	1	—	—	31
Middlewich ...	12	8	—	—	—	4
Sandbach ...	76	37	4	—	10	25
Silvertown ...	8	3	2	—	—	3
Totals ...	495	219	36	5	41	194

AGES OF THOSE WHO HAVE DIED.

Works.	Average Age when granted Relief.	Average Age at Death.	Average Period on Relief.
Winnington	63.7 years	68.6 years	4.9 years.
Lostock	65.8 „	67.5 „	1.7 „
Middlewich	58.5 „	60.5 „	2.0 „
Sandbach	62.1 „	62.4 „	0.3 „
Silvertown	66.0 „	72.0 „	6.0 „
Averages	63.2 years	66.2 years	2.98 years.

Mond Pensioners

When Dr. Mond died in 1909 he left a sum of £20,000 in trust to provide pensions for some of the old men among whom he had worked. The money, however, was to be paid only after the death of Mrs. Mond, and as there was every hope and anticipation that she would live for many years, it became apparent that many of the men whom Dr. Mond knew best might be gone before the pensions became available. Mrs. Mond and her sons therefore decided that, to avoid such a contingency, they would pay annually from their own pockets a sum of money equivalent to that which the legacy would earn if invested; and they agreed that pending the appointment of trustees under the Will, the annual payment should be administered by a representative Committee appointed by Brunner, Mond & Co. This Committee decided that the pensions should be of the value of £1 per week, and therefore it was possible to elect 15 men; but with the object of allowing a larger number of Dr. Mond's old workmen friends to benefit immediately, and in memory of Dr. Mond, the Company decided to maintain an equivalent number of Mond Pensioners, making 30 altogether. The Committee are empowered to elect a new pensioner whenever a vacancy occurs through death, the number being thus kept at 30; but during the last year or two, when men with very long periods of service have been retiring and there have been no vacancies, the Directors have asked the Committee to elect

several additional pensioners on the understanding that their places are not to be filled at their death. For this reason, the number at the end of 1922 was ten in excess of the regulation number.

AGES OF THOSE WHO HAVE DIED.

	Number Elected.	Age.	No. died.	Age.	Pensioned.	Stopped.	Present Number.
Winnington ...	66	65.6	35	68.2	3.11	1	30
Sandbach ...	14	67.1	4	67.4	2.39	—	10
Middlewich ...	1	77	1	86	9	—	—

MOND PENSIONERS.

Name.	Works.	Service.	Date. Elected.	Date Died.
Leicester, Faithful ...	Winnington ...	Years. 28½	Jan., 1912 ...	Dec., 1919.
Jones, James ...	" ...	35	" ...	Sept., 1918.
Thomson, James ...	" ...	26	" ...	July, 1916.
Marsh, Frank ...	" ...	28	" ...	Sept., 1921.
Proudfoot, John ...	" ...	26	" ...	April, 1912.
Davies, Thomas ...	" ...	26	" ...	—
Clarke, John ...	" ...	34	" ...	Feb., 1913.
Stringfellow, Robert ...	" ...	29	" ...	Nov., 1914.
Chandler, Edward ...	" ...	32	" ...	March, 1915.
Beaman, Samuel ...	" ...	27	" ...	Aug., 1913.
Flavell, Isaac ...	" ...	29½	" ...	Jan., 1914.
Nield, Ralph ...	" ...	33	" ...	—
Bradshaw, John ...	" ...	33	" ...	July, 1912.
Gaunt, William ...	" ...	30	" ...	—
Moore, Francis ...	" ...	33	" ...	July, 1922.
Aimson, Frederick ...	" ...	29½	" ...	June, 1913.
Brownbill, James ...	" ...	23	" ...	July, 1913.
Whiteley, Henry ...	" ...	29	" ...	Nov., 1916.
McDermott, James ...	Sandbach ...	37	" ...	Nov., 1914.

MOND PENSIONERS—continued.

Name.	Works.	Service.	Date Elected.	Date Died.
		Years.		
Stead, Daniel	Sandbach	24	Jan., 1912 ...	—
Cresswell, William	„	35	„ ...	—
Hockenhull, James... ..	„	30	„ ...	—
Hancock, Levi	„	34	„ ...	—
Elvin, James	Middlewich	30½	„ ...	March, 1921.
Jones, William	Winnington	23	April, 1912 ...	July, 1913.
Bray, Thomas	Sandbach	33	„ ...	March, 1918.
Smith, George	Winnington	23	Aug., 1912 ...	Dec., 1918.
Wright, Richard	„	29	„ ...	Dec., 1914.
Allen, Henry	„	30	Feb., 1913 ...	Dec., 1913.
Rathbone, Frederick	„	31½	Aug., 1913 ...	Oct., 1917.
White, Alfred	„	31¾	„ ...	—
Aston, Samuel	„	41	Oct., 1913 ...	—
Johnson, Henry	„	32	Jan., 1914 ...	April, 1915.
Insley, David	„	29½	„ ...	Aug., 1920.
Gerrard, Samuel	„	33	Nov., 1914 ...	May, 1915.
Gibson, John	Sandbach	38	„ ...	Aug., 1915.
Worrall, John	Winnington	33	Jan., 1915 ...	Oct., 1920.
Blower, Thomas	„	31½	Feb., 1915 ...	Oct., 1917.
Heesom, Richard Henry	„	31	„ ...	May, 1923.
Janion, William	„	33¾	„ ...	—
Hitchen, Amos	„	26	„ ...	—
Cooke, James	Sandbach	36	„ ...	—
Lawley, Robert	Winnington	28	June, 1915 ...	July, 1915.
Done, Joseph	„	36½	July, 1915 ...	May, 1918.
Drinkwater, Frederick	„	32½	„ ...	—
Shallcross, Robert	„	26	Oct., 1915 ...	March, 1923.
Unsworth, William	„	30	„ ...	—
Buckley, Walter	„	39	May, 1916 ...	June, 1922.
Poole, James	„	38	Sept., 1916 ...	—

MOND PENSIONERS—continued.

Name.	Works.	Service.	Date Elected.	Date Died.
		Years.		
Hurst, Ernest	Winnington	28	Dec., 1916 ...	Feb., 1917.
Brodie, William	"	32½	May, 1917 ...	Jan., 1918.
Webb, James	"	32	Dec., 1917 ...	June, 1921.
Wingfield, William	"	32	"	—
Yarwood, George	"	35½	March, 1918 ...	May, 1918.
Racster, William	"	30½	May, 1918 ...	July, 1918.
Finney, John... ..	Sandbach	38	"	—
Siddall, John	Winnington	31	June, 1918 ...	—
Robinson, John	"	40	Oct., 1918 ...	—
Buckley, Charles	"	30	"	—
Forster, Thomas	"	29½	Jan., 1919 ...	—
Moore, Thomas	"	38½	May, 1920 ...	—
Moore, Edwin	"	41	"	—
Beckett, George	"	43½	Nov., 1920 ...	—
Tweedle, Edward	"	34	"	Sept., 1922.
Shepherd, John	Sandbach	40	"	—
Moran, Patrick	Winnington	42	March, 1921 ...	June, 1921.
Clarke, William	"	42	May, 1921 ...	—
Condliffe, Charles	Sandbach	45	June, 1921 ...	—
Palin, George	"	45½	Aug., 1921 ...	Sept., 1921.
Smith, Thomas	Winnington	39½	"	—
Pearson, James	"	42½	"	—
Angus, Edward	"	42	"	—
Moore, John	"	39	"	—
Garnett, John	"	43	Sept., 1921 ...	—
Farr, Samuel	Sandbach	43	"	—
Wakefield, Frederick	"	45½	May, 1922 ...	—
Malam, Robert	Winnington	40	July, 1922 ...	May, 1923.
Edwards, William	"	40½	"	—
Blaine, Edward	"	40	Nov., 1922 ...	—
McKenzie, Alexander	"	39½	"	May, 1923.

IV.—SICK BENEFIT.

A Works' Sick Club was instituted at the starting of the Winnington Works. Men had 4d. per week deducted from their wages, and boys 2d. During sickness, they received free medical attention and medicine and sick pay—8s. per week for the men and 4s. for the boys. These benefits were raised to 10s. and 5s. respectively in 1897. The Club was managed by a Committee elected by the workmen, and they appointed the doctor.

When the Shops' Club Act of 1902 made it illegal to maintain any such club by deductions from wages unless 75 per cent. of the employees voted for it, the Company took over the whole responsibility for maintenance without any contributions from the men, and left the benefits the same as before. They arranged for their own choice of doctor, and took power to appoint a proportion of the Managing Committee.

When the National Insurance Act of 1911 came into force, obliging each employer and each employed person to pay a weekly contribution to the State, the Sick Benefit Scheme was naturally abandoned so far as insurable persons were concerned; but the Company devised a new scheme to give:—

(A) For all workmen—

- 1.—Free medical and surgical attendance and medicine in case of accident arising out of, and in the course of, employment.
- 2.—Sick pay for the first week after any such accident.
- 3.—Extra sick pay in necessitous cases beyond that provided under the National Insurance Act, 1911, or any amending Act, or under the Company's scheme, or in addition to payments under the Workmen's Compensation Acts.
- 4.—Payments on the death of workmen, their wives, and children under 14 years of age.

(B) For workmen who are not insured persons under the National Insurance Act:—

- 1.—Free medical attendance and medicine.
- 2.—Sick pay.

(C) For men on Compassionate Allowance and Mond Pensioners—

- 1.—Free medical attendance and medicine.
- 2.—Payments on death of men or their wives.

The management was vested in a Committee composed of 10 members elected by the men, along with 5 nominees of the Company, until 1918, when it was transferred to the Works Committee.

It should be understood that although the arrangements before described applied solely to Winnington in 1874, the same action was taken in every other works when built or acquired.

Distress Fund

In voting extra sick pay in necessitous cases on behalf of the Company to men unable to work through sickness or accident, the Committee frequently found that the limit of 50 per cent. of what the man was receiving under the National Insurance Act or the Workmen's Compensation Act was not sufficient. An arrangement was therefore made to create a fund to be utilised to augment such payments. Men who were desirous of subscribing to the fund signed a written request to the Company to deduct a specified sum weekly from their wages, and the Company promised to pay to the fund an amount equivalent to the total of the men's contributions.

Benevolent Fund

In course of time, after the transfer of the management to the Works Committees, it was felt that, with the development of interest in the work of hospitals and convalescent institutions, the employees might help in many directions if they could secure an income that was not specially earmarked for the relief of distress. Ultimately it was arranged to appeal to the men for larger deductions from weekly wages, to change the name of the fund to "Benevolent Fund," and to divide the income into two accounts—No. 1 to be for relief in cases of sickness or accident (to which the Company's contribution is continued), and No. 2 to be for general philanthropic work. There was an immediate response from the men, and the Committee have done most useful work with the funds placed at their disposal.

During the last two years of bad trade (1921 and 1922), when so many men were out of work, the men at Winnington and Lostock Works, at the suggestion of the Committee, taxed themselves still further to provide funds for feeding the children of the unemployed, and thus did much to alleviate the distress in the district.

District Nurses

The Company have always recognised that it does not pay an employee to be away from work minus wages any longer than is absolutely necessary, and therefore they have taken care to see that their men are well nursed during periods of sickness. For the neighbourhood immediately surrounding their large works (Winnington and Lostock) they maintain four nurses solely to look after the men and their wives and families. In other districts they subscribe to existing nursing associations in order to secure benefits for their employees.

V.—HOUSING OF EMPLOYEES.

The estate purchased from Lord Stanley when the Winnington works were established consisted of Winnington Hall and park, with its gardens, orchards, stables and outhouses. Beyond accommodation for coachmen, grooms and gardeners in the immediate vicinity of the Hall, there were no cottages whatever except for the lodge-keeper. As the works were a mile-and-a-half distant from Northwich, and one mile from Barnton, and there were no nearer places at which workmen could reside, the Company built twenty cottages and eight villas in 1879 at the top end of the park nearest to the main Runcorn road. A short street was made opposite the cottages; but the rest of the park remained wooded pasture land, and access to the works could be obtained only by making a semicircular *détour* round the enclosure.

In 1882, however, in view of the extension of the works, the street was extended straight across the park and christened "Solvay Road," and 107 more cottages were built, a second street being formed at the back of the top part of Solvay Road and called "Hemming Street." About seven years later 121 cottages more were built, and a new street was made parallel with the bottom half of Solvay Road and called "Faraday Road." The first villas were called "Dyar Terrace," and thus the names of Harrison Gray Dyar and John Hemming, so long famous in the history of ammonia-soda, were perpetuated at Winnington, the first works in their native land to make a commercial success of their process.

With the construction of Solvay Road and the growth of quite a considerable village at Winnington, a demand arose for a shop, and this was met by the formation of a Co-operative Society, registered in 1883 under the Industrial and Provident Societies' Act. This had a most successful career, and in a few years outgrew its accommodation at 109, Solvay Road, and built its own premises opposite. It opened branches in various districts round Northwich, and amalgamating with the smaller and younger Northwich Society, ultimately formed a strong and important society under the name of the Winnington, Northwich and District Co-operative Society, Limited. The society is mentioned here, although it has no connection with Brunner, Mond & Co., because when the Company bought a plot of land at Barnton, known as Hill Top Farm, they expressed their willingness to sell it off in small plots to any of their men who were desirous of building houses for themselves if the Co-operative Society would organise a building scheme. This was done, and arrangements were made to advance money on equitable mortgage to those who wished to build, on condition that they paid at the outset a deposit equal to 10 per cent. of the estimated cost, and thereafter paid 6½ per cent. on the remainder until the total sum was repaid, which was in fifteen years. Under this scheme a large number of the Company's men built their own houses, and these, in view of the then cost of building and the present post-war value of house property, must have proved a very good investment to them.

By 1910 the whole country was feeling the want of more and especially better-class cottages for working men, and numerous so-called "Garden Cities" were started in different parts. The demand in Northwich was perhaps keener than elsewhere, because, owing to subsidence and consequent neglect, many houses were becoming unfit for habitation, and the speculative builder was not active.

In order to house an additional number of men urgently needed for works' extensions, the Company placed a contract with Messrs. Humphries, Limited, in 1912, for the erection of fifty corrugated iron and timber bungalows along the Avenue Road leading to Winnington. These four-roomed houses, built with four firegrates all coupled to one central brick chimney, detached, with good gardens back and front, good water supply and sewers,

and electric lighting, were completed in a very few weeks, and have proved very popular. At the same time, the Company built a large Bachelors' Hall, capable of accommodating 200 men.

After several interviews with Mr. Henry Vivian, the pioneer of "Garden City" building, the Company arranged, in 1912, with the Co-partnership Tenants' Association to develop the remaining land at Hill Top Farm, Barnton, by putting up model houses along wide and pretty roadways. This plot accommodated forty-nine houses. While this was being done for the benefit of those employed at Winnington, there arose a demand from Lostock for accommodation for its workers, and the Co-partnership Tenants' Association was called in to undertake the erection of fifty-eight houses.

These were barely finished when the war came, and house building ceased throughout the country. During 1915, 1916, and 1917 practically no houses were built, and, with an ever-increasing population, the shortage of 1910 was emphasised, while the cry of "houses fit for heroes to live in" gave force to the demand that something should be done. It was obvious that with the current prices of materials and labour private enterprise could not be expected to do anything, and that if houses had to be built the excess of cost over the value would have to be borne by the taxpayer. Ultimately, local authorities were given power to undertake building schemes (approved by the Ministry of Health) at a cost to the ratepayers not exceeding the yield of a penny rate. They were empowered to borrow money locally upon the best terms they could obtain; they were compelled to let the houses on completion for the nearest possible approach to an economic rent; and then it was arranged to value them at the end of seven years and pay from the Imperial Exchequer any difference between that value and the cost.

Being anxious to secure the erection of more houses in the district, Brunner, Mond & Co. approached both the Northwich Urban and Rural Councils in 1918 and suggested the adoption of the Government's scheme, promising to give land at Rudheath and at Winnington for the purpose and to help by lending money. The Rural Council developed a scheme for building 240 houses at Rudheath, and the Urban Council planned for 275 on the old golf links site at Winnington. While the first blocks of these were being built in 1920-21, the great depression in trade took place, and

the Ministry called for curtailment of the enterprises down to the barest necessity. The result was that only 128 houses were completed at Rudheath and 78 at Winnington.

In view of their decision to erect large works at Wallerscote, near Winnington, Brunner, Mond & Co. felt it incumbent upon them to provide houses for the men who would be required for the erection and operation of the works, and, as they had allocated all the suitable building land at Winnington, they bought a plot at Weaverham from Lord Barrymore. This land, adjacent to Owley Wood, lent itself most admirably to the design of a beautiful village. On account of the rapidity with which it could be erected, the Dorman-Long type of house, constructed of steel frames and concrete, was chosen. A contract was let for 250 houses built in pairs. The land was laid out with wide curved roads containing grass margins planted with trees. The houses were all built round open spaces, so that in addition to a fairly large garden each tenant might have an allotment at the back. A good and ample water supply was developed on the land, and all the houses were supplied with electric current. The Company have built a few houses at Sandbach and Middlewich for the accommodation of their foremen, and have built or purchased a number of houses for members of the staff. Altogether, the Company own over 700 houses.

VI.—WORKMEN'S BATHS.

Recognising the probability that a man will get more or less dirty during the course of his work, and is just as likely to get hot, the Company constructed baths and clothes drying rooms in 1909 at the cost of about £8,000, so that a man could walk from his home in good clean clothes, change into a dry working suit at the baths, and then proceed to work. On leaving work for the day he could take a bath, change into his home clothes, place his working clothes in the drying room, and return home without any fear of contracting a chill, and in confidence that he would not introduce dirt into the house. Moreover, he would then be ready to go out for recreation without further preparation. The building is equipped with fifty shower baths, nine slipper baths, one hundred dressing rooms, and two clothes drying rooms.

It has to be confessed that the baths have been a failure. The before-mentioned procedure seems ideal; but the men have never adopted it. The building was constructed so that it could be enlarged whenever it became necessary. A staff was arranged to keep the place open day and night, whenever men were going home or coming to work, lockers were provided, and the drying rooms kept constantly heated, soap and towels and admission all being free. But it soon appeared that the men would neither come a few minutes earlier nor stop a few minutes later in order to use the place, and gradually the hours have been reduced and the drying rooms closed. Some baths are taken, but only in the slipper baths, and mostly on Saturdays.

VII.—AMBULANCE.

The first ambulance classes, under the auspices of the St. John Ambulance Association, were held at Winnington in 1889, and thereafter, with hardly any exception, each winter has seen the training of an additional number of men. In this way the Company have secured the services of many hundreds of men trained in first-aid work. It was, however, realised in course of time that this preliminary training is not enough to ensure the constant presence of men who would be skilful and up-to-date in action when called upon in case of emergency, and so in 1902 works' teams were organised and located in different parts of the works, with their own ambulance cupboard fitted with all appliances. In order to keep the men composing the teams constantly efficient, periodical drills were arranged and the services of an instructor were obtained. Admission to the teams is secured only by special examination.

This organisation is common to all the works, and once a year the representative teams compete for the possession of a Challenge Shield that was presented by the Company, and for the special prizes and medals that are offered. The judge who conducts the competition is always chosen from outside the district. The following is a list of the winners of the Shield up to the present time :—

WINNERS OF AMBULANCE CHALLENGE SHIELD.

1904.

WINNINGTON.

"B" Process Team

R. Worsley (Capt.).
J. Bramhall.
J. Astbury.
E. A. Gibson.
O. Hornby.
G. Hughes.

1905.

SANDBACH.

"B" Process Team.

G. W. Lee (Capt.).
J. Bowyer.
T. W. Spurrier.
S. Bebbington.
J. Oakes.
H. Clowes.

1906.

WINNINGTON.

"B" Process Team.

R. Worsley (Capt.).
J. Bramhall.
O. Hornby.
J. Astbury.
G. H. Young.
J. Atherton.

"A" Bleach Team.

J. A. R. Cree (Capt.).
G. Gilbert.
T. Davies.
J. B. Gorst.
R. Kirkham.

1907.

WINNINGTON.

"A" Bleach Team.

J. A. R. Cree (Capt.).
J. B. Gorst.
G. Gilbert.
R. Kirkham.
G. H. Hitchens.

1908.

WINNINGTON.

"B" Process Team.

G. H. Young (Capt.).
O. Hornby.
J. Astbury.
J. Bramhall.
T. H. Tomlinson.
E. A. Gibson.

1909.

MIDDLEWICH.

"C" Process Team.

G. O. Stuffins (Capt.).
R. Arden.
R. Pugh.
J. Bailey.
J. A. Wrench.
W. Bailey.

1910.

WINNINGTON.

"B" Process Team.

O. Hornby (Capt.).
T. H. Tomlinson.
E. A. Gibson.
J. Bramhall.
J. Smith.
J. Astbury (Reserve).

1911.

MIDDLEWICH.

"C" Process Team.

G. O. Stuffins (Capt.).
R. Arden.
R. Pugh.
J. Bailey.
J. A. Wrench.
J. Coppenhall.

1912.

SANDBACH.

"A" Shift Team.

B. C. Ryder (Capt.).
J. Challinor.
S. Sherratt.
J. Potts.
J. Large.
J. Bennett.

WINNERS OF AMBULANCE CHALLENGE SHIELD—continued.

1913.

WINNINGTON.

"B" Process Team.

O. Hornby (Capt.).
T. H. Tomlinson.
R. Hewitt.
J. Bramhall.
J. Smith.
J. Stretch (Reserve).

1914.

SANDBACH.

No. 1 Day Team.

G. W. Cooke (Capt.).
P. Gater.
F. Harrison.
E. Seaman.
H. Holford.
E. Dale (Reserve).

1915.

SANDBACH.

"B" Process Team.

S. Bebbington (Capt.).
G. Poole.
J. Bowyer.
J. Oakes.
H. Ollier.
H. Clowes.

1916.

MIDDLEWICH.

"A" Process Team.

G. O. Stuffins (Capt.).
J. Bailey.
W. Wilkinson.
G. E. Manley.
J. Clarke.
M. Reynolds.

1920.

SANDBACH.

"B" Process Team.

G. H. Mason.
F. R. Sherratt.
G. Poole.
B. G. Ryder.
T. W. Spurrier.
J. Corwood.

1921.

WINNINGTON.

"A" Process Team.

W. S. Sutton (Capt.).
C. Hignett.
C. Gilbert.
G. Hindley.
A. E. Dutton.
M. Coombs.

1922.

WINNINGTON.

"A" Process Team.

W. S. Sutton (Capt.).
C. Hignett.
C. Gilbert.
G. Hindley.
T. Hubbard.
M. Coombs.

1923.

WINNINGTON.

"B" Process Team.

T. H. Tomlinson (Capt.).
J. Stretch.
H. Bramhall.
E. Pawson.
J. Smith.
T. Mills.

The value of this ambulance training was demonstrated during the war, for quite a large number of the Company's men were, on enlistment, drafted into the Royal Army Medical Corps.

Special medals are awarded for conspicuous first-aid service in cases of accidents in the works.

VIII.—EDUCATION.

With the creation of a new village in Winnington Park, distant about a mile from any school, the education of the children became a pressing problem. This was solved by the erection of a thoroughly up-to-date building in the park itself at the expense of the Company. The schools were opened on May 10th, 1886, under the head-mastership of Herbert Caress. There were 115 pupils admitted in the first year; the numbers increased to 238 in the second year, and continued to grow until it became necessary in 1892 practically to double the school. In 1907 there were 879 pupils at Winnington, notwithstanding the fact that other new schools had been opened (Sir John Brunner gave new schools to the village of Barnton in 1898, and Victoria Road Council Schools, Northwich, were opened in 1907). In July, 1903, the schools were placed under the control of the County under the Act of 1902. From 1887 to 1904, Sir John Brunner offered scholarships tenable at the Grammar School to pupils at the elementary schools of the town, and of these Winnington scholars won the majority, viz., 32. In 1894 the County established scholarships of its own open to all the schools in the County, and tenable at any higher-grade school. Of these, up to 1922, Winnington had won 168.

Being fully convinced that, if a boy upon leaving school at the age of fourteen gave up all education, he would rapidly forget most of what he had learnt, the Company started evening continuation classes in 1886. During the first four years attendance was optional, and the numbers varied from 26 to 35; but in 1890 the Company made it a condition of employment that all youths between the ages of fourteen and eighteen should attend an evening school. The age was raised to nineteen in 1894, and a rule was made that no boy should be engaged who had not passed the sixth standard. Apprentices were obliged to attend until they were twenty-one. Concurrently, a promise was made to return all the fees to such as made satisfactory attendances. After this, the numbers at the evening classes naturally rose, but as the syllabus was enlarged and became more interesting, many voluntary students were attracted in numbers almost equalling those of the Company's employees. In 1897 there were 352 attending, and by 1907 the number had grown to 400.

In 1905 the Company arranged for apprentices over eighteen years of age to attend classes at the Northwich Technical Schools on two afternoons per week, and in 1906 agreed to send all youths to evening classes at the Technical Schools after they had been for three sessions at Winnington Evening Schools. For a few years before this, Winnington had been working on a very comprehensive and advanced syllabus, with crowded classes, and had established a great reputation throughout the district. It was charged with doing some of the work that ought to fall upon the Technical Schools, and after much negotiation the Managers most reluctantly agreed to simplify the curriculum and leave the advanced and scientific teaching to the higher school. The removal of some of the employees after three sessions naturally reduced the numbers attending at Winnington, and the exclusion from the syllabus of some of the most interesting subjects caused a serious falling off of the voluntary students.

After twenty-one years of experience with the evening schools, Mr. Caress reported that there had been a steady and continuous improvement in the general attainments of the boys ever since the compulsory rule was put into force. He expressed the conviction that it was useless to send a boy straight from an elementary day school to a technical school; but that the training received in a continuation school was just what was needed to prepare him for the higher grade curriculum.

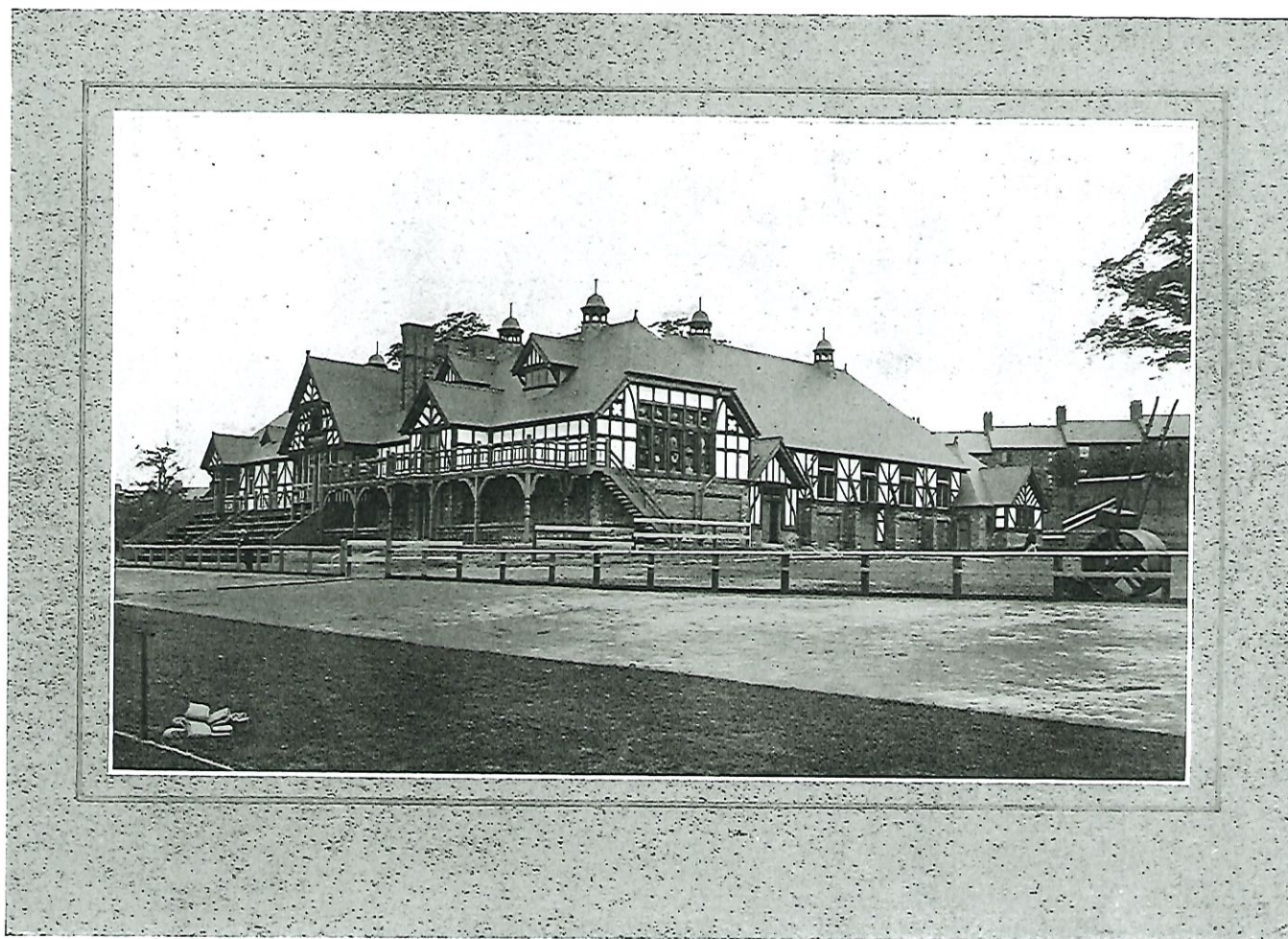
In the Education Act of 1918 power was given to Education Committees to institute day classes for boys of fourteen to sixteen years of age. It was assumed that at such ages, if boys were employed all day, they were apt to be too tired to benefit by attendance at an evening school, and that they would derive more benefit if they began their attendance after they had reached the age of sixteen. By arrangement with the majority of the employers in the town, the Northwich Education Committee took advantage of the permissive clause in the Act, and organised day classes at the Technical Schools suitable for such boys. Brunner, Mond & Co. arranged to send their boys, from September, 1919, for one whole day per week, and to pay their wages during absence.

At the end of 1921, Mr. Caress, who had some months previously become seriously ill, found it advisable to resign his position as headmaster of the

schools, after holding it for over thirty-five years, and on January 23rd, 1922, in the presence of all the scholars and most of the school managers, Mr. Roscoe Brunner (Chairman of Brunner, Mond & Co.) presented him with a gold watch to commemorate his long service. In making the presentation, Mr. Brunner remarked that Mr. Caress had come to the schools as quite a young man, but had brought a reputation with him, and that in the thirty-five years he had not only increased his fame as a leading teacher throughout the County, but had made the Winnington schools famous in all educational centres. Mr. Caress' retirement was marked upon another occasion by a meeting of past and present teachers and past and present pupils, and the presentation of addresses and mementos from each group.

Allusion has already been made to the generosity of Sir John Brunner in giving new schools to Barnton; but a description of the improved educational equipment of the district cannot be complete without a statement of what he did for the Northwich Grammar School.

In the sixteenth century a certain Sir John Deane left money to found a grammar school in Witton-cum-Twambrooks (the original name of a township which now forms part of Northwich), and a building was erected in close proximity to the parish church. Although suitable for the purpose for which it was originally designed, this building became in the twentieth century totally inadequate for the needs of the district, and its curriculum more befitted its age than the requirements of modern times. Sir John built at his own expense (over £20,000) a capacious school, which he offered to the Governors, along with a playing field, on condition that they applied for a revision of the Trust giving them power to admit girls. He further arranged with the Directors of the Girls' High School (which he had been instrumental in establishing) for the transfer of that school to the care of the Governors of the Grammar School and the reception of the pupils in the new building. Sir John's offer was accepted, and the scheme was remodelled, the Trust being given to a new body of Governors. Mr. F. C. Weedon, B.Sc., who was appointed headmaster, soon created such a reputation for the school that in the course of a few years it was quite full, and has remained so up to the present. In the old school there were about forty boys, but now there are five hundred boys and girls in the new building.



WINNINGTON PARK RECREATION CLUB

It should be remembered that Sir John Brunner was always a pioneer in educational matters, and that all the work done by Brunner, Mond & Co. in that direction was owing to his initiative.

IX.—RECREATION.

In 1890 the Company constructed a cricket ground and cycle track in Winnington Park, and in 1898, in commemoration of the twenty-fifth anniversary of the erection of the works, Sir John Brunner and Dr. Mond gave a pavilion containing a billiard room with four tables, a reading room, dressing rooms and baths, kitchen and bar. At the same time, the Company built a large hall with library and dressing rooms, and laid out additional ground to form lawn tennis courts, bowling greens, and football grounds. These cost £11,150. The buildings were completed in 1901.

Any person over 16 years of age employed by the Company may become a member of the Club on payment of an annual subscription of 3s. 6d. This entitles him to the free use of the pavilion, and gives him entry to the grounds. For participation in various games additional subscriptions have to be paid; but an annual payment of 12s. 6d. covers membership of all sections. The Club is governed by a Council elected by the members, but containing representatives of the Company elected by the Directors. All profits made are employed for the benefit of the Club.

The Company built a Recreation Club at the Lostock Works in 1906, at a cost of £5,800. This is equipped with billiard tables, dressing rooms, bowling greens, a large hall and a bar, and is managed by a Council elected on the same lines as that at Winnington. A similar Club was erected for Sandbach works in 1908, with billiard room, bowling green, and bar, at a cost of £2,930. The addition of a large hall is being made in celebration of the fiftieth anniversary. Middlewich Recreation Club was built in 1909 at a cost of £2,590, and is equipped similarly to that at Sandbach. The management of all the Clubs is on the same lines as at Winnington.

In 1909 the Company provided a gymnasium and Lads' Club at Winnington for the use of those who were too young to join the Recreation Club.

Silvertown Works have a Recreation Room in the office building, opened in 1919. This has billiard table, piano, and tables for cards, and any employee may join on payment of an annual subscription of 2s. 6d.

X.—BOY SCOUTS.

Early in 1918, the General Manager of the Lostock Works allowed a workman to instruct a small troop of scouts drawn from Lostock village, using the Lostock canteen one evening per week. This small troop, however, dwindled away until it had only a membership of seven, and it was then taken charge of by the Lostock Welfare Department. The canteen not being available, a small room near the works was placed at the disposal of the boys, five boys officially transferring to the new troop. Under the leadership of Mr. Mervyn Allen, the movement extended, and the whole of the women's canteen was handed over to the Welfare Department for their use. The troop increased to 200 boys. Mr. Houlgrave, a painter at Lostock, undertook to teach these boys, and in 1920 he successfully formed a brass band of twenty-four instruments.

In October, 1920, the Company decided to start a troop of scouts at their principal works, Winnington, and began by enrolling eight on the first night. This troop has steadily grown, and now occupies the large buildings known as the Lads' Club and Scouts' Hall, the latter being specially erected for their benefit. Small troops of scouts attached to the works have also been raised at Sandbach and Middlewich, and a second band was formed in 1922 and attached to the Winnington Scouts.

At present the strength of the scouts is as follows :—

Winnington	..	..	..	500
Lostock	..	..	..	365
Middlewich	..	..	..	63
Sandbach	..	..	..	90
Total	..	..	..	1,018

These boys are drawn from the ranks of employees and sons of employees at the various works.

Camps

A varied programme of camps has been gradually evolved. Three summer camps have already been held. The first was at Prestatyn in 1920, thirty-four boys attending; the second was also at Prestatyn in 1921, with eighty

boys attending ; and the third, in 1922, was held at Abergele with a strength of 240. These camps are elaborately arranged ; the boys are taken and brought back by special train, paid regimental cooks are engaged, and a special hospital camp in the charge of two ladies is available for boys who are not up to the mark.

A large number of week-end camps are arranged during the camping season, parties of boys being out for the week-end practically every week-end throughout the summer. Whitsuntide camps take place, with all troops attending, at such places as Sandbach or Middlewich, close to the works. The boys bring their own food, and pay a small charge for transport. These camps enable recruits to get their first taste of camp life. Last Whitsuntide the strength in camp was 300.

The works' troops are run on strictly non-sectarian lines, and every facility is given to members of the different denominations to attend their place of worship on Sundays. The movement is very popular among the boys. The buildings placed at the disposal of the scouts have an enormous percentage of attendance, Winnington and Lostock headquarters being open every evening of the week.

Gymnasium Teams

During the winter, the boys' gymnasium at Winnington is open on Mondays, Wednesdays, and Fridays, two lessons being given each evening, and squads up to thirty members catered for. The scouts have been divided into squads in order that every boy may get training.

The Lostock gymnasium is also open three evenings a week, and is worked on similar lines.

Winnington Boys' Club is largely used by the works' scouts, and is open every night of the week except Tuesdays. There are two small-size billiard tables, one bagatelle table, and a large number of table games and magazines. Drinks suitable for boys can be obtained at a small shop in the Club. An average of 70 boys use the Club every night.

Brunner Mond Junior Football League

The Brunner Mond Junior Football League was started in the autumn of 1918 for the juvenile employees of the Company at the various works,

who, forming themselves into groups or clubs, made up a league under the control of a committee and the Welfare Department. In 1921 the League was divided into a Junior and a Senior Section, the Junior Section for boys from fourteen to sixteen years of age, and the Senior Section for boys from sixteen to nineteen years of age. The 1922-23 season was very successful, 11 teams taking part in the senior section and 6 teams in the junior.

XI.—A NOTABLE TRIBUTE.

On July 10th, 1920, there was a memorable gathering in the pavilion at Northwich, when the employees of the Company presented an illuminated address to the Chairman and Directors. Dr. Shard (Chairman of the Representative Committee) presided, and was supported by members of the Committee and several Trades Union secretaries.

The Directors present were Mr. Roscoe Brunner (Chairman), Sir John Jarmay, Mr. Robert Mond, Mr. J. I. Watts, Mr. A. W. Tangye, Mr. J. J. Harper, Mr. J. G. Nicholson, Mr. C. F. Poole, Mr. A. T. Smith, and Lieut.-Col. G. P. Pollitt, D.S.O. Letters regretting inability to be present and expressing appreciation of the object of the gathering were read from Mr. James Fitton, Secretary of the Amalgamated Engineering Union; Mr. G. H. Postles, Secretary of the Weaver Watermen's Association; and the Rt. Hon. J. R. Clynes, M.P., President of the National Union of General Workers.

Mr. Fred Clare spoke as a representative of the Winnington workers, and was followed by Mr. R. Slade as the mouthpiece of Lostock. Dr. Thornton Lamb, representing Silvertown, added his testimony to the good feeling which has always existed between the Directors and the employees. Mr. George Plant, of Winnington, on behalf of the Committee, presented the address, which was read by Mr. Lloyd Roberts, Secretary to the Committee.

The address was signed by representatives of the technical staff, the commercial staff, the foremen, the tradesmen, the general daymen, and the shiftmen, the men chosen from each group being those with the longest periods of service.

Mr. Roscoe Brunner expressed the extreme pleasure which such a presentation had afforded him and his colleagues, and referred to the feeling

of good fellowship which had always existed between the Company and its employees.

Mr. J. I. Watts and Mr. A. T. Smith returned thanks on behalf of all their colleagues on the Board.

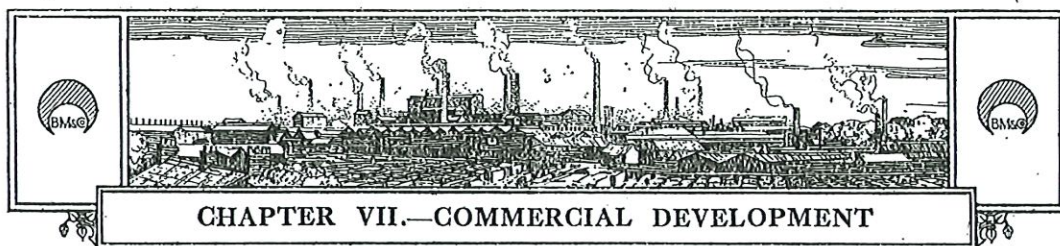
Mr. T. Winstanley (Winnington) and Mr. E. B. Sant (Middlewich) then asked Mr. Brunner to accept a present of a silver tray. The presentation was made by Mr. Frank McCormack (Winnington). The tray bore the inscription :—

“Presented to Mr. Roscoe Brunner, Chairman of Messrs. Brunner, Mond & Co., Limited, by the employees of the firm, as an expression of their appreciation of his consistently friendly attitude towards them, and as a token of the personal esteem and affection in which he is held.

“Winnington, July 10th, 1920.”

In attempting to return thanks for the gift, Mr. Brunner was interrupted by the singing of “He’s a jolly good fellow.” But when he could speak, he said: “If I deserve this, it is due to the example, which I have always had before me, of my father. No man ever had a better. If I continue to deserve it, it will be with the help of you and my colleagues who sit around me.”



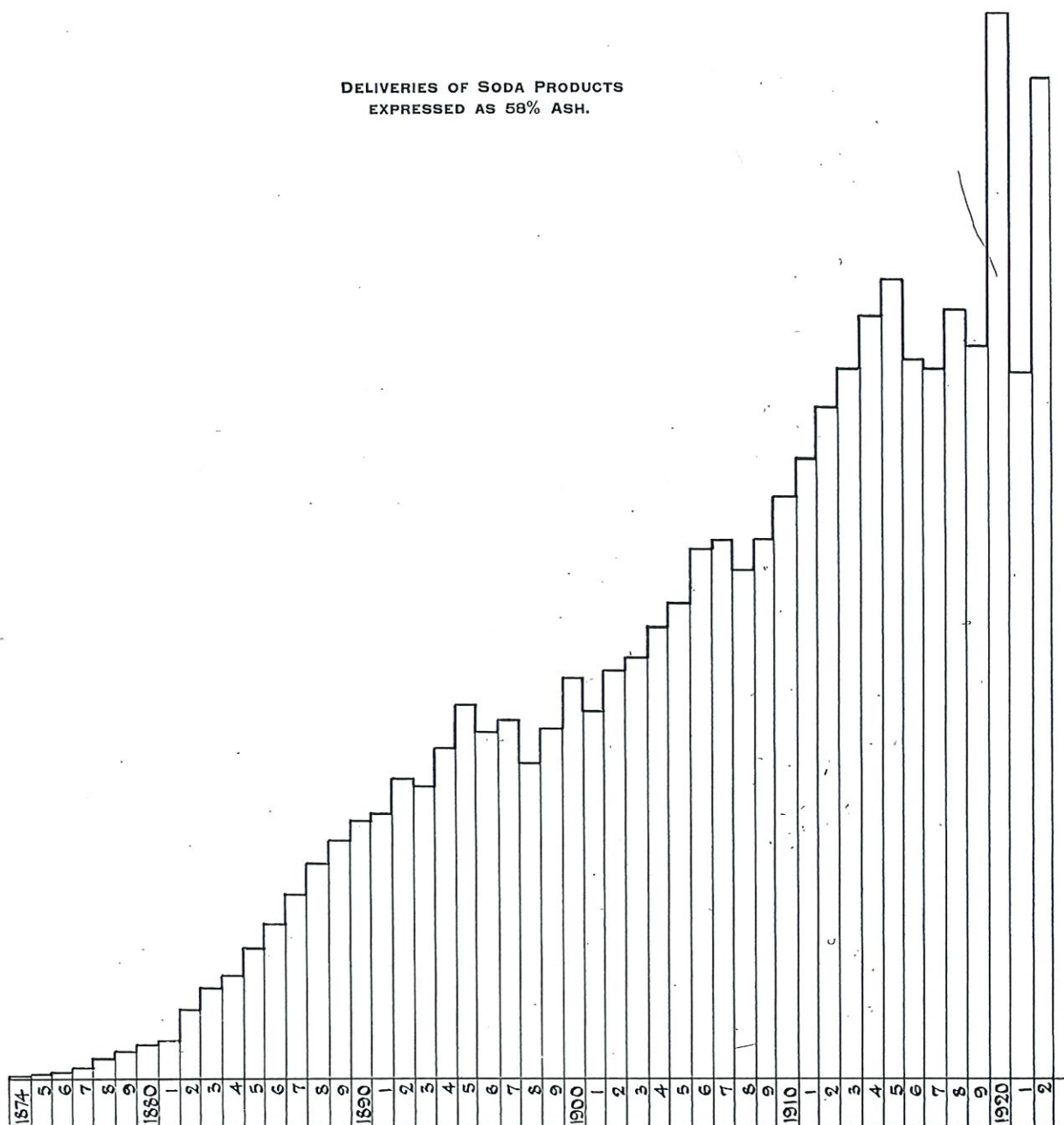


HE general development of process and production from the earliest days having been outlined in the preceding chapters, a word does not seem out of place with regard to the commercial development, particularly in regard to sales.

Reference has been made to the fact that the late Sir John Brunner originally did practically the whole of the commercial work of the Company, and his activities therefore included the actual selling. In a short time it became impossible for him to carry on without assistance, and part of the commercial work was delegated to Thomas H. Forgan, who was appointed Secretary of the Company when it was formed in 1881, and who continuously took a very active interest in its sales policy. This interest he retained when he was appointed to the Board, and Fred W. Brock, who succeeded him as Secretary, gave his attention to the continuation of the selling policy initiated by his predecessors. The policy has already been outlined, and its development has followed on the same lines as that of the process. From its inception, the Company's main endeavour has been to supply the best possible product at the cheapest possible price, and to establish direct dealings between the manufacturer and the consumer.

In 1874, when production commenced, soda ash of the purity now universally recognised as the standard was practically unknown, and it was not uncommon at that time to sell high-grade ash at a price per degree—a practice which, it may be noted, has not yet completely died out in the United States. For the first twenty-two years of the Company's existence the major portion of the production was exported to America, and this may account for the reluctance of buyers there to abandon the old selling basis. It was in 1876 that the late Sir John Brunner first visited the market, and there seems no doubt that he then confirmed an arrangement with Wing & Evans, New York, to act as the Company's representatives

DELIVERIES OF SODA PRODUCTS
EXPRESSED AS 58% ASH.



in the States. This association continued until it became impossible to compete successfully from this side, and the Solvay Process Company, who had established works, took over Wing & Evans as their selling agents. At the same time as the States trade was making rapid strides, Canada was also a progressing market, and Winn & Holland, of Montreal, acted as the Company's agents there. They are still interested in marketing soda products throughout the Dominion on behalf of Brunner, Mond (Canada), Limited.

The only other market of interest was at home, and as the demand exceeded the supply, it did not become necessary to seek fresh outlets until 1881, when the first travelling representative, Martin Taylor—at one time an alkali manufacturer himself—was appointed. He had a very uphill task in convincing the conservative home consumers that it was to their own interest to buy the higher test product produced by the Solvay process, at a higher price per ton than they paid for the lower grade they had hitherto been accustomed to use. As the business developed, it soon became impossible for one man to cover the whole of the British Isles, and in 1884 Arthur & Hinshaw, of Glasgow, were appointed sole representatives for Scotland—a position which they still occupy; whilst in 1885 a further appointment was made for the Yorkshire district in the person of John Appleby, followed a year later by that of Walter Archibald for Ireland.

Until 1895, Joseph P. Brunner & Co., of Liverpool, had acted as forwarding and shipping agents for all the export traffic, but in consequence of the rapid development and greatly increased detail work in connection therewith, an office was established in Liverpool, and commenced operations on January 1st, 1896.

On the erection of the Silvertown works in 1894, Martin Taylor was transferred to the London area, where he continued his pioneer work. The London office of the Company was opened in 1901, and, in more recent years the number of home offices has been increased by the addition of one in Leeds.

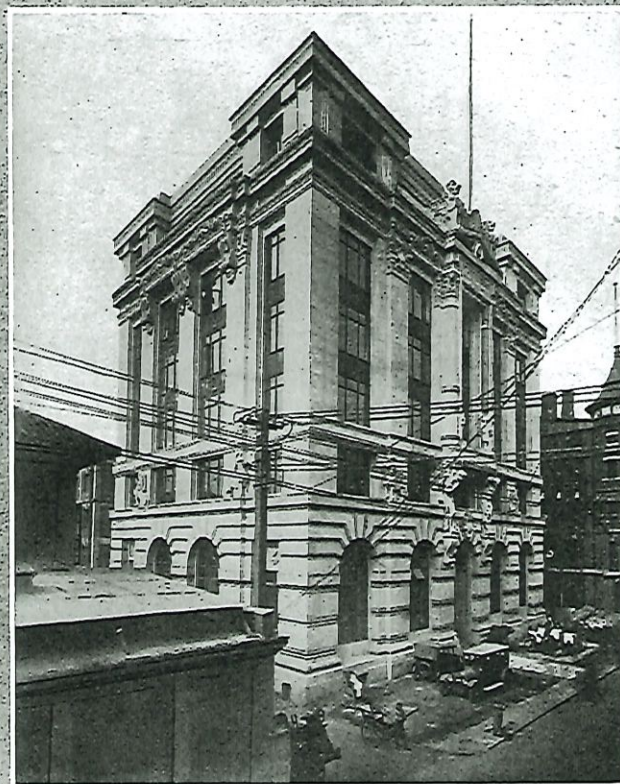
On the passing of the Dingley tariff, it was foreseen that the business in soda ash, etc., which had in the past been done between this country and the U.S.A., would rapidly diminish, and with an ever-increasing productive capacity, it became a necessity for the Company to investigate the possibilities of other markets. With this object in view, Mr. Glendinning proceeded in 1898 on a tour in the Far East, and on his return home the

first appointment of a foreign representative was made for China. In 1901 the Company opened its own office in Shanghai. Within a few years the China trade, which had previously been reckoned in tens of tons, increased to thousands of tons, necessitating a network of offices scattered all over China, Manchuria, Mongolia, and Eastern Siberia. So extensive became this organisation that in 1920 a separate Company, in which the parent Company holds the majority of the shares, was formed to control the trade in Brunner, Mond's products in that territory, and to assist other British manufacturers, not so fortunately placed, to get into direct touch with the consumers of their goods. The results proved so satisfactory that the policy laid down by the founders of having direct contact between the manufacturer and buyer, wherever situated, has been continued, and visits by various representatives have been paid from time to time to all the markets of the world in which the Company is interested.

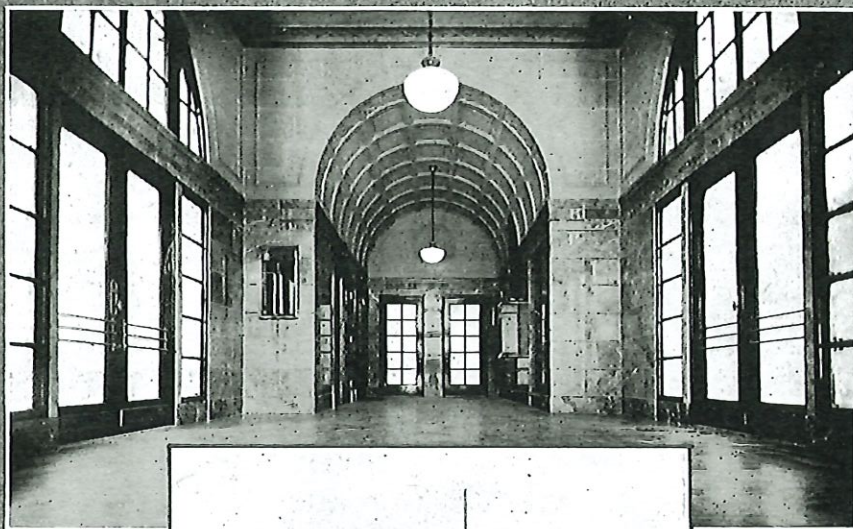
Although the Company's own office was established in Shanghai, the methods of business in Japan were so entirely different that for many years after the first visit was paid to the market, the trade was still handled through a firm of resident agents; but, again following the policy of direct contact, the Company's own offices were opened at Kobe and Yokohama in 1918, and, two years later, a separate Japan Company was formed for the same purpose as in China.

It was not until after several visits had been paid to India by various representatives that it was found desirable to attempt to alter the previous method of doing the business; but eventually it appeared to be possible and advisable to apply the same policy as elsewhere, and in 1910 an office was opened in Calcutta, followed, in 1915, by one at Bombay. A separate Company, formed in 1922, now carries on the business, with agencies in the various centres.

In regard to Australia, it was possible for many years to maintain personal contact with consumers through their London representatives, especially as the principals visited this country frequently. As the number of manufacturers increased, and many of them became less closely associated with home firms, the Company appointed a resident agent in Sydney, and eventually, in 1919, appointed its own representatives and opened offices in Sydney and Melbourne.



SHANGHAI OFFICE OF BRUNNER, MOND (CHINA) LTD.



KOBE OFFICES BRUNNER, MOND & CO. (JAPAN) LTD

Within recent years the industrial importance of South America has increased, and the outlet there for the Company's products has assumed considerable proportions. Although it was not until 1921 that the Company's own office was opened in Buenos Aires, there has been a permanent representative there since 1913, and business has been conducted through agencies in all parts of the continent, one of which was established so long ago as 1882. Personal touch is maintained by representatives from the Buenos Aires office constantly visiting all the principal ports and main centres of consumption.

The other markets of the world in which the Company is interested have all been visited from time to time, and although so far the volume of trade does not warrant the continuous service of the Company's own representative, the business is efficiently handled by resident agents.

The accompanying chart (see page 99) showing the Company's deliveries of soda products year by year from 1874 to 1922, illustrates the increase and development of the business. Where this chart shows a decrease, it is always capable of simple explanation; as an example, the falling off in 1921 was entirely attributable to the miners' strike and the general trade slump in all markets of the world.

With such a rapidly expanding business, it naturally follows that the staff necessary to deal with the Company's affairs in its head offices has increased at a corresponding pace, not only in the selling department, but also in those dealing with purchases and accountancy; and whereas originally, as has been seen, the late Sir John Brunner did most of the work in connection with sales and accounts, and Dr. Mond with purchases, the staff now numbers several hundreds. When Dr. Mond found it necessary to devote his time chiefly to scientific work, and the partnership between him and the late Sir John Brunner became a Limited Company, Edward Milner took over the buying, and, later on, Dr. Hewitt supervised this part of the Company's activities, with the valuable assistance of Oswald Brock; whilst in later years, Charles F. Poole, who has been in the service of the Company since 1878, and was appointed to the Board in 1919, has carried on this work.

In conclusion, it is perhaps superfluous to say that the principle so successfully adopted in the works of always applying the most up-to-date methods is also equally apparent in the commercial life of the Company.

APPENDIX A.

ESTIMATES MADE BY SIR JOHN BRUNNER IN THE LATTER PART OF THE YEAR 1872.

(1) Cost of a ton of soda ash of 56 per cent. made by the Leblanc process at Widnes :—

	£	s.	d.
Capital required for a make of 60 tons weekly	13,500	0	0
17½ cwt. Pyrites at 8d. per unit (48 per cent. sulphur), with carriage, breaking, etc., 35s. per ton	1	10	9
29 cwt. Salt, 8s. 6d. per ton	0	12	3
¼-cwt. Nitrate of Soda, £14 per ton	0	7	0
88 cwt. Slack, 8s. per ton	1	15	2
35 cwt. Limestone, 6s. 6d. per ton	0	11	4
Wages	1	12	0
Repairs of plant, tools, etc.	0	14	0
Packages	0	18	0
Salaries, rent, rates, insurance, and depreciation of plant	1	5	0
Freight to Liverpool	0	2	0
	<u>£9</u>	<u>7</u>	<u>6</u>

At a works buying saltcake at £3 10s. per ton the cost would be about £10 5s.

At the best-situated works in Newcastle about £9 15s.

(2) Cost of a ton of soda ash of 56 per cent. made by Solvay's process at Winsford :—

	£	s.	d.
Capital required for a make of 60 tons weekly	10,000	0	0
1½ cwt. Sulphate of Ammonia, £20 per ton	1	16	0
40 cwt. Salt in shape of Brine, 9d. per ton	0	1	6
39 cwt. Slack, 8s. 10d. per ton	0	17	3
44 cwt. Limestone, 6s. 6d. per ton	0	14	4
5½ cwt. Coke, 18s. per ton	0	5	0
Wages	0	15	0
Repairs of plant, tools, etc.	0	11	0
Packages	1	2	0
Salaries, rent, rates, insurance and depreciation of plant	0	14	8
Freight to Liverpool	0	3	6
Royalty	0	8	0
	<u>£7</u>	<u>8</u>	<u>3</u>

APPENDIX B.

THE WAGES LIST FOR 1875.

- FOREMEN.—J. Lowery, W. Walsh, E. Marriott, J. Baird, J. Mitchell.
- STORES.—A. Tainsh, T. Fryer, J. Grieve, J. Thomson, G. Evans.
- ENGINES.—D. Stead, H. Flude, E. Jones, S. Wakefield, J. Owens.
- BOILERS.—J. Buckley, J. Boulton, J. Donovan, J. Owens, S. Wakefield, T. Williams, L. Buckley, W. Jones, G. Bartle, J. Green.
- STILLS.—J. Mitchell, J. Skatul, R. Boden (W.E. January 10th), J. Fox, M. Ford, J. Morgan (W.E. February 14th), S. Aston, H. Birkenhead, E. Holmes, J. Jordan, W. Gaunt, P. Raney, E. Tearney, J. Stubbs, S. Boden, M. Collins.
- FILTERS.—A. Owen, P. Maniel, J. Allman (W.E. January 10th), W. Gaunt, J. Gordon, J. Mirrel, J. Dudley, S. Curley, A. Fahey, J. Watts, P. Dooley, J. Graham, J. Lane, J. Tearney, W. Jones, T. Eyres, T. Heffron, J. Buckley, J. Marley, J. Noon, E. Holmes, E. Starkey (W.E. April 25th), E. Appleton, P. Clarke, A. Biley, T. Hansbury, J. Pover, J. Riley, W. Dickens, M. Coe.
- FURNACES.—J. Jones, W. Carpmail, J. Broady, J. Joyce, B. Burns, T. Watts, J. Norcross, G. Carpmail, W. Jones, T. Shallcross, J. Stubbs, T. Tearney, T. Underhill, P. Mulligan, J. Dutton, H. Smith.
- KILN.—J. Carney, J. Mulary, J. Brown, M. Cunningham, J. Stubbs, T. Carey, M. Burke, J. Noon, P. Malony, P. Jordan, T. Hansbury, P. Scanlan, M. Curley, P. Riley, E. Chandler, P. Collins.
- MILL.—J. Plant, J. Jennings, J. Carpmail, W. Bell, J. Tearney, J. Mills, T. Eyres, G. Bartle, J. Bell, J. Coomber, M. Nurphy, M. Graham.
- STONE-BREAKERS.—E. Teenan, T. Wilkinson.
- COOPERS.—F. Bonnell, W. Yarwood, J. Timmins, T. Owens, G. Dunn, D. Pownall, W. Parker, Howeth, R. Heath.
- LIME.—J. Mahoney, M. Collins, T. Conway, T. Tearney, M. O'Brien, M. Screen, J. Machiney, M. Fahey, J. Connelly, E. Tearney, Kenesley, P. Higgins.
- SLACK.—D. Wakefield, W. Wakefield, Buckley, W. Jones, P. Dooley, J. Green, J. Goulden, G. Goodier, M. Dooley.
- FITTERS.—J. Elliott, J. Kay, J. Layton, H. Rogen, E. Lewis, S. Greenall, Ratcliffe, Shufflebottam, R. Gaunt, R. Steel, J. Potts, W. Edwards, J. Atkinson, J. Cooper.
- SMITHS.—J. Jeston, T. Gleave, W. Lloyd, J. Foxley, L. Huyton.
- ESTATE.—J. Done.
- FLAT.—J. Poole, Alcock, R. Blares, T. Poole, H. Pickering (W.E. May 2nd).
- ARTISANS' LABOURERS.—M. Brown, S. Boden, M. Ford, J. Hankey.

APPENDIX C.

DIRECTORS OF BRUNNER, MOND & CO., LIMITED.

Name.	Elected.	Died.	Retired.
Sir John T. Brunner (Chairman, 1891-1918) ...	1881	1919	—
Dr. Ludwig Mond	1881	1909	—
John Crosfield (Chairman, 1881-1891)	1881	1901	—
Chas. M. Holland	1881	1905	—
Edw. Milner	1881	1902	—
Alfred Solvay	1883	—	1885
Harry Coghill	1884	1897	—
Chas. J. Galloway	1885	1904	—
David B. Hewitt	1885	—	1913
Robert Verdin	1885	—	1885
Henry Brunner	1886	1916	—
Sir John Jarmay	1889	—	—
Thos. H. Forgan	1890	1918	—
H. A. Schellhaas	1892	—	1914
J. F. L. Brunner	1894	—	—
Sir Alfred Mond	1895 } 1923 }	—	1916
F. van der Straaten-Solvay	1897	—	1912
Sir Hugh Bell	1897	—	—
Robert Mond	1897	—	—
Roscoe Brunner (Chairman, 1918)	1901	—	—
B L. Leesmith	1903	—	1911
Emile S. Mond	1906	—	—
F. W. Brock	1907	1916	—
J. I. Watts	1909	—	—
H. Glendinning	1909	—	—
Armand Solvay	1912	—	—
Georges Querton	1913	1914	—



DIRECTORS, 1896

Back row.—H. Schellhaas, R. Mond, J. G. Jarmay, T. H. Forgan, A. Mond, E. Milner, H. Brunner.
Front row.—J. F. L. Brunner, D. B. Hewitt, Dr. Ludwig Mond, Sir John Brunner C. J. Galloway.



DIRECTORS, 1913

Back row.—J. H. Gold (Secretary), E. S. Mond, J. J. Watts, F. W. Brock, R. Brunner, J. G. Jarmay, T. H. Forgan, H. Schellhaas, H. Glendinning.
Front row.—R. Mond, Sir A. Mond, Armand Solvay, Sir John Brunner, Sir Hugh Bell, H. Brunner, J. F. L. Brunner.



DIRECTORS OF BRUNNER, MOND & CO., LTD., 1921

Back row.—A. Colegate, Col. G. P. Pollitt, J. H. Gold, J. J. Harper, A. T. Hawes, A. T. Smith, C. F. Poole, J. G. Nicholson, A. W. Tangye, Louis Solvay, D. Marsh (Secretary).

Front row.—H. Glendinning R. L. Mond Sir John Jarmay, Armand Solvay, Roscoe Brunner, Sir Hugh Bell, Sir John Brunner, Gerald Balfour E. S. Mond, J. I. Watts.
(Chairman).

Name.	Elected.	Died.	Retired.
A. T. Smith	1916	—	—
A. T. Hawes	1916	—	—
J. H. Gold	1919	—	—
Louis Solvay	1919	—	—
G. P. Pollitt	1919	—	—
G. F. Poole	1919	—	—
A. W. Tangye	1919	—	—
J. G. Nicholson	1919	—	—
J. J. Harper	1919	—	—
Rt. Hon. G. W. Balfour	1920	—	—
A. Colegate	1921	—	—

SECRETARIES OF BRUNNER, MOND & CO., LIMITED.

Name.	Appointed.	Elected Director.	Died.
T. H. Forgan	1881	1890	1918
F. W. Brock	1890	1907	1916
Chas. White*	1907	—	—
J. H. Gold	1910	1919	—
D. Marsh	1919	—	—

* Appointed Chief Accountant in 1910, and retired 1921.

OFFICES AND REPRESENTATIVES OF BRUNNER, MOND & CO., LIMITED.

Head Office : Northwich.
London Office : 7, Cavendish Square, W.1.

SCOTLAND.

Arthur & Hinshaw, Glasgow.

INDIA.

Brunner, Mond & Co. (India), Limited, Calcutta and Bombay.

DIRECTORS :—R. M. Hughes, E. B. Pratt, E. G. Hughes, J. G. Nicholson, Guyton Butler, W. O. Wright, Khan Bahadur K. H. Katrak.

SUB-AGENTS OF BRUNNER, MOND & CO. (INDIA) LIMITED :—Katrak & Co., Karachi ; Parry & Co., Madras ; Hayley & Kenny, Colombo ; Bulloch Bros. & Co., Ltd., Rangoon.

CHINA, etc.

Brunner, Mond & Co. (China), Limited. Head Office : Shanghai.

DIRECTORS :—P. Fowler, H. G. Allen, H. Y. Irwine, G. F. R. Jackson, J. G. Nicholson, G. Stewart Jones, M. Reader Harris.

OFFICES at :—Hongkong, Tientsin, Peking, Hankow, Chinkiang, Wuhu, Tsinanfu, Chungking, Kiukiang, Chefoo, Newchwang, Dairen, Harbin, Moukden, Vladivostock, Blagovestchensk, Khabarovsk, Canton, Foochow, Yunanfu.

JAPAN AND KOREA.

Brunner, Mond & Co. (Japan), Limited, Kobe and Yokohama.

DIRECTORS :—P. H. Wootton, W. R. Devin, G. D. Waters, J. G. Nicholson, G. Stewart Jones, E. B. S. Edwards.

AUSTRALASIA.

Brunner, Mond & Co., Limited, Sydney and Melbourne.

SUB-AGENTS FOR NEW ZEALAND :—Ellis & Manton, Limited, Wellington.

SOUTH AMERICA.

General South American Office :

Brunner, Mond & Co., Limited, Buenos Aires.

SUB-AGENTS :—

ARGENTINE :—Geo. Bell & Sons, Buenos Aires.

URUGUAY :—Edward Cooper & Son, Montevideo.

BRAZIL :—Davidson, Pullen & Co., Rio de Janeiro and Sao Paulo ; Edwards, Cooper & Co., Porto Alegre ; F. Stevenson & Co., Bahia ; Ayres & Son, Pernambuco ; Quinn, Higgins and Co., Para and Maranham.

CHILE :—Graham, Rowe & Co., Valparaiso and Antofagasta ; Lockett Bros. & Co., Iquique.

BOLIVIA :—Graham, Rowe & Co., Oruro.

PERU :—Graham, Rowe & Co., Lima.

MEXICO.

William Young & Co., Mexico City.

CANADA.

Winn & Holland, Limited, Montreal.

STRAITS SETTLEMENTS AND FEDERATED MALAY STRAITS.

H. Wolskel & Co., Limited, Singapore.



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