The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XXXII. May 4, 1935 No. 827

The Royal Silver Jubilee

THE CHEMICAL AGE takes pride in presenting to its readers this issue which commemorates the Silver Jubilee of the King's accession. The chemical and allied industries join with the rest of His Majesty's subjects in tendering to him their affectionate congratulations on twenty-five years of unresting service to the nation and in renewing their pledge of enthusiastic loyalty to him and his House.

The present reign, happily far from finished, will be remembered by future generations as the witness of some of the greatest events in the annals of this country. The King's place in history is secure not only by reason of the epoch-making nature of his times, but because of the fine qualities which he has displayed in the discharge of his Royal duties. The best possible tribute to King George the Fifth is the habit of his people to take his position as constitutional ruler for granted. Those who are old enough will recall the existence of a vocal republican movement with which the names of well-known politicians were from time to time associated in the middle years of Queen Victoria's peaceful and prosperous reign. It is the literal truth that there is no republican movement in Great Britain to-day, and the fact is the more remarkable in view of the unexampled vicissitudes through which the organs of government in most of the countries of the world have passed in the quarter of a century under review. The present strength of the monarchical principle in these islands is not to be attributed only to the practical common sense of the people. Their shrewd instinct for a national symbol, which is above parties and is a barrier to revolution or dictatorship, would not have been given such unanimous expression if the monarch had not shown himself worthy of the trust reposed in him. It is unquestioned that no constitutional ruler has ever adapted himself to the moods and sentiments of his people so successfully as King George.

His Majesty King George V.

Accordingly the monarchy, as it actually functions to-day, stands for historical development, continuity of tradition, and ordered progress. The King, in fact, stands for stability, which is the only true begetter of confidence. What constitutional stability means to this country has been shown during the present reign by the national reaction to two tremendous crises. The first was the outbreak of the Great War in 1914 and its continuance for four-and-a-half years; the second was the financial crisis of 1931, with repercussions on the economic structure which are not entirely absent from the calculations of the business community nearly four years afterwards. Both shocks fell in due course upon all the great nations of the world, and it is indisputable that the life of the British people was less seriously disturbed than that of nations less happy in their institutions. The overwhelming importance of stability to the great trades which are the life-blood of the community, has never been more convincingly shown than in the slow but steady progress towards industrial recovery after the second of these blows. Other countries, as suddenly flung into the maelstrom of the greatest depression the modern world has known, wildly reached out for revolutionary weapons, which are now seen to have made little impression on their remorseless adversary. Great Britain preserved its sanity, shouldered its new burdens under the constitutional monarchy, and has put behind it the most menacing of its dangers. In the middle of 1931 international confidence wilted in a night. Most unhappily it has not yet been restored. At the moment of crisis Great Britain suffered with the rest of the world, but there can be no doubt that her confidence in herself and in her economic and financial structure has to-day been fully re-established.

The King's Silver Jubilee is being celebrated in more favourable conditions than the Mother Country and the Empire generally have known for a considerable time. The peoples over whom the King rules have been called upon to face more severe ordeals than confronted former generations in more placid times. The King, by virtue of his high office and by the example he has set by his discharge of the duties attaching to it, has contributed far more than any other single individual to this inspiriting result. Under his sceptre, the most destructive war in the history of mankind ended in a complete victory on land and sea for the British Empire and its Allies. Beneath his guiding hand, what seemed an almost desperate peace-time problem has been largely solved to the incalculable advantage of his subjects at large, and to no interest more decisively than to that engaged in trade and business of every description. He guaranteed his people stability, which in turn promoted confidence, pointing the way to revive trade, renewed prosperity, and a fuller and more contented national life.

It is with these thoughts, possibly only half-consciously formed but yet instinctively held, that the chemical and allied trades join with the rest of the British people in thanksgiving for His Majesty's Silver Jubilee, and in prayer that he may long remain head of the Empire which he holds for them in trust.

The period of the King's reign has seen more advance in chemistry than in any of the other sciences or industries, and the Silver Jubilee is an appropriate occasion on which to reflect upon the developments which have marked this wonderful quarter of a century. Special articles in other pages describe what has been done in various spheres of chemical enterprise, the trend of thought and action in a number of the principal professional and industrial organisations and the growth of a number of firms whose names have been well known throughout the period under review. At the time of the King's accession the position of British chemical industry was far from satisfactory. Though British inventive genius had been responsible for a large share in the discovery of new chemical processes most of the advantage had gone abroad. At the time of the outbreak of the great war the manufacture of dyestuffs for British use was almost entirely in the hands of Germany, involving a great national danger, for the German chemical industry was the source of supply of high explosives and poison gas used in warfare. Great Britain had virtually to rebuild its chemical industry, and it is a tribute to our chemists and engineers that by the end of the war we were in a position, so far as technical equipment was concerned, to compete in the international market. Production rose to be over six times the pre-war figure.

Great amalgamations—of which Imperial Chemical Industries, Ltd., is the outstanding example—have taken place during the past twenty-five years, and no less significant has been the establishment of organisations of chemical manufacturers, plant makers and professional men. The profession of the chemical engineer has come into its own and research laboratories and research organisations have sprung up in every industry. The making of artificial silk as a British industry has risen to its present greatness during the King's reign. The world to-day produces about 200,000,000 lb. of artificial silk yearly and in quantity Great Britain's output ranks among the first four in the world.

A great new plastics industry has grown up and promises to become one of the most important of the many chemical industries in the country. The development of special materials for the construction of chemical plant has also been noteworthy. The production of optical glass provides another example of post-war progress in an industry which can be rightly classed as chemical. Before the war only about 10 per cent. of the optical glass used in Great Britain was home-produced; since the war practically all the optical glass we use has been made here. At no other time and in no other country has optical glass superior to the present British product ever been manufactured. Generally speaking, all branches of chemical industry have flourished remarkably during the past twenty-five years. At present, exports of our chemical industries surpass in value imports of chemical products by over £8,000,000 yearly.

At the moment, since we are all a little "Jubilee minded," it is interesting to note the colours in the past made famous by members of royal families. Purple has, of course, from earliest times been significant of noble rank. This association arose because of the difficulties and high cost of obtaining the original dyestuff. Consequently it became a precious colour and one admirably suitable as a sign of royalty. Yellow was also a royal colour and can be traced back to very remote times in the culture of China. Now, though these colours are more easily obtained by the means of synthetic dyestuffs, their associations remain.

In more recent times we have Medici blue, connected with Catherine, Queen of Henry II of France, and this year the "Jubilee of our Royal House" will be marked by three colours chosen by members of the British royal family. Jubilee blue, a soft light blue, was selected and named by Her Majesty the Queen. Margaret rose, the delicate pink of the English wild rose, was selected and named by Her Royal Highness the Duchess of York. Both of these colours were chosen to mark the royal Jubilee year and are now reproduced in all manner of materials. A third colour which has achieved great popularity in all colour using industries, and which has acted as a useful stimulus to trade, is Marina green, sponsored by Her Royal Highness the Duchess of Kent to mark the occasion of her marriage to His Royal Highness the Duke of Kent.

World Tin Consumption

Increased Demand from Russia

According to the April issue of the "Bulletin of the International Tin Research and Development Council," world consumption of tin in manufacture for the year ended February 28, 1935, amounted to 130,200 tons, compared with 137,300 tons for the previous year. The consumption of 6,278 tons of tin in Russia during the year ended February, 1935, is the highest recorded for that country, and represents an increase of 2,463 tons or 64.6 per cent. over the previous twelve months. Considerable increases are shown also in the following countries: Canada 47.0 per cent., Japan 28.9 per cent., Denmark 27.8 per cent., Poland 18.4 per cent., Sweden 16.0 per cent., Norway 11.9 per cent. Decreases of 21.0 per cent., 11.1 per cent. and 4.7 per cent. respectively are recorded for the United States, France and Germany.

Twenty-Five Years of Progress

By G. E. Foxwell, D.Sc. F.Inst.P., F.Inst.F., M.Inst.Gas E.

THE development of the chemical industry during the years 1910-1935 has been dominated by the war and by its after-effects, That, of course, is true of any industry, but it is so in a special way of the chemical industry. Before the war, the chemical industry had come to be dominated by Germany. It has been suggested that our early lead in dyeing was lost because the leaders of the dye industry—the men who were developing the methods and manufacture and who were discovering new dyes—retired too early in life. There is no likelihood of history repeating itself, for it is more difficult to make a fortune from industry to-day. Whatever the reason may have been, the British chemical industry in 1910 was undoubtedly playing second fiddle to the Germans, and even to this day some manufacturers endeavour to go abroad for their plant and chemicals under the delusion that British chemists and plant makers are not good enough. The result of this attitude was that in 1914 British chemical industry was making the more or less "common" chemicals—our heavy chemical industry was of respectable dimensions, for example—but most of the more "difficult" substances, such as dyes and drugs, were imported.

Early Days of the War

When war broke out we had virtually to rebuild our chemical industry. The number of trained chemists was far fewer in 1914 than to-day; experience in manufacturing intricate chemical plant was lacking save for a few exceptions. Raw materials and the provision of plant amid the stress of war were difficult. Communication with the German chemists, to whom we had looked for so much, had failed. Nevertheless, within a few years a great British chemical industry had been built—an industry that unlike many another war-time creation could turn its equipment to useful purposes after the war. It is a tribute to our chemists and engineers that whatever was necessary was done successfully, research was intensified, men were trained, plant was designed and constructed, so that by the end of the war we were in a position so far as concerns technical equipment to compete in the international market. The power to compete was one thing—the maintenance of a successful challenge in the markets of the world was another.

In the old days, many a discovery was the result of accident, some pioneers were helped by chance, as, for example, Caro; many achieved their success by skill, aided by sound training, a few had no chemical training whatever. It is noteworthy that many of the pioneers of the nineteenth century worked in pairs, such as Mond and Brunner, Pears and Barrett, wherein one was the scientist and technician and the other the business man. In that way, production and sales marched forward together. The same thing was immediately found to be doubly necessary after the war. It was not sufficient to have efficient plant and to have a skilled chemical industry—business direction and international power was essential. Hence arose the second great movement of post-war years—amalgamations wherein science, business and finance all had their part.

Great Amalgamations

Two of these amalgamations only need be mentioned here as examples—the formation of Imperial Chemical Industries and the growth of Lever Bros. The latter concern is, of course, an old-established one, having been incorporated in 1894 with a capital of £1,500,000. It is, moreover, an early example of the practical application of that abracadabra of modern industry, rationalisation. Very wisely it was early realised that if the concern was to take the place in the chemical industry that was hoped it must be in control of its own essential raw materials, and already in 1905 some 300,000 acres of land had been acquired in the Solomon Islands for the cultivation of coco palm. Major developments commenced in 1911 when large concessions were acquired in Africa, which were consolidated in 1920 by incorporation of the Niger Company, later to be merged in United Africa Co., Ltd. The whaling industry was also developed, and by the close of the war Lever Bros. must have been one of the largest individual firms in the country. After the war, this company established factories in 21 countries, comprising all the five continents. During this time, consolidation was taking place by the purchase of many smaller soap concerns till by 1917 the capital had expanded to over £15,000,000. A number of the largest firms were absorbed in the decade following the war, so that by 1924 the capital of the concern had reached £56,000,000 and it became the largest commercial undertaking of its kind in the world. Lever Bros. is an example of the steady growth of a huge concern over a period of 40 years, mostly during the past 25 years, in which the truth of the old fable of the increased strength of the bundle of sticks tied together has been amply demonstrated.

The genesis of I.C.I. was different, though the truth of the fable remained unaltered. It was a post-war development and like many post-war developments was of the nature of a sudden movement rather than a progressive growth. Realising the advantages of united action, the late Sir Alfred Mond (as he was then) formed the project for an amalgamation of many of the most important firms in the heavy chemical, dyestuffs and allied industries. In 1926, the idea took form and Imperial Chemical Industries, Ltd., became an established fact. From that time, more and ever more firms have become amalgamated with the major concern, and to-day the paid-up capital of the concern is £77,000,000. The story of the growth of I.C.I. has been told too often to tell it again in detail, but one fact deserves mention. At the time when it was formed, many people, and those not ignorant of the chemical and allied industries, were gravely anxious lest the scheme should result in disaster to the British chemical industry. It was felt that the concern was too large for any one man or for any one board to administer successfully, but the courage and vision of the band of eminent industrialists that the late Lord Melchett gathered round him were triumphantly vindicated.

Trade Organisations

In 1916, the Association of British Chemical Manufacturers was formed. This body had for its objects the promotion of close co-operation of the chemical manufacturers; the formation of a body which could adequately represent the industry in dealings with the Government; the improvement of technical organisation and the furtherance of research; closer co-operation with the universities; the development of new British chemical industries and the furtherance of existing ones. To-day, the Association comprises 117 firms, having a capital of over £200,000,000. The Association has had a battle to fight to gain that measure of recognition to which it is entitled, and many complaints were at first made that Government Departments took action without first consulting it. Fortunately, as the influence of the Association has grown, these complaints have steadily disappeared and there is now close co-operation. The activities of this Association will be dealt with in another place in this issue and therefore no further account need be given here, other than to express the value that it has been and will be to its members.

Following upon the formation of the A.B.C.M., the makers of British chemical plant also formed an association—the British Chemical Plant Manufacturers' Association—which comprises all or nearly all those firms in the country that manufacture British chemical plant. This body has done valuable work in putting the undoubted excellence of British chemical plant before the industry and the Government, and there is now practically no plant for which it is either necessary or desirable to go abroad, The members of this association are not necessarily confined to the manufacture of chemical plant, which is perhaps fortunate for the chemical industry since the home plant requirements are not so large as would keep any considerable number of firms fully employed; the chemical industry thus has at its disposal a great mass of engineering knowledge obtained in supplying the requirements of practically every industry in the country.

It would be impossible, as has already been indicated, to deal within the limits of this article with all the technical advances made in the chemical industry during the period under review, and all that can here be done is to mention some of the " high spots." These developments have been to some extent dependent upon the great expansion that took place during the war to supply explosives, poison gases, medical supplies and so forth; when the war ended, some of this plant continued its work, the rest had either to be scrapped or turned over to other remunerative peace-time use. Concurrently with this need for new manufactures the supply of trained chemists and engineers had become very much greater than it was before the war—indeed, the increased standard of knowledge among the staff of the chemical industry, taken as a whole, is one of the features of post-war development. At the same time, the profession of chemical engineer came into being and the basis of chemical industrial technique was widened.

Encouragement of Research

Research has been encouraged to a degree never before known. The formation of the Department of Scientific and Industrial Research has encouraged the growth of research associations throughout industry as a whole. The inception of the National Chemical Laboratory has been another notable step in the accumulation of knowledge. It is highly desirable, though it was not universally recognised as being so at the beginning of the period, that there should be facilities for research into possible processes and subjects of no probable immediate application, into subjects, in short, which the normal industrial research laboratories could not afford to investigate. Research laboratories and research organisations have sprung up in every industry, some being private laboratories and others working for the industry as a unit, until it is probably safe to say to-day that never has the money spent on scientific and engineering research per unit of population been so high in any country.

Among technical developments, the manufacture of synthetic ammonia figures prominently. The manufacture of ammonia by the Haber-Bosch process began in Germany in 1913. The war made the same manufacture necessary here, and the Government decided to erect the first Haber-Bosch plant in 1917. After considerable experimental and semi-works scale experience had been gained, a large industrial unit was erected at Billingham. This huge ammonia factory, undoubtedly of the greatest national value, has had an unfortunate effect on the coal carbonisation industries and has deprived them of the revenue previously gained from their principal by-product. Another recent development, also at Billingham, may have a like effect upon the oil interests and, ultimately, upon the next best by-product of the coke oven—benzol. The hydrogenation plant now under erection is too recent to require more than brief mention; the immense expenditure that has been incurred on research work could only have been possible to a firm of the magnitude of I.C.I. and to a Government-controlled body such as the Fuel Research Board.

Developments in the Alkali Industry

Developments in some of the associated industries are dealt with elsewhere in this issue, and in view of the excellent account just given by Dr. J. T. Conroy, his recent Hurter Memorial Lecture, it is only necessary here to mention that this period under review has seen the last of the Leblanc process and the final establishment in its stead of the electrolytic Castner and Hargreaves processes; of a progressive decline in sulphuric acid, which, though far from being discarded, is being replaced by other acids, such as silica, and (in the synthetic ammonia industry) by gypsum, for making sulphate of ammonia, to say nothing of the synthetic manufacture of many substances for which formerly large amounts of sulphuric acid were required. Manufacture of chlorate ceased in this country in 1918, because the high power costs made it imperative to produce it only in cheap power countries. This causes a brief reference to the electric grid. The great drawback to the grid is the difficulty of storing the current generated, which, in turn, causes undue capital expenditure in plant that remains idle for many hours out of the twenty-four. There can be little doubt that the chemical industry could obtain cheap current during off peak hours, and if certain manufactures could be arranged to be worked at those times only it might—only " might "—be possible to re-introduce the manufacture of certain products for which present power charges are too high.

The explosives industry went ahead during the war and developments in this direction continue, though with less publicity than in other branches. Dyestuffs have been a feature of the developments during the period, receiving their stimulation from the cessation of German dyes during the war. The Government formed British Dyes, Ltd., from Read Holliday and Sons in 1915; Levinsteins developed their manufactures in the same period; then both amalgamated with others to form the British Dyestuffs Corporation, later to be incorporated in I.C.I. These are, of course, not the only dye-making firms in the country, but to them and to all dye-makers the country owes a debt of gratitude in building up so essential an industry in so short a time after years of neglect on the part of those who should have known better had allowed this initially British industry to pass into the hands of other countries. It is an achievement of which the British chemical industry has every right to be proud.

Cellulose has been termed " the rival of coal tar as a raw material." Research on cellulose since 1900 has entirely changed the outlook; it is limitless in amount, since it is derived from wood and cotton, cheap to produce and rapid in growth. It is to-day being used for the manufacture of paper, explosives, lacquers, artificial silk, foodstuffs, films, and clothing material. It would take us too far to examine these uses, but the artificial silk industry demands some mention. The first British patent was taken out in 1894 by Cross and Bevan, but, owing to difficulties, it was not until later that an industry developed. In 1906, there were 22 artificial silk factories in Europe, one being in England—that of Courtaulds, who commenced to make in 1906. After the war, British Celanese was formed to acquire the factory at Spondon which had been used for making cellulose acetate for aeroplane dope. Courtaulds worked Cross and Bevan's process in which cellulose is treated with caustic soda and then with carbon disulphide, whilst British Celanese use the Dreyfus process. Each of these processes has its special advantages, a fact that those who studied the recent lawsuit on the rival processes will have observed.

The Plastics Industry

A great industry has also sprung up in the moulding of many articles and even of furniture from materials termed " plastics." These were based on " bakelite," a condensation product of formaldehyde and phenol or other substances to form the synthetic formaldehyde resins. Bakelite had just been discovered when the period under review commenced, and this great industry, which each year is growing more rapidly, must have a total production of not far short of 50,000 tons.

In fine chemicals, the war has also brought its measure of stimulation. Many fine chemicals were not made here until after foreign supplies were cut off such, for example, as salvarsin, aspirin, phenacetin, saccharine and atropine. The achievements of the fine chemical industry deserve a chapter in themselves, and because it is difficult to discuss the developments of an industry in which individual firms specialise in different substances without mentioning each firm engaged in the work and its triumphs in detail, the writer prefers to content himself with calling attention to the fact that although the quantities of the individual substances produced are small when judged by the standards of other branches of chemical industry, the task of manufacturing the wide range of drugs of complicated and often unknown structure and of preparing the commoner substances in the high degree of purity in which they are sold as chemical and medical reagents is probably more difficult than many of the spectacular performances of other branches of the chemical industry.

In concluding this necessarily brief review of the progress made in the chemical industries during the period 1910 to 1935, it must be confessed that, taken as a whole, there is much justification for the dictum of Lord Melchett that was quoted at the commencement of this description. The British chemical industry in every branch can look back on the period with satisfaction, and historians may one day record the reign of King George V as the golden era in British chemical industry.

THE SOCIETA GENERALE PER I PRODOTTI AZOTATI SINTETICA, Milan, has been authorised by the Ministry of Corporations to erect a new plant for the production of synthetic ammonia and its derivatives, with a maximum annual capacity of 14,000 tons of nitrogen.

Chemical Discoveries and Ideas, 1910-35

By E. F. Armstrong, Ph.D., D.Sc., Ll.D., F.R.S.

THE chemical fraternity gladly celebrate the Jubilee of His Majesty's Reign, which had a chemical inauguration. Under no other sovereign has the chemical industry and the practical application of chemistry made such progress. In fact, the development of our subject during the last decade has been so outstanding as to make it possible to claim that we are entering upon a chemical age.

The Seventh International Congress of Applied Chemistry met in London in May, 1909, and was opened by King George, then Prince of Wales. Subsequently, His Majesty, on his accession, accepted an address from the Society of Chemical Industry and assured chemical science in all its branches of his continued interest. The proceedings of the International Congress and the report of the annual meeting of the Society, held in Glasgow in 1910, afford a picture of the state of applied science at that time. An American, Professor Ira Remsen, was in the chair; his address called attention to a few thoughts suggested by coal, iron, petroleum, forests and water. Of coal, he said the question before the world is what can be done to offset the excessive use of coal; he stressed how coal is wasted to an enormous extent when used in fuel. Since then so much has been done in the direction of fuel economy that the prosperity of the coal mines has been affected and there are some who cry the slogan " Use more Coal."

In no direction has the chemist co-operated with the engineer more successfully than in the economic production of power, using the word in the wide sense given it at the meetings of the World Power Congress, and the progress must be counted as fundamentally the most important during the reign, though it has lacked sensational features. It will continue because cheap power is the life-blood of the individual as well as of industry.

Achievement of the Oil Technologists

Remsen remarks: " Perhaps it is not going too far to say that the most important product of petroleum to-day is the naphtha (petrol) and the lubricating oil is not far behind," and draws special attention to the awful waste of natural gas on the oil-fields. The oil technologist can be proud of his achievement during the 25 years; the natural gas is collected and transmitted through pipelines upwards of a thousand miles, the liquid hydrocarbons, propane and butane, are carried in bottles or tank cars all over the United States so that every cottage, however isolated, can have its own gas supply. Oil refining has passed from the rule-of-thumb stage to an exact science and the great modern refineries are outstanding examples of applied chemical engineering with automatic control. Cracking, hydrogenation and solvent extraction lubricating oils are sensational developments in oil technique.

In speaking of forests, Remsen's story was again one of waste. But that has all been altered: twenty million tons of wood are now made into paper annually by processes which are no longer wasteful. Though the wood distillation industry has had to give way to chemical syntheses based on catalysts for the manufacture of methanol, of acetic acid and acetone, the solution of another problem, the manufacture of alcohol via sugar from wood, is claimed to have been made, though for economic reasons the manufacture of alcohol by fermentation from cheap molasses is preferable. Alcohol is also being made in increasing quantities at a competitive price from ethylene, a by-product of the cracking of crude petroleum. " Sensational " is the necessary word to describe the progress of the cellulose industries during the reign. Rayon and acetate silk have effected nothing short of a revolution in the clothing and social evolution of our womenfolk; nitro-cellulose dissolved in suitable organic solvents has provided the body paint for the millions of motor cars, and much leather cloth and other fabricated materials for their furnishing. The chemist can be well satisfied with what he has done with forest products during the reign; he knows that he is only on the threshold of more striking progress.

At the same Glasgow meeting, the incoming president, Mr. Walter F. Reid, referred to the possibility that some day the atmosphere would supply some of the nutriment of the human race. Within a year or two the ammonia synthesis from atmospheric nitrogen had been effected by Haber and a large plant was at work at Oppau before 1914. The subsequent history of this development is common knowledge; in consequence of it, nitrogenous fertilisers are available in any desired quantity. We regard this as the second major discovery of the period. Following this, there came the discovery of the conversion of ammonia to nitric acid by means of catalytic oxidation, thereby making the world independent of Chili saltpetre for the manufacture of its explosives and other nitrated products.

Thus encouraged the chemist has found in the air a veritable Aladdin's cave of other treasures: oxygen made by liquefaction and fractionation is used for cutting and welding in the largest quantities, whilst the smaller fractions of the once so-called rare gases have surprised everyone in their potentialities for usefulness. Though present in but small proportion in the air, the large quantities handled for liquefaction have made considerable quantities of the rare gases available. Argon was the first to be used in gas-filled electric lamp bulbs; helium followed, also as a filler, but on the grand scale for airships. Neon, with its warm light, has won its place in our affections as an advertising medium, being used as the filler for gas-discharge lamps which have thrice the energy efficiency of metallic-filament lamps. More general utilisation of this property is at hand and we are promised before long that krypton will introduce a revolution into electric lighting as lamps filled with it can emit 90 per cent. of the energy supplied as light.

The chemist has not rested content with the extraction and industrial utilisation of every constituent of air, he has been constrained to condition it or, in other words, wash it, heat or cool and supply the right humidity to it so that whatever the weather outside we may live under pleasant conditions in our homes, offices, public buildings or trains. This is largely a new development, its potentialities in difficult climates are immense.

The Chemist and Coal

The chemist should regard coal as the most important source of his raw materials, *e.g.,* of the benzol for his dyes and medicinals, or the phenols out of which he has now learned how to make those remarkable condensation products which are classed as synthetic resins. Coal which is directly burnt is in reality largely wasted and in the ideal state all of it should be first carbonised to rescue the volatile products. Real progress in this direction is perhaps for the next decade, though the way is being made clearer. Town's gas should have the benzol scrubbed out of it before distribution, and there is much in tar worthy of a better fate before it goes on the roads. Two developments remain outstanding in their promise for the future, namely, the hydrogenation of coal itself or of tar oils for the production of products akin to petroleum, and the syntheses from water gas either to produce similar hydrocarbon materials or by the use of other catalysts to give methanol and higher alcohols. The gases from coal—H_2, CH_4, CO, CO_2—contain all the elements necessary for organic synthesis. In the same way the gases, particularly those of the ethylene series, which result during petroleum refining afford the elements for further syntheses. Those two raw materials, coal and oil, are ideal in respect to their availability, low cost and ease of transport, and their use for synthetic operations, made possible by the aid of catalysts, in the wider sense would give the chemist powers to excel nature in her productivity. This may be claimed as the third great development of the period. In one field, that of organic solvents, the fruits of progress have already been begun to be gathered; a large number of substances are now available in tank car quantities, although a few years ago they were regarded as scientific curiosities.

Within the special fields of organic chemical enterprise the period has seen amazing progress both in chemical knowledge and its application. In 1910 natural indigo was still struggling against the synthetic product; that battle has been lost for ever whilst the dyers' list has been enriched by a host of colours, above all by the very stable vat colours. The return to Britain, since 1914, of its dye-making and fine chemical industry is of an importance which only the chemist can realise; it has been effected under the shelter of protective legislation of a drastic character.

Perhaps the chief influence in the development of many sections of our subject has been the spread of the knowledge of catalysts and its practical application; the patent literature on this subject is enormous. As a consequence, older processes have been improved almost out of recognition and a more refined control of chemical operations has been introduced.

Another factor contributing to progress has been the spread of chemical engineering technique, the study of unit operations, the design of a plant for a specific purpose with full use of the relevant physical chemical data. The effect of this development is only just beginning to make itself obvious and that largely in the United States. In the future it will result in the building of large continuously-operated plants, mainly automatically controlled by flow meters, thermostats and the like; such plants will produce commodities at prices far lower than hitherto thought possible. An outstanding example of the new phase is the bromine from sea water plant of the Dow Chemical Co., which has recently been described in these columns.

Training of the Chemist

The training of the chemist and of the engineer in relation to the design and operation of future chemical plants will undoubtedly require reorganising. The reign has seen the teaching of chemistry vastly improved at our universities; it is no longer advisable to go abroad to graduate as was customary in Victorian days. It is probably, however, now too theoretical in character for the average student who expects to make a career in industry. Such will be less interested in the multiplicity of new carbon compounds or the vagaries of obscure inorganic derivatives, and desire to understand more fully the reactions which are technically of importance and the theories on which they are based.

Ideas of this type require discussion; their fulfilment is basically at least as important as new discovery for, without the men to build and operate, the former is of little practical value. A fruitful idea which has permeated all industry is the conception of hydrogen ion concentration and its expression as a measure of the degree of acidity or alkalinity first introduced by Sörensen. There is an optimum *p*H concentration for almost every reaction, biological or chemical, and the working out of methods of how to determine this, and how to measure and maintain it, has blessed industry with a new tool of great refinement.

World Food Supplies

In 1910 the wider question of the food supplies of the world and their increase to supply a rapidly-growing world population was regarded with some anxiety in certain quarters. To-day all such anxiety in relation to scarcity has vanished; the problem, indeed, is how to deal with a glut. The change is due to a variety of causes in all of which the chemist has had his share. The development of agricultural chemical knowledge has increased the fertility of the soil; chemical manufacturing processes have lowered the cost and increased the quantity of fertilisers available, so that it is possible to grow maximum crops. Prolific yielding races of cereals and fruit trees have been bred often with specific immunity to certain diseases. Controlled spraying with chemicals has held other pests at bay.

Just as essential as the increased productivity above indicated are the new methods of transportation which have made it possible to bring perishable foods from the ends of the earth in prime condition to the consuming markets. Refrigeration and cold storage, after much painstaking research, have become an exact science, such questions as the degree of chilling, ventilation and gas storage, have been put and answered; a new refrigerating means has been found in solid carbon dioxide or dry ice. Both retardation and acceleration of ripening can be effected by suitable gas treatment. The radius along which fresh food can be brought to the crowded city has been extended almost indefinitely. Side by side is the progress in the canning industry, also made possible by chemical co-operation: canned fruits, vegetables, poultry and meats are being rendered available of constantly increasing quality.

The discovery of the vitamins, of which the chemist has begun to elucidate the constitution, has given a new impetus to food chemistry, in so far as it concerns the preparation of foods for consumption. Enough has been said to indicate in how many ways the work of the chemist concerns food supplies, and he is equally active in all those other ways that concern the public health, water purification, sewage treatment. The progress is continuous though, perhaps, seldom sensational. It is a great story, of which we have endeavoured to sketch only the outlines in the short space available. The achievement has not been easily won, it has demanded energy, enthusiasm, judgment and imagination, coupled with human understanding and patience. In Ruskin's words, the chemist is "no more a seller of plasters nor of ounces of civet"; his aid to-day is to achieve, to make order, to be intent on the real essence of things, so that it may be said of him as Talleyrand said of Richelieu:

"C'était quelqu'un."

Refinements in Apparatus

Effect of Key Industries Duty

THE last 25 years have seen many changes in the chemical and allied industries, and one of considerable national importance has been the growth of the manufacture of laboratory glassware and apparatus in this country. In 1910, the bulk of the chemical glassware used was imported from Germany and other parts of the Continent. During the war period great efforts were made to supply the requirements of government and industrial laboratories, and the industry then started was given the protection of a Key Industries Duty at the end of the war. With the depreciation of sterling, a further impetus was given to the home manufacture of scientific glassware, etc., and an ever-increasing number of articles, formerly only obtainable from the Continent, are now being made in this country. It must be remembered, however, that the manufacture of many of these articles requires considerable skill and the methods of manufacture are the outcome of long experience. The training of an expert glassblower, for instance, takes many years.

The Chemical Glassware Industry

It will thus be seen that the successful building up of the chemical glassware industry has only been the result of continued effort and initiative on the part of the firms concerned. One of these is J. W. Towers and Co., Ltd., of Widnes, who now have a large staff of experienced glassblowers making such articles as hydrometers, weighing bottles, graduated pipettes, burettes, etc., condensers, stopcocks, soxhlet extraction tubes, gas analysis apparatus and a multitudinous number of other lampblown laboratory apparatus. The majority of these articles were formerly imported.

Not only has the manufacture been transferred to this country, but, in addition, the quality, accuracy and design have, in many cases, been improved and standardised. To give a few instances, the graduated glassware made by J. W. Towers and Co., Ltd., is all of guaranteed accuracy within the N.P.L. limits of error; the weighing bottles all have interchangeable stoppers; "Victor" hydrometers have non-slip scales and are figured on both sides; and the various parts of soxhlet extraction apparatus are all interchangeable. In addition, this firm manufactures hydrochloric, nitric and sulphuric acids of highest purity and has recently introduced a range of over 200 "Towers Tested Analytical Reagents" of guaranteed purity. These reagents are packed in amber glass bottles with non-metallic screw caps and were the first British reagents to be packed in this manner. A specification of purity is given on every label. Foreign balances have now been largely replaced by all-British balances, the "Victor" balances offering a wide selection of models. The most recent introduction has been an entirely new range of "Victor" electrically-heated drying ovens and incubators, which combine robustness with sensitive temperature control.

It is interesting to note that J. W. Towers and Co., Ltd., celebrated its Golden Jubilee three years ago, having been founded by the present chairman, Mr. J. W. Towers, in 1882, and, whilst Mr. Towers still takes a very keen interest in its welfare, the management of the company is now in the hands of his son, Mr. J. S. Towers.

Plant Design and Construction, 1910-35

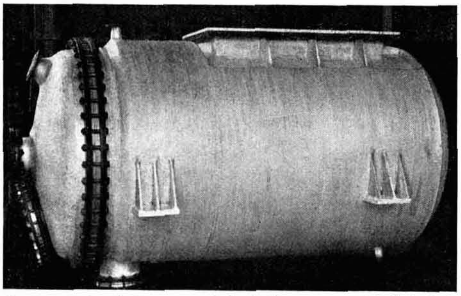
By Hugh Griffiths, Chemical Engineer

In considering the progress which has been made in plant design and construction during the last 25 years, one is compelled to wonder what would have happened had there been no war period. The immediate effect of the war was to bring out the realisation that the chemical industries were important as key industries to all countries and to create a demand for many products which had not been manufactured previously on a large scale. Technical information and even trade secrets were pooled and, in so far as this country was concerned, chemical engineers were faced for the first time in their lives with the technical problem of manufacturing regardless of any possible difficulties in marketing the products. The consequences of the war, partly resulting from economic exhaustion and the existence of productive plants capable of manufacturing quantities of material far in excess of normal demand, had a stimulating effect upon competitive manufacture in which chemical engineering has had to play an important part. In consequence, chemical engineering is now regarded as a subject to be taught and a profession to be practised.

A Wide Use of Technical Data.

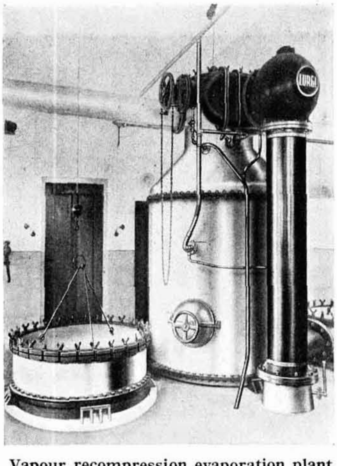
Technical data, formerly the exclusive property of suppliers of proprietary chemical plant, is now more generally available, and the purchaser of chemical plant is more critical and less disposed to embark upon the erection of any new installations, unless he is in a position to foresee every factor of technical performance clearly. To-day every chemical engineer is expected to know the theoretical side of heat transmission, and the publication of a comprehensive work on this subject by H.M. Stationery Office in 1932 may be regarded as a sign of the times. Distillation plants of important size were likewise regarded as only to be purchased from a few firms and, in spite of theoretical contributions to the literature on the subject of distillation before 1910, it is safe to say that to-day the chemical engineer speaks in a different language in dealing with distillation problems. Whereas in 1910 the purchaser of distilling plant was usually satisfied by a statement of output and concentration of product, in these days he very wisely insists upon being informed in respect of thermal efficiency and is usually prepared to subject proposals placed before him to a physical analysis.

During the last 25 years, materials of construction have been greatly improved and many entirely new materials are now available for chemical plant construction. The rapid rise in the application of corrosion-resisting steels has had a substantial influence on plant construction and, whereas the early expectations were not entirely realised, a more exact knowledge of the properties and limitations of these steels is now available. With the accumulation of this knowledge their application is likely to increase. Little progress, however, has been made in the production of acid-resisting cast irons. The silicon irons, of which great things were expected before the war, still have their applications, but their limitations are now better known. Pure nickel and monel metal have been much more extensively used, and silver (alone or reinforced with copper) is used more frequently where resistance to organic acids is necessary.



Jacketed aluminium vessel, body hammer welded, jacket electrically welded.

In respect of metallic materials of construction, the chemical engineer is now in a much more satisfactory position. Twenty-five years ago, very few engineers had even a fragmentary knowledge which would enable them to predict the probable behaviour of metals at high temperatures. The investigations into limiting creep stress, corrosion fatigue and similar subjects which have taken place in every country have done much to remove the uncertainties from chemical plant design for high temperature operations. The importance of this fundamental knowledge will be recognised in view of the developments of high pressure and high temperature processes in the manufacture of synthetic ammonia, alcohols, and in the hydrogenation of fuels.



Vapour recompression evaporation plant for material sensitive to heat.

At the present time, the chemical engineer is in a considerably better position in having improved methods of fabrication at his disposal. In 1910, in so far as this country was concerned, it was rather difficult to obtain a high pressure autoclave of any considerable size; at present, however, hollow forgings in special steels, the properties of which at high temperatures are accurately known, can be obtained. The introduction of welding has had a cheapening effect upon chemical plant of all kinds. There is still room for great improvement and for a wider appreciation of the nature of welding and its limitations. In this country the boiler insurance companies have always adopted a very cautious policy in respect of welded constructions, and it is correct to say that this caution has been well justified. Apart from the application of welding processes to the construction of plant in mild steel, important advances have been made in the welding of aluminium and pure nickel, and the welding of copper has now become of such importance that the fabrication of chemical plant in copper now follows closely upon the lines of fabrication in mild steel.

Non-Metallic Materials.

The non-metallic materials of construction have also been greatly improved, so that qualities of chemical stoneware, glass, rubber, ebonite and synthetic resins now available are entirely different from those offered in 1910. Mass production methods have been applied to stoneware which have enabled suppliers to place upon the market components accurately ground to size and strictly interchangeable. It is, for example, now possible to obtain stoneware pumps and fans of the armoured type which possess the same mechanical reliability as the corresponding metal constructions.

Whereas, in 1910, ebonite was regarded as an important material of chemical plant construction, and an excellent range of components could be obtained, the application of this material was somewhat limited owing to the necessity for vulcanisation. It is now possible to line very large vessels either with soft rubber or one of the unvulcanised materials, such as Cabtyrit or Nordac. It is possible to obtain ebonite coatings which will resist the action of non-oxidising reagents even at temperatures slightly over 150° C. The synthetic resins have also made considerable progress in the construction of chemical plant and are likely to make further headway. An interesting product of this type may be formed in course of building from the raw materials, thus giving the hope that something equivalent to an acid-resisting reinforced concrete may yet be available for chemical plant construction. Whilst progress has also been made in the production of acid-resisting enamels, particularly on steel, and homogeneous lead coatings are now much more extensively employed, many other coating processes have proved to be disappointing. It is probable that improved methods of fabrication may bring into use nickel-clad and stainless-steel-clad mild steel plates to a greater extent.

High Pressure Steam

Competitive production has made it necessary for the chemical engineer to examine processes, not only from the point of view of yield, but to take into account every factor of operating cost. It is, therefore, usual to make a physical analysis of the process and to estimate the cost of heat and energy beforehand and to arrange the scheme of production accordingly. Many of the large chemical works are, for example, now raising steam and producing power under conditions which would have frightened engineers 25 years ago. The advantages of high pressure steam raising, combined with back pressure systems for process steam, are now accepted and this system has been adopted not merely in the larger chemical works but also in the smaller factories where the power output may be below 200 kW.

The availability of high pressure steam in chemical works eliminates at once a number of heating processes which were beginning to become fashionable 25 years ago, but there has, nevertheless, been some extension in the use of high pressure hot water and hot oil circulation in heating for the higher temperature ranges and to a smaller extent mercury vapour and diphenyl have been similarly used. Electric heating is developing steadily, but the chemical engineer is cautious and usually expects some advantages which will counterbalance the higher cost of heat obtained by electrical methods. The use of submerged low-temperature resistance units for heating such materials as varnishes appears promising, and the development of the high-frequency induction furnace has made possible the use of electric heating under conditions of the most exceptional kind.

In heating and cooling operations it is beyond question that the greatest advance is not so much in plant as in a knowledge of the theoretical principles involved and a greater appreciation of the possibilities of thermal economy. One noteworthy development is in the application of the plate-heating system for such materials as dairy products, the plate heaters being assembled after the manner of a filter press. These heaters can be completely dismantled for cleaning, access being obtained to all internal surfaces.

Evaporation

Evaporating plants have been improved in performance, although revolutionary changes in principle are not noticeable. There is an increased tendency to use the external calandria type of heater and to arrange the liquor circuit in a more rational way. Improved knowledge of heat transfer has led to the use of a pump circulation in evaporating plants, with considerable improvements in specific output in the case of viscous and scale-forming materials. The principle of vapour compression, *i.e.,* the application of the thermodynamic principle of the reversed heat engine, is now extensively used. Whilst this principle has been known for over 100 years, its correct utilisation and the recognition of its limitations are of recent date. Modifications of this type of plant enables evaporation of solutions to be effected at temperatures as low as −10° C. It is, therefore, possible, for example, to crystallise Glauber's salt from a solution boiling at a low temperature, whereas evaporation at a higher temperature would only result in the separation of the anhydrous sulphate.

Drying plants have changed but little. In the case of vacuum-drying plants, for example, most of the installations in use to-day are identical with those used over 25 years ago. This is not so much for the want of invention, but is an indication of lack of courage. Air-drying plants have, however, been improved by increasing application of the principle of air re-circulation with the object of securing increased thermal economy. The mechanical details of air-drying plants have also been greatly improved. Spray-drying plants are also more frequently employed. No fundamental improvement in the principle of these plants has been made, but the principle of mechanical atomisation has been brought to a high pitch of reliability, and the details of the plants have been improved so that the overall operating costs in most commercial applications will compare favourably with any other available method for the same class of work.

Distillation

The theory of distillation, which 25 years ago was seldom understood by many who posed as experts, is now part of the equipment of every chemical engineering student. The knowledge of the operating conditions of rectifying plants for all purposes is now substantial and of enormous practical value. Continuous distillation processes are now employed whenever possible, and in, for example, the oil and glycerine industries the cost of heat is considerably less than ever before, partly by reason of increased knowledge of heat transfer technique. Vacuum distillation has also been improved and plants are now in operation for dealing with materials which would have hitherto been considered almost impossible to distil.

Filtration and Crystallisation

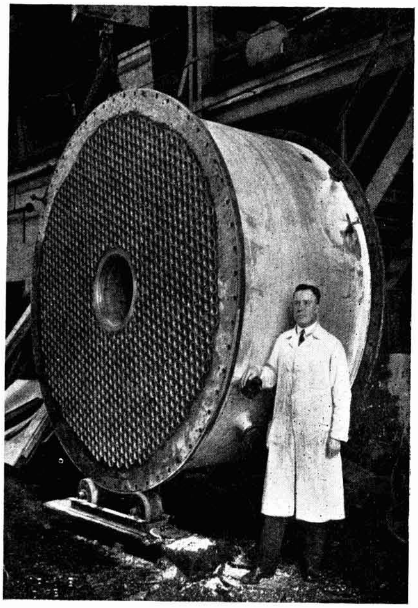
Filtering appliances have not changed in any revolutionary way, but in practice there is an increased tendency to look for labour-saving equipment. In consequence, thickeners, rotary filters and leaf filters are now extensively used. For the filtration of liquors containing small quantities of suspended matter, the newer leaf type filters offer great advantages, particularly in respect of accessibility. Ultra-filters or edge-filters, as exemplified by the streamline and metafilters, have been successfully employed.

Crystallising plant has undergone substantial changes. Before 1910, the mechanism of crystallisation processes was not understood, although plants had been built in which remarkable results were obtained. About 15 years ago, manufacturers placed upon the market certain materials in the individual crystal form and a demand arose for mechanical crystallising plants to deal with this class of work. Investigation of the crystallising process became necessary, and at the present time certain products are manufactured in this country almost entirely in the individual crystal quality. Mechanical crystallising plants have not yet succeeded in displacing stationary crystallisers, but the investigations which have been made point clearly to a better understanding of crystallisation processes.

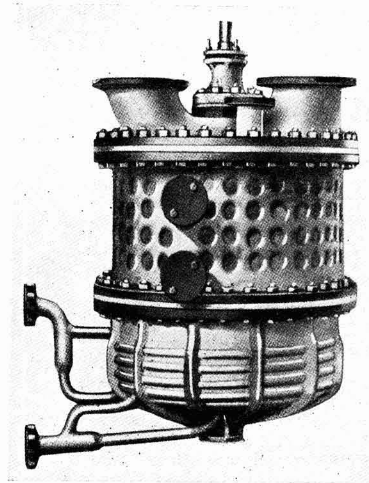
Adsorption

One of the most interesting developments is in the application of adsorption processes, particularly in solvent recovery and in the extraction of benzole from gas. The carbon adsorption process may also be regarded as a war product, the fundamental patent being taken out in 1916 by the Bayer Company. The progress made in adsorption technique is now so great that one organisation has built over 300 installations, many of them of very large size. The fundamental characteristic of the process is that it enables vapours to be extracted from a current of gas at very low concentrations, *i.e.,* under conditions in which condensation by cooling or compression or recovery by absorption would not be economical. An interesting example of the application of this process is to be found at the Beckton Gasworks. This installation is capable of extracting over 20,000 gallons per day of benzole from 76,000,000 cubic feet of gas and is the largest benzole extraction plant in the world.

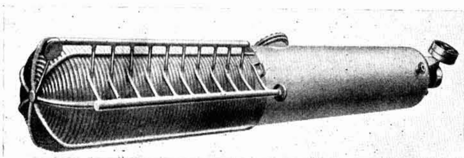
PRIVATE capital has been offered to the Mexican Federal Government for the establishment of semi-official and official industries, such as wood-preservation plants, fertiliser companies and power plants, the funds so employed being amortised and guaranteed by the production and profits of the industries, according to a broadcast of the Mexican Chief Executive. The financial assistance offered will be accepted.



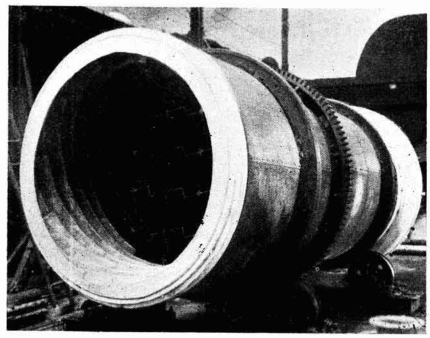
Aluminium evaporator, 2,150 sq. ft. heating surface, with hammer welded body.



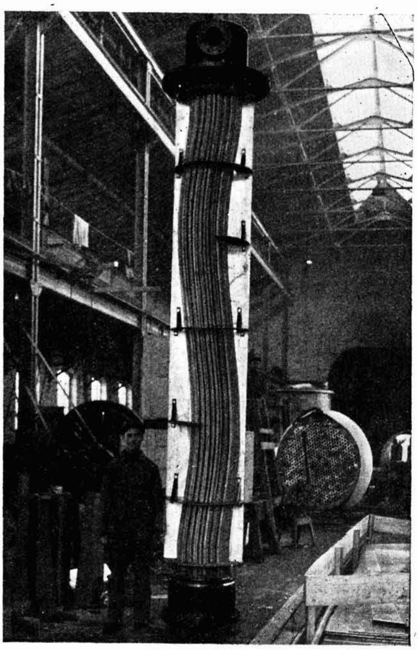
Aluminium reaction vessel with welded-on jacket and tubes; lower part for heating to 360° C., upper part for pressure of 120 lb. per sq. in.



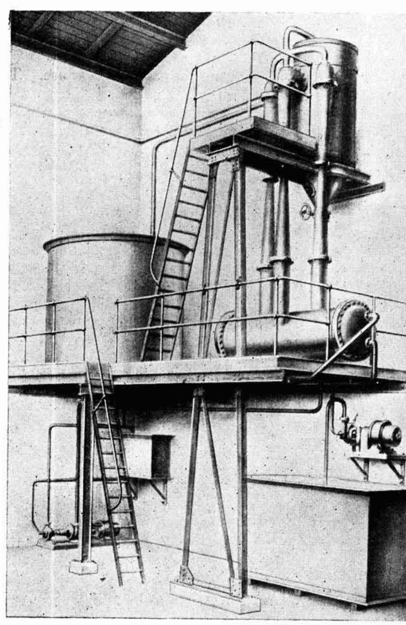
Stainless steel reaction vessel, 26 ft. × 3 ft. 3 in., with welded-on coil for steam tested to 120 atm.



Aluminium drying plant; a good example of hammer welding.



Stainless steel heat exchanger of novel design.



High vacuum plant for crystallisation from solutions at low temperature by evaporation.

The British Association of Chemists

A Fine Record of Eighteen Years' Work

THE British Association of Chemists was founded in 1917 as a provisional society. Its aims and objects were to improve the professional organisation of chemists with a view to the protection of the economic status of the profession. But from the beginning it was realised that the economic depended upon other aspects of status. The Association, therefore, included among its aims and objects a more comprehensive organisation of the profession than any previously envisaged. Its policy was and is, therefore, directed to the questions of legal redefinition of the term chemist and the adoption of a suitable title for the chemical practitioner, and to the formation of a register of qualified chemists primarily upon the widest possible basis which is compatible with the competent practice of chemistry.

The Association during the eighteen years of its existence has done a great deal in the furtherance of these objects. Immediate economic objectives were first attached. In 1920 the Association laid it down that a salary of £350 per annum was a bare minimum for the chemical practitioner. In all its negotiations since that time this economic policy has been adhered to with great success.

Unemployment Benefit

In 1922 the Unemployment Benefit Fund was inaugurated. After thirteen years in operation its continued and increasing success may properly described as an event for first-rate importance in professional history. Its chief advantage is that it is in no sense a charitable institution. It is supported entirely by the members themselves who draw, as a matter of right, unemployment insurance in proportion to their subscription to the fund. The operation of the fund gave great cause for anxiety during the first years of its administration. From 1922 to 1926 the condition of the fund was, at certain periods, precarious in the extreme. The Council and Unemployment Committee had not then the experience regarding the probable incidence of unemployment and other related problems which are so necessary to an undertaking of this kind. The organisation of the fund is in some respects unique and actual experience of its working in practice was the only method of securing its efficient operation. Thanks, however, to the experience gained, and to the able manner in which that experience has been utilised by the Unemployment Special Purposes Committee, the fund is to-day in an unassailable position. Contemporaneously with the organisation of the Unemployment Benefit Fund, the Appointments Bureau was initiated. The work of the two departments has always been complementary in a very real sense. The council always has been and still is opposed to the acceptance of a post by a chemical practitioner at an inadequate salary, and it brings pressure to bear upon its members, which greatly discourages this uneconomic and unprofessional practice.

Adequate Salaries

But until in 1928 the Unemployment Benefit Fund was in a sound position, very little could be done in this connection. Since, however, the Association is now in a position to offer a large measure of protection to its unemployed members, the result has been that they are in a position to refuse posts offered at inadequate salaries. It was from 1928 that the appointments bureau became a factor of real importance in the Association's work. It has been steadily developed from small beginnings. At the present time the services of the bureau are utilised not only by chemists but by a large number of employers. Important posts commanding substantial salaries are frequently negotiated direct with the employers concerned through the bureau.

In 1927 an important development of the Association's work arose in connection with the employment of alien chemists in this country. The Association was then in touch with the Ministry of Labour regarding this matter. As a result the Ministry approaches the Association for its views when questions concerning the appointment of foreign chemists arise. In a large number of instances the Association has recommended that a British chemist could be supplied who was competent to undertake the work, and by means of its Appointments Bureau it has frequently supplied British chemists for post of this kind.

In connection with the policy of registration and regulation for entry into the profession, the progress has necessarily been slower. The Association has since 1921 advocated the formation of a general chemical council whose specific functions it would be to explore the present situation and draw up a preliminary scheme for the registration of chemists. Up to now advance in this direction has not been so rapid as the Association would wish. The council, however, maintains a register of its members all of whom are required to satisfy the nominations committee that they are properly qualified, and this register will be made the basis of a wider scheme.

Some Eminent Presidents

The British Association of Chemists has numbered many eminent chemists among its presidents and vice-presidents. From 1918 to 1923, Professor J. W. Hinchley, the founder of the Association, was president. He guided the Association through the most critical years of its existence. Without his wisdom and counsel the Association would not have been in the position it occupies to-day. Dr. Herbert Levinstein was president from 1923 to 1924. He performed great services to the Association and generously supported it both with donations and wise administration. Dr. E. F. Armstrong, who was president from 1924 to 1925, was most energetic in furthering the Association's policy. A great deal of the prestige enjoyed by the Association is due to the work he did during his period of office. Mr. C. S. Garland (1925-1926), did a great deal to consolidate and advance the work of his predecessor. He was exceptionally active and kept close touch with the work of the council and its committees during his period of office. Professor G. T. Morgan was president from 1926 to 1928. He was particularly interested in the work of the nominations committee and the Unemployment Benefit Fund. Very interested in the co-operation of the chemical societies he did, while president, and has done since, a great deal to promote closer co-operation between chemists and chemical societies. One of the original members of the Association, Mr. F. Scholefield, 1928-1930, identified himself closely with the work of the council. During the terms of office of Professor Morgan and Mr. F. Scholefield the membership of the Association advanced considerably. This was due to a great extent to their individual efforts on its behalf. Mr. S. Reginald Price, sometime general secretary of the Association, was president from 1930 to 1932. During his period of office the membership increased, and the prestige of the Association was considerably advanced.

Professor Baly's Work

Professor E. C. C. Baly is the present president. He has carried on the tradition of activity and interest in the administration of the Society which has been established by the previous holders of the office. Professor Baly's great influence in the sphere both of pure and applied chemistry has greatly advanced the scope of its influence. So valuable have been Professor Baly's services that the council departed from its usual custom and invited him to serve for a third year as president.

The membership has steadily increased since 1925. The membership was then about 700. At present it exceeds 1,700. Close co-operation between the council, the local sections, the executive officers, and the membership has achieved this remarkable result. The work of the Association is, however, merely begun. Of its policy the greater and most important fact remains to be achieved. The economic position of its members is highly satisfactory and the status of the chemist has greatly increased as a result of its activities, which have influenced not only its members but the whole profession of chemistry. Its future work lies in the advancement of its fundamental policy regarding registration and winning for the chemist the same status as that enjoyed by the professions of medicine and law. The ultimate success of its work depends upon its closer co-operation with all other chemical societies.

Chemical Personalities, 1910-35

By Professor H. E. Armstrong, F.R.S.

LOOKING down the 1910 list of scientific workers, and comparing it with to-day's list the blanks are very numerous. Two of the senior names now missing serve to remind us of times far off but yet near, as we still live in their shadow—those of *Alexander Crum Brown* and *Sir James Dewar.* We are told by Frankland, in the preface to his "Lecture Notes for Chemical Students," published in 1866, that the book was mainly a transcript of notes of his lectures delivered at the Royal College of Chemistry in the winter session 1865-66—his first course. To illustrate constitutional formulæ, he had, he says, "extensively adopted the graphic notation of Crum Brown, which appeared to him to possess several important advantages to that proposed by Kekulé." Kekulé, his great rival, it may be mentioned, only suggested his hexagon symbol for benzene in 1865. I heard the course referred to by Frankland and read the proofs of his book—so was brought up upon Crum Brown's system. It was so simple and thorough that those who had mastered it could not look with patience upon the inconclusive "typical" formulæ of the Gerhardt school, used by Williamson, Odling, Kekulé and others. Strange to say, Hofmann, Frankland's predecessor, had proclaimed himself a convert to Gerhardtism only shortly before he left England, early in 1865. I heard him give his wonderful demonstrations of the volumetric composition of the four typical compounds—HCl, H_2O, H_3N, H_4C—described in his well-known book. In fact, the fundamental ideas of valency now current come from Frankland (1852): based only upon fact and as they are embodied in the Crum Brown formulæ, they still suffice us for all practical purposes. The papery, electronic gloss now put upon them and the stilted nomenclature many are ill-advised to use, are nothing but a cloak to premature speculations and a most unnecessary burden upon the poor deluded student.

Our Symbolic System

Frankland and Crum Brown together may be said to have completed the task begun by Berzelius—they made our symbolic system the wonderfully simple and perfect tool it now is: when something real can be inferred of atomic structure maybe we shall improve it. The service Frankland rendered is the more valuable when it is recollected that Crum Brown had already thought of the carbon atom as tetrahedral; he had derived this conception from Kekulé: he only fell short of perfection in that he failed to take the step, later made by van't Hoff (1875), of applying geometric considerations. As a matter of fact, optical isomerism was in every way to the fore in those days. Attention was drawn to Crum Brown's astounding theoretical precocity recently, at the Centenary celebration of the Royal Society of Edinburgh.

Sir James Dewar, Playfair's most distinguished pupil, was Crum Brown's contemporary. Dewar's work is too well known to need more than a passing reference, especially as his published papers have been issued in a collected form by the Cambridge University Press; they are a mine of wealth, deserving closest study. Dewar stands on high as a master experimentalist: ever working with balanced judgment and most acute perceptive power; an artist of high degree. With his colleague at Cambridge, Liveing, he was a pioneer, exact worker in spectroscopy. He then created a new field in chemistry. Not only did he greatly extend and improve the means of condensing gases but immortalised himself by introducing his vacuum flask, without which little economic use could have been made of low temperatures produced by the evaporation of liquefied gases. He further improved vacuum technique by the introduction of a specially prepared charcoal as a gaseous absorbent at low temperatures. All workers at very low temperatures now depend upon the use of cooling methods which he devised. His chief distinction, however, lay in the fact that he not only developed practical methods but himself applied them, in every direction, to the study of changes in properties, often very remarkable, at low temperatures. A man of outstanding individuality of character, by his death the circle scientific has suffered an infinite social loss; his work will ever remain.

Sir Norman Lockyer, Lord Rayleigh and *Sir William Ramsay* were a strangely different trio, representative of three very different types—the slap-dash, the deliberate, the adventurer. The story of their work is part of the romance of scientific discovery. To Lockyer we owe the popularisation of the spectroscope—a weapon whose full value the chemist is only beginning to appreciate now that its findings are being mathematically interpreted. With prophetic vision, he located an unknown element in the sun; he even had the hardihood to name it "helium," most appropriately, as it would seem to be the element destined to lighten atomic darkness: even if it do not jump out spontaneously it can be knocked out of most elements. Some day, perhaps, it will figure as the "hexagon" component in atomic structures.

We marvelled when Lord Rayleigh, following Cavendish, studying the one per cent. or so which Cavendish left as an unconsidered trifle in atmospheric aid, gave us argon. Still more when Ramsay, treading upon his heels, with the devil's own luck, brought helium to earth and then soon surrounded it with a bevy of still greater varieties, neon, krypton and xenon. Neon, an infinitesimal component of our atmosphere, made aglow, to-day proclaims not only music halls but blatantly turns night into ruddy dawn everywhere: it is fast becoming the most widespread of advertising agents. Rayleigh's argon is also put to commercial use in the glow lamp. Perhaps most remarkable of all is the use of helium in the airship. Dewar's demonstration that sufficiently purified helium is a non-conductor, remains unregarded.

We thought much of Ramsay's resolution of argon residues into neon, krypton and xenon: each of these has now been resolved by an Astonian electro-ballistic wizardry into a family circle. The term element has lost all significance. What it means, who shall say? Never is one so shameless as when it is niton—a gas spontaneously emitted from the earthy solid, thoria, easily condensable, which breaks up before our eyes, inevitably and uncontrollably, into lead and helium! When Rutherford and Soddy, in Canada, set a ball rolling of this kind, they little thought of the immensity of the snowball-like game they were foisting upon the chemist. It is impossible for him to take himself seriously any longer: he is fast becoming a romantic of the first order. You never can tell what he will do next.

Discovering New Elements.

The fun of the fair in all this discovering of elements was only known to the few. Lord Rayleigh was a sober peer, given to good works in physical measurement, as exact and refined an experimenter as Cavendish was before him, though without his disinclination to publish his results; he must have been rudely disturbed when Ramsay burst in upon his prime discovery and showed him how to separate argon easily; still, he profited by Ramsay's aid in completing his study of the new gas. Prior to this time, Ramsay had no very definite outlook as a chemist: in fact, he had not yet found himself in any clear way; we thought little of his work and had no faith in his judgment, hence there was suspicion when rumours came of a new gas in air, unsupported by evidence. When helium was put into his hands by A. H. Miers calling his attention to Hildebrand's work on cleveite, he at once rose to his opportunity. Full of dash and a wonderful manipulator, a skilled observer with the spectroscope, repeating Hildebrand's experiment he quickly saw that the gas was again a new one but Crookes had to tell him how he had verified an old prophesy by Lockyer. To understand his next step, it is necessary to know that a feud had long raged between him and his fellow Scot, Dewar, over the liquefaction of hydrogen. In old days, he would simply have gone over the hill into his neighbour's valley and lifted his cattle. Dewar, in order to obtain helium, had long been engaged in collecting gases from the Bath springs and had published enough to show that these contained unidentified constituents; Ramsay definitely set out to raid his preserves, finally succeeding by making use of argon residues from liquefied air. That he should fall upon the nest of three new eggs in the way he did was the greatest possible surprise. He used his opportunity with astounding skill. We benefit greatly from his work to-day.

The struggle marked a great change in scientific ethics—the introduction of the freebooter. Maybe progress is secured but at what cost? The field of scientific inquiry is now no bed of roses: it is a field of strife, if not of battle; at best a hunting field on which the chase is first after this, then after another hare as the scent changes; often a shadow is followed. Weekly bulletins are issued from the stables—usually about very little; of course, the reports are often misleading. The publicity agent plays his part right royally, only the coloured poster is wanting. Heavy water from the Cam! Heavy oxygen from Manchester! All these are duly set before a public which has no understanding. Poor Science, once co staid and modest, is sadly vulgarised in practice; as no one can fathom the language used in its press, this matters little, perhaps. Fortunately, the real leaders, the few men of worth who must out with the genius that is in them, quietly continue their quests. Behind all the chicanery the light of truth blazes out sufficiently often to keep a track illumined.

The All-Pervasive Electron

No more remarkable character than *Sir William Crookes* has crossed the stage. Almost unscientific in character, though credulous and without judgment in ordinary affairs, he was a most gifted experimenter, as well as an acute observer, yet neither a critic nor a constructive thinker. He and Ramsay were not unlike—neither had any theoretical convictions and so were free workers, prepared to follow up any hare. So he became a founder-worker. An early worshipper at Faraday's feet, though unwittingly, no one has contributed more to give substance to Faraday's greatest conception—that of the unit electric charge, now known as the all-pervasive electron, conjured into material existence by J. J. Thomson, on the basis of Crookes's observations. Trained under Hofmann, nominally an analytical chemist, without the faintest sympathy for the organic side, he early discovered thallium in a residue which came into his hands. This he studied most thoroughly and thereafter ceased to be a chemist. Attracted by vagaries in his balance while weighing in a vacuum, he took up the study of radiation phenomena under low pressures and invented the radiometer He then passed on to the study of the electric discharge in high vacua. He thereby set a new fashion, the pursuit of which, here, there and everywhere, was to lead not only to the public recognition of the electron but also to X-rays and wireless telegraphy. Incidentally, he wasted much time in attempting to separate the rare earths and thereby gave an impetus to study in this field. His results were of little positive value, as he made the mistake of working in soft glass vessels (Winchester quarts), so that, whilst separating his material into fractions, he was constantly loading them with impurity. He sought to characterise the earths by the phosphorescent spectra they gave when submitted to an electric discharge: the effects he observed were most beautiful but they await further study and interpretation.

Relationship of the Elements

That a man of Crookes's temperament should have been a spiritualist is in no way surprising. He and not a few others, however, afford invaluable proof that mentality is something apart from its environment; that the mind is built in compartments, in no way necessarily interconnected. Scientific occupation would seem to be compatible with entirely unscientific behaviour.

Although Crookes discovered only a single element, he rendered infinite service by leading up to the recognition of X-rays, which, in fact, he had in his hands. The rays were to be used with dramatic effect in laying bare the relationship of the elements. Suddenly, just before the war, inspired by the speculation of his teacher, now Lord Rutherford, on the electronic structure of the atom, out from the murky atmosphere of Manchester came the young philosopher, *H. G. J. Moseley*, to lead us into a promised land of simply related "atomic numbers." Moseley was killed in Gallipoli. That a life of such promise should have been squandered in the war is one of the great tragedies of our time. In effect, he showed that the elements might be arranged as it were upon a stairway, each step, from 1 to 92 being a place for a separate element. The order was that chemists had long foreseen, not always the numerical order of the atomic weights. Mendeleeff was justified for all time. Meanwhile, the devil had been among the tailors and badly upset the atomic apple-cart. Radium had been discovered and the unpleasant fact established, that certain elements had an uncontrollable habit of blowing themselves to pieces, becoming in this way reduced to Ramsay's helium and lead—not only to one lead but to two leads, differing in atomic weight by a couple of units, but otherwise identical.

Full light on the picture came later when J. J. Thomson introduced a kinetic, electroballistic method of determining atomic weights. In recent times this has been developed with wonderful perfection by Aston. We now know that most of the steps of Moseley's stairway carry more than a single element—some, a whole family of sisters, of cousins and of aunts apparently. The picture now before us is less that of a ladder than of a stepway, up and down, over several hills of increasing height, corresponding to Mendeleeff's periods. The scenery varies from step to step. At the distant end is staged a strange fireworky crowd, continually sending up rockets. Thus is fulfilled the dream which some of us have had since the introduction of Mendeleeff's generalisation: that the elements generally must be structurally related, like the compounds of organic chemistry. We may call the family parties isotopes, after Soddy: there is no reason, however, to suppose that they are otherwise than sets of homologues. Our story of the elements to-day is indeed a "dainty dish to set before a king."

Whilst the elements have been undone and shown to be complex structures, akin to organic compounds, the old chemistry has continued to flourish. No one did more to lay foundations for the outburst of activity, in the organic field in our country, after the war, than *W. H. Perkin, Jr.* He was more than a chip of the old block, whether perforce of innate genius or by virtue of higher training and a wider range of opportunities is difficult to say. As a worker, he was characterised by a boundless enthusiasm and freshness of outlook. In common with his father and brother, he had an intense love of experimental laboratory work as such and was a master of the laboratory arts but more an artist than a philosopher. A man of wide and generous outlook, he had the family gift of music and was a great garden lover—a *bon vivant* to the last, as his father seems to have been in his early days, before a second marriage made him prim. Unfortunately, he had no literary gift and never did justice to his work on paper; the accounts he wrote are difficult to read. As a worker he was full of dash, with no little genius—but he never displayed the logic and cold precision of an Emil Fischer. His constructive work on the terpenes and his analytical studies of alkaloids are of supreme value.

The Worship of the Ion

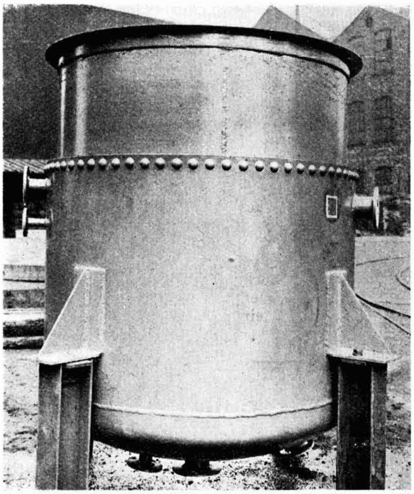
As I am completing this notice, the news comes of the sudden death of one to whom I was intending to make oblique reference in speaking of his master, H. B. Dixon. The work of Dixon and *H. B. Baker* is fundamental to the inquiry into the all-embracing problem of the nature of chemical change. Issue was raised when Dixon (1880) showed that carbonic oxide was incombustible in absence of moisture, a result confirmed up to the hilt by Bone in recent years. Just fifty years ago, on April 19, 1885, Baker, at the Chemical Society, gave similar proof that carbon and phosphorus did not burn when dry. In the discussion, I ventured to insist that all chemical change was electrolytic in character and ventured to predict that a properly dried mixture of hydrogen and oxygen would be inexplosive. Baker was able later on to verify my prediction. He has done much work in the interval, all to the same effect. I hold the doctrine to be proved. He was a man of remarkable simplicity of character and the means he used were always simple—hence his success.

Unfortunately, in the interval, under the misleading influence of a forerunner of Hitler—the pre-Nazi Ostwald—chemists have been led to accept a new faith, well suited to Nordic simplicity, the worship of the ion: they have ceased to think for themselves and consider facts. "The Times," at the close of a leader on Nazi control of the Press (April 27), quotes the following words used by the Führer in "Mein Kampf": "The German has not the slightest idea of how a people must be misled if the adherence of the masses is sought." Ostwald, as the perfect publicity agent, had the most complete understanding: he misled most perfectly. Not only the Germans but chemists also must learn to think for themselves if they are to recover their freedom—be chemists.

Of the major groups of German chemical exports, dyestuffs, as in previous years, made by far the best showing in 1934, and in contrast to the downward trend recorded for other groups increased 7 per cent. over the two preceding years.

Seventy Years of Progress in Chemical Plant Manufacture

THE BENEFIT OF THIS EXPERIENCE IS AT YOUR DISPOSAL WHEN ENTRUSTING US WITH YOUR REQUIREMENTS FOR ANY OF THE FOLLOWING :



Jacketted Kettle

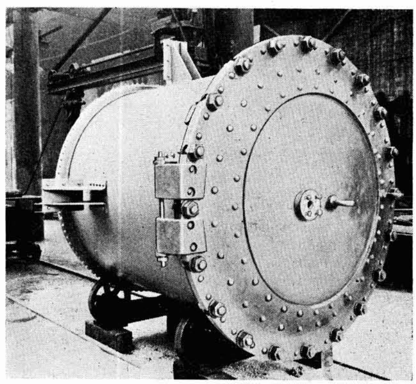
Pans, Vessels, Tanks and Pipes Lined to resist Corrosive Liquids.

" CASCADE " System Plant for Tar Dehydration & Distillation and for De-Gumming and Re-conditioning Oils used in the extraction of Benzole.

We also manufacture Plate Work of every description.

ALSO

GAS HOLDERS
OIL REFINING PLANT
TANKS
STEAM BOILERS
PIPES and GAS MAINS



Boiling Kier

All Enquiries to

Telegrams : Gas, Leeds
Telephone : Hunslet 75226

CLAYTON SON & CO. LTD.
CHEMICAL PLANT MAKERS FOR OVER 70 YEARS

London Office :
5 Victoria Street, S.W.1.

MOOR END WORKS, HUNSLET, LEEDS

Institution of Chemical Engineers, 1922-35

"Let us now praise famous men and our fathers that begat us."

ALTHOUGH the final incorporation of the Institution of Chemical Engineers did not take place till late in 1922, the existence of and the need for engineers with special training in the design, erection and operation of chemical plant was certainly (even if only dimly) appreciated as far back as 1880, since in that year an abortive attempt was made to form a " Society of Chemical Engineers," while a second attempt, which was equally unsuccessful, took place ten years later. For the seed planted in 1880 to flourish and bear fruit, a favourable conjunction of circumstances was required, and it was not until the war brought home the well-nigh overwhelming monopoly of German chemical industry in respect of almost all classes of organic products that the favourable conjunction arrived. The pressing need for home production of munitions and other materials revealed a serious shortage in the supply of trained chemical engineers, which was overcome in traditional makeshift fashion by collecting from the army and elsewhere such chemical workers as were available, both trained and partially trained, and drafting them to Government and other factories where their training in munitions production was amplified and completed. The vital necessity for the training of chemical engineers as such, not only for the temporary production of war materials, but in order that British chemical industry should stand independent of foreign supplies after the war, was stressed by Lord Moulton, Director-General of Explosives Supply, while at the same time the formation of the Institution was foreshadowed. On March 6, 1917, what was probably the first detailed discussion in Great Britain on the training of the chemical engineer was held by the Faraday Society, under the chairmanship of Sir Robert Hadfield.

A Tribute to Professor Hinchley

It was, however, due to the late Professor J. W. Hinchley, more than to any other one man, that the Institution of Chemical Engineers came into being. Having, after his return to this country from Siam, realised the great and growing importance of chemical engineering, he was able (in 1911) to start systematic courses at the South-Western (now the Battersea) Polytechnic, and (in the following year) at the Imperial College of Science and Technology, while, with characteristic enthusiasm, he fought constantly for the greater recognition of chemical engineering and the chemical engineer. Since enthusiasm begets enthusiasm, an influential body of opinion was developed in favour of some action being taken whereby the study of chemical engineering should be encouraged and its importance to national industry be given a place in our education system. The first step was the formation, in 1918, of the Chemical Engineering Group of the Society of Chemical Industry, the object of the Group being to further the study of chemical engineering, a function which it has pursued with marked success. It speedily became evident, however, that the formation of a special group of an existing society was insufficient, and at the fourth conference of the Chemical Engineering Group, held at Newcastle-upon-Tyne in 1920, a meeting was held to promote the formation of an Institution of Chemical Engineers, while in the following year an ultimatum was delivered to the effect that unless steps were taken by those who helped to found the group, such an institution would be founded in the North of England. As a result, at a meeting called by Professor Hinchley on November 9, 1921, it was proposed by Mr. W. J. U. Woolcock and seconded by Mr. F. Heron Rogers, " that the formation of an Institution of Chemical Engineers is desirable," whereupon Mr. F. A. Greene, seconded by Mr. D. Brownlie, moved " that a Provisional Institution be hereby formed." Mr. J. Arthur Reavell thereupon moved, and Mr. W. Macnab seconded, a resolution that a provisional committee be appointed. These resolutions were all carried with enthusiasm; Sir Arthur Duckham was elected chairman, with Professor Hinchley as convener, the other members of the provisional committee being Messrs. D. Brownlie, F. A. Greene, Jas. MacGregor, W. Macnab, J. Arthur Reavell. F. Heron Rogers, H. Talbot, and W. J. U. Woolcock. Mr. Woolcock was elected vice-chairman, Mr. Rogers hon. treasurer, and Mr. A. C. Flint was appointed assistant secretary. Later, three additional members were elected to the provisional committee, Messrs. D. M. Newitt, E. W. Smith and S. G. M. Ure. Owing to the generosity of the original supporters of the project, a guarantee fund adequate to cover the expenses of formation of the Institution had been raised, therefore it was unnecessary to ask for further donations.

The next six months were occupied in considering and drafting the memorandum and articles of association, and this having been accomplished, the inaugural meeting was formally incorporated on December 21, 1922, the first meeting of the provisional council being held on January 10, 1923, when the first 61 members and 20 associate-members were elected.

Encouraging the Younger Members

The official life of the Institution commenced with the first annual corporate meeting, held on June 8, 1923, Sir Arthur Duckham being elected president, Mr. F. Heron Rogers, hon. treasurer, Mr. C. S. Garland, hon. registrar, and Professor J. W. Hinchley, hon. secretary (which office he held until his death in 1931). After the death of Professor Hinchley, continuity of the close association of the Institution with the teaching of chemical engineering was maintained by the election of Mr. H. W. Cremer, as hon. secretary. At the first meeting of the Institution, just referred to, the first paper was read, being an account by Mr. T. Campbell Finlayson of an investigation into the possibilities of obtaining cheap oxygen. During the succeeding twelve years, nearly 150 papers, addresses and lectures have been delivered and published in the Transactions, nearly every aspect of chemical engineering being dealt with at one time or another. There has been a steady growth in membership, from 81 in January, 1923, to over 800 at the end of 1934.

From its inception, the Institution has concerned itself with the education of the chemical engineer; an education committee was appointed at the first council meeting, in July, 1923, and one of its first tasks was to prepare an " Outline of Training," in connection with which many firms connected with the chemical industries were consulted. In view of the number of applicants who had not received systematic training in chemical engineering, it was considered, in 1926, that the time was ripe for the Institution to impose a test by examination on those candidates for the associate-membership about whose training in fundamental principles the nomination committee might be doubtful.

In 1928, an important step was taken to increase the interest of the younger members in the work of the Institution by the establishment of a graduates and students section, which is run by the non-corporate members. The section, which is very much alive, holds six or seven meeting a year at which papers are read and discussed; for the best paper read at such meetings the Junior Moulton Medal is annually awarded, the winning paper being published *in extenso* in the Transactions.

Annual Award of Medals

The dissemination of chemical engineering information is carried out by the publication of a volume of Transactions, edited by Professor S. G. M. Ure, published until 1933 once a year, but since 1934 in three or more parts annually.

In 1925, a party of about 30 of the American Institute, with their ladies, visited England and participated in the third annual corporate meeting of the Institution, and a return visit of a number of members of the Institution was paid to Eastern Canada and the United States in 1928, while an invitation has been extended to the American Institute to visit England in 1936 at the time of the Chemical Engineering Congress, of which the sixth president of the Institution, Viscount Leverhulme, is president.

Three medals are awarded annually: the Osborne Reynolds Medal, presented by Mr. F. A. Greene, hon. treasurer since 1929, for the most meritorious contribution to the progress of the Institution during the year; the Moulton Medal (in gold) for the best paper of a mature character; and the Junior Moulton Medal (in silver) with prize of books, for the best paper read by a graduate or student of the Institution.

Mention should also be made of the appointments bureau which was established in 1925 under the able directorship of Mr. H. J. Pooley.

Born shortly after the war, the Institution represents the fruition of a vision conceived by a band of far-seeing enthusiasts of whom the majority are, happily, still with us. Amongst those who have passed on, leaving the Institution of Chemical Engineers as no unworthy monument, should be mentioned Sir Arthur Duckham, first president, Sir Frederic Nathan, second president, and the first hon. secretary, Professor J. W. Hinchley.

The Institute of Chemistry

To Celebrate its Charter Jubilee this Year

In 1910, the Institute of Chemistry—which had then been established nearly a third of a century and incorporated under Royal Charter nearly a quarter of a century—offered its loyal congratulations to King George V on the occasion of his Coronation. At that time, the profession of chemistry, in relation to public affairs, industry and commerce, stood in a very different position from that it occupies to-day. The total membership of the Institute was less than 1,300, and many who contemplated a career in chemistry were discouraged by the difficulty of making a start and the lack of prospects. Indeed, it was generally held that it was not a profession for a young man without means, and it was a common occurrence for a professor, or a manufacturing firm, or a private practitioner to "make a vacancy," at no salary or at a very nominal one, where the beginner might "mark time" until he could hear of an appointment where he was really wanted. Often, indeed, although he had good qualifications, he would be required to pay a premium, possibly repayable as salary, to be allowed to gain experience on the staff of an established consultant. At that time and with the right type of consultant, it was well worth the venture. In general, however, the Council of the Institute discouraged, and still does, the system of articled pupilage, because the training of a chemist necessitates a broad and systematic education, not only in chemistry, but in allied sciences.

Memorial Lectures and Monographs

The president in 1910 was Dr. George Beilby, the distinguished chemical engineer, who later received a knighthood for exceptional service during the war. During his term of office, at the suggestion of Professor—now Sir—Herbert Jackson, a scheme of lectures was inaugurated with the object of bringing the younger generation of chemists into direct touch with well-established men who had been successful in various branches of work. The scheme was temporarily suspended during the war, but has since been revived and developed, with the addition of the Streatfeild and Gluckstein Memorial Lectures. The collection of monographs, published during the past twenty-five years, covers such subjects as cement, cellulose, sugar, quinine, rubber, fermentation and brewing, and, associated with industry generally, fire risks, industrial gases and fumes, works costing and ventilation; patents, contracts of service, copyright and other legal subjects affecting chemists; the progress of the profession in connection with affairs of State; and the bearing of chemistry on health and food.

The Institute, which had been founded before many of the modern universities had become incorporated or were in a position to provide professional technical training, had, through the co-operation of the leading teachers, undoubtedly taken a part in determining the standard of education required for a career in chemistry, and its own qualifications were already well recognised as signifying sound professional training and ability. In 1912, Dr. Beilby was succeeded by Professor Meldola, during whose term of office an important conference of professors of chemistry was held to consider the relation between the qualifications of the Institute and those of the universities and colleges. It was clear that some concordant scheme of joint action was desirable in the cause of chemistry as a whole, and that something could be done to obviate a waste of resources owing to the overlap of examination systems. Sir James Dobbie, notwithstanding his heavy duties as Government Chemist, succeeded Professor Meldola in 1915 and gave particular attention to the steps to be taken to modify the regulations of the Institute, and its general policy. Thus, the ultimate outcome of the conference held under the chairmanship of Professor Meldola was incorporated in the regulations adopted in April, 1918, when special provision was made for the admission to the Institute of graduates with higher honours in chemistry who had completed a four-year course, or the equivalent, and had otherwise fulfilled the conditions necessary for qualification.

Neglect of Science in Education

From the early days of the war, the nature of the activities of the Institute was temporarily changed. The Council took immediate action, jointly with the Society of Public Analysts, to encourage the production of reagents and chemicals, glass and porcelain, filter paper and apparatus, which had hitherto been obtained from abroad, and the Institute was the chief agency through which chemists were recruited for all services required by the Government. In 1915, the Institute participated in conferences on the neglect of science in education and similar matters, and co-operated with other societies in supporting the Royal Society in its representations to the Government on the importance of developing chemical industry, the ultimate outcome of which was the establishment of the Department of Scientific and Industrial Research. With the return of peace, employers having realised how helpful chemists could be in almost any industry, the demand for trained and qualified men became greatly increased, with a consequent increase in British chemical personnel. In this connection, the Appointments Register of the Institute was of good service. The number of members known to be unemployed was for several years less than one per cent.; at the worst, it hardly exceeded three-and-a-half per cent., and to-day, with a membership of 6,300, is less than two per cent., while conditions generally have improved.

During the presidency of Sir Herbert Jackson, local sections, of which there are now 20, were formed in various parts of the country, as well as overseas, a movement which has been remarkably successful in affording opportunities for social intercourse amongst chemists, while provision was also made for the election of district members of Council. As a memorial to members and students who fell in the war, a Benevolent Fund was established in 1920, which has been found of great assistance to the widows and dependents of deceased members, as well as to those who have fallen on bad times, unemployment, illness or other misfortune.

Watching Legislation in the Public Interest

Successive Councils have consistently watched, in the public interest, legislation on which chemistry has a bearing, and in this connection, Dr.—now Sir Christopher—Clayton, who succeeded Professor Smithells in 1930, has rendered valuable service to the Government, as did also Lord Henley (then a member of Council) in the House of Lords, particularly in connection with the Pharmacy and Poisons Act.

The present president, Professor Jocelyn Thorpe, has devoted much time to the problem of bringing about closer co-operation between chemical societies, which now shows some promise of being, in some measure, effected, and has recently had the pleasure of announcing that the King has been graciously pleased to accord the Institute his patronage, to mark the Charter Jubilee of the Institute, which will be celebrated on July 9 and 10.

Association of British Chemical Manufacturers

A Survey of its Formation and Work, 1916-1935

THE first steps towards the formation of the Association of British Chemical Manufacturers were taken early in 1916, when a joint committee of the Chemical Society, the Society of Dyers and Colourists, and the Society of Chemical Industry met, at the suggestion of the first-named, to consider the best methods of promoting co-operation between British chemical manufacturers. At a meeting on May 23, 1916, representatives of over 100 firms unanimously agreed that it was desirable that British firms engaged in chemical manufacture and its allied industries should form an association to promote closer co-operation between chemical manufacturers, to form a medium for placing before the Government and Government officials its views upon matters affecting the British chemical industry, for the furtherance of better technical organisation and the promotion of industrial research, to keep in touch with the progress made in chemical knowledge and practice, and thereby to facilitate the development of new British industries, and the extension of existing ones, and to promote closer co-operation between chemical manufacturers and the various universities and technical colleges.

Representative Body of the Industry

A provisional committee, under the chairmanship of Dr. Carpenter, then president of the Society of Chemical Industry, was appointed to carry the proposals into effect, and on December 28, 1916, the Association of British Chemical Manufacturers (the word "Limited" being omitted by licence of the Board of Trade) was incorporated under the Companies Acts, with Dr. Charles Carpenter as the first chairman and Sir Charles Bedford as the first general secretary. The first meeting of the Council was held on January 4, 1917. The first statutory general meeting was held on March 7, 1917, and by the date of the first annual general meeting in July, 1917, 110 firms had taken up membership, representing a capital of some £30,000,000; the present figures are 117 firms, representing a capital of over £200,000,000. The Association was at first divided into eleven groups, which was later increased to the present number of twelve.

The first report contains accounts of the formation of an Industrial Alcohol Committee, a Joint Committee of Sulphuric Acid, Spelter, and Fertiliser interests to negotiate with the Government in regard to the disposal of Australian zinc concentrates, together with committees dealing with patent law, trade marks, commercial treaties, fiscal policy and statistics and commercial intelligence. Progress was also reported in regard to the other objects set forth in the original resolution and a start was made on the compilation of the first issue of the Association's now well-known directory. The new Association soon achieved one of its objects in being recognised by the Government as the representative body of the chemical industry and was invited to nominate representatives to Government committees dealing with industrial reconstruction, labour resettlement and sulphuric acid supplies. Representations were also made to the Government on behalf of members in connection with education, drums for caustic soda, nitric acid, dyestuffs and cresylic acid. Sir Charles Bedford, the first secretary resigned in February, 1918, and was succeeded by Mr. W. J. Uglow Woolcock, who held the post until May, 1928, when he was succeeded by the present general manager and secretary, Mr. J. Davidson Pratt.

Long Record of Achievement

The annual reports show a long record of achievement on behalf of the chemical industry and indicate that it has been prominently associated with all movements of importance since its formation. Its first post-war activities were concerned with the reorganisation from a war-time to a peace-time basis, particularly as regards the "national" factories, re-absorption of labour and demobilisation, disposal of waste products, and resumption of trade with overseas countries, while a Traffic Committee was formed to deal with the growing problems of railway transport. In 1919, the Association sent a commission to visit the German chemical factories in the occupied zone. Following the Patents and Designs Act, 1919, for many of the alterations in which the Association was responsible, the next important step in the history of the Association was the passing of the Dyestuffs (Import Regulation) Act, 1920. As the result of endeavours to bring manufacturers of chemicals and chemical plant into closer touch with each other, the British Chemical Plant Manufacturers' Association was inaugurated in July, 1920, and has ever since worked in the closest co-operation and from the same office as the A.B.C.M. Other associations dealing with special problems have also been formed or become affiliated to the A.B.C.M., and at present the number of such affiliated Assotions is thirteen.

Almost immediately afterwards came the Safeguarding of Industries Act, 1921, and the Railways Act of the same year. The latter may appear to be a somewhat curious activity for an association of chemical manufacturers, but the A.B.C.M. has always endeavoured to assist its members in every way possible and since transport matters represent an extremely important portion of a firm's activities, and since chemicals figure largely in the dangerous goods classification, the Traffic Committee is just as active at the present time and equally valuable to members. The question of transport by rail of goods classified as dangerous was just as important in 1919 as it has recently become in connection with road transport. The Association organised the first chemical section at the British Industries Fair in 1922, and was responsible for the corresponding section at the British Empire Exhibition in 1924 and 1925. It has continued to organise the chemical section at the British Industries Fair and is responsible for the chemical exhibit in the British pavilion at the Brussels Exhibition this year.

Growing Influence

The Association may be considered to have "settled down" by 1920, and we find the subjects dealt with becoming fairly stabilised. A comparison of the Association's annual reports at the beginning and end of the period under review reveals a remarkable similarity in the problems requiring attention. At the Victory Dinner in August, 1919, Sir Alfred Mond (as he then was) drew attention to the new position that had arisen as the result of the war through the accumulation of stocks abroad, the growth of home production in former markets and the new standard of living caused by inflated war-time wages. These words are as true to-day as when they were uttered. In 1919 and 1920 difficulties were being experienced by dye makers in obtaining supplies of toluol and benzol; similar difficulties in a similar connection have been encountered recently. The constant vigilance which is necessary in regard to action by Government Departments is frequently mentioned in the early reports and there are complaints that action is too often taken without consulting the industry. Fortunately, as the influence of the Association has grown, these complaints have steadily disappeared and in the latest reports we find references to the close co-operation which exists between the Association and the Factory Department of the Home Office and the Board of Trade, for instance. The Association has always been a strong advocate of standardisation and after valuable work by a joint Research Committee with the British Chemical Plant Manufacturers' Association in regard to filter presses and steam jacketed pans, steps were taken by the A.B.C.M. in 1931 which resulted in the British Engineering Standards Association being reorganised to form the British Standards Institution, which now includes a Chemical Division as one of its four main divisions.

The incidence of the Import Duties Act, 1932, enlarged the Association's activities in connection with tariffs. During the last three years it has been successful in securing additional duties on a large number of important chemical products made in this country, and in securing the addition to the free list of the more important raw materials of the chemical industry that are not obtainable commercially in the Empire. The Association played an active part at the Ottawa Conference where it was represented by the chairman and general manager, and is closely associated with all the negotiations for new commercial treaties with foreign countries.

Manufacture of Fine Chemicals and Drugs, 1910-35

The British Drug Houses, Ltd.

In 1908, The British Drug Houses, Ltd., was formed by the amalgamation of five leading firms of wholesale druggists into a large undertaking operating on one site at Graham Street, City Road, London. Each of the businesses had been conducted separately for over 150 years, but the joining of forces afforded facilities for the adoption of new machinery and improved manufacturing process.

The early part of the twentieth century, before the outbreak of war in 1914, was a period of trade expansion; industrial methods were being closely overhauled, new methods of production and sales were being introduced, and the B.D.H. arose during this peace-time activity. The outbreak of war was another milestone in the progress of the B.D.H. Great Britain was cut off from continental supplies of pure chemicals for analytical work and for research, and also from supplies of synthetic medicinal chemicals. The B.D.H. promptly undertook the manufacture of these substances, and this necessitated considerable expansion and the acquisition of new adjoining premises at Wharf Road. After the war period the world shortage of goods in all countries again stimulated the B.D.H. to still further activity. An important addition to the company was made by the incorporation of an old-established business of export wholesale druggists, and this resulted in a great increase in the company's overseas trade. To-day the company has branches, resident representatives, or agents in all parts of the world; and in Canada and Australia two associated companies, The British Drug Houses (Canada), Ltd., at Toronto, and The British Drug Houses (Australia), Ltd., at Sydney.

The B.D.H. is perhaps best known as manufacturers of pure analytical reagents and an exceedingly wide range of laboratory chemicals, a term now used comprehensively to include chemicals for analytical, research, teaching and all other laboratory purposes. The " B.D.H. Catalogue of Laboratory Chemicals " has continued to expand year by year, and now contains over 4,500 items. It includes " Analar " chemicals and other chemicals of specified purity for use in analysis and research; reagents for " spot " tests, and for use in micro-chemical analysis; indicators and outfits for the determination of pH value; oxidation-reduction indicators and adsorption indicators; materials for use in biochemical analysis, and microscopical stains specially prepared for bacteriological and histological work.

Specifications for Analytical Reagents

For a number of years specifications of purity for certain analytical reagents were published separately by The British Drug Houses, Ltd., and Hopkin and Williams, Ltd., and the chemicals conforming to these specifications were characterised by the letters " A.R." signifying " Analytical Reagent." The two firms guaranteed their products to conform to their respective specifications, but as these, although similar, were not identical, users of laboratory chemicals were occasionally in doubt as to the exact quality denoted by the term " A.R." Much more serious consequences, however, were brought about by the practice of some firms who applied the letters indiscriminately to substances in respect of which no specification existed, and issued chemicals labelled "A.R." which did not conform to either of the published specifications. The designation " A.R." lost the value which at one time made the term synonymous with purity and reliability, and chemists could no longer rely upon getting material of the requisite degree of purity by merely specifying " A.R."

On this account, The British Drug Houses, Ltd., and Hopkin and Williams, Ltd., decided to undertake the unification of their respective specifications, so that definite standards of purity for British laboratory chemicals should be available. This project was carried out during 1934 by co-operation between the chemists of the two firms, in the course of which there was conducted an extensive investigation into the technique of detecting minimal quantities of impurities. The outcome of this collaboration was the publication of a book of standards containing specifications for 220 chemicals, and published under the title " AnalaR Standards for Laboratory Chemicals." In this book particular attention has been paid to the wording of the tests so that only one interpretation can be placed on them. It is well-known that in testing chemicals for extremely minute amounts of impurities it is frequently impossible to specify the amount present as a definite quantitative figure. There is a minimum sensitivity to all tests, and where no reaction for an impurity is obtained, it cannot be stated with certainty that the particular impurity is absent. The limiting values of such tests have been studied, and where no reaction is obtained, the amount of impurity present is recorded as being less than the minimum amount which under the conditions of the test gives the faintest possible reaction. A statement of the maximum limits of impurities present in all " AnalaR " laboratory chemicals is made in the book of " AnalaR " Standards, but the actual amounts of impurities present in " AnalaR " chemicals are usually considerably less than the maximum permissible limits.

Reagents for " Spot " Tests

The organic reagents used for " spot " tests and delicate analysis comprise a series of compounds which are selective for various organic and inorganic radicles and will detect them in minute quantities. The reactions are carried out in micro test tubes, on microscopic slides, or by means of papers impregnated with various reagents. Over 60 of these reagents are now available, and an account of the practical working methods involved is given in the " B.D.H. Book of Reagents for ' Spot ' Tests and Delicate Analysis." An outfit comprising a selection of 27 reagents and the accessories required for their use is provided for analysts and all who are engaged in schools and colleges, and desire to demonstrate the technique of this new branch of analytical chemistry. The B.D.H. micro-analytical reagents are provided for the use of chemists who employ micro-methods of chemical analysis. These are prepared in strict accordance with the directions laid down by Pregl and other workers. Rigorous tests are applied to all of these reagents in order to ensure their suitability for micro-analytical work.

The colorimetric determination of hydrogen ion concentration has become increasingly important in analytical practice and in the control of many industrial operations. Over seventy pH indicators are available for the rapid determination of the acid or alkaline condition of solutions, and these cover a range extending from pH −0.2 to pH 13.0. The B.D.H. Universal Indicator is an alcoholic solution of a number of indicators, and shows the whole range of spectrum colours from red to violet in the correct order. It is very useful for determining quickly the approximate pH of a fluid. Many other " special purpose " indicators are available. These are mixed indicators which show well-marked colour changes at definite points on the pH scale.

Special Purpose Indicators

A notable application of the use of bromo-cresol purple indicator is illustrated by the recent itnroduction of the B.D.H. " Dislac " Test Outfit. This is supplied for the detection of mastitis, an udder disease which renders milk harmful for human consumption, and unsuitable for butter and cheese making. A jet of milk from each quarter of the udder is directed in turn on to a series of four muslin discs impregnated with the indicator. The muslin retains any clots which may be present in infected milk, and the indicator changes colour when the milk is alkaline. The test has been developed from investigations carried out in a well-known dairy research institute.

The new series of 28 substances for use as oxidation-reduction indicators is also available. The oxidation-reduction indicators are compounds which show a reversible colour change on reduction and oxidation. The colour is an indication of the oxidation-reduction balance, a matter of importance in such varied applications as milk-testing, fruit-canning, meat-packing, the analysis of alloy steels, the control of sewage effluents, and the differentiation of dyestuffs. In addition, special adsorption indicators are provided for the rapid determination of small amounts of chloride, bromide, or iodide, alone or together, in fluids containing proteins. Among other novelties may be mentioned the B.D.H. Chlorotex Reagent which affords a simple means of determining the amount of residual chlorine in swimming pools and in drinking water purified by chlorination. The increasing popularity of swimming pools has lately emphasised the importance of water sterilisation, and when this is effected by means of chlorine, the need for carefully controlling the chlorination is obvious. By mixing measured quantities of the Chlorotex Reagent and the water under test, and then comparing the colours produced with those given on a chart, the chlorine content of the water can be ascertained.

Every year new complex organic synthetic substances are added to the number of products available for the use of physicians, and the output of these is often bewildering. Many chemotherapeutic products, such as Contramine and the various symmetrical ureas, notably S.U.P.36, S.U.M.36, S.U.P.-468, and entrypol are in constant demand. Pure dyestuffs are used for medicinal purposes, and some of them constitute valuable antiseptics. In this connection the three flavine antiseptics, acriflavine, enflavine and proflavine must be mentioned. Among the compounds used as local anæsthetics, as hypnotics, and in the treatment of tropical diseases, there are many which are of importance in clinical medicine.

Hormones and Vitamins

A study of the hormones has proceeded with great activity. These substances, which are secreted by the ductless glands, are of vital importance in medicine. Life and health are dependent upon a constant supply of them. Insulin A.B. was the first British insulin to be offered to the medical profession; the standard of purity now approaches that of pure crystalline insulin, the proportion of reaction-producing protein being negligible. The commercial production of thyroxine has been successfully accomplished. The clinical possibilities of the sex hormones including oestroform, which is keto-hydroxy-oestrin, progestin, the hormone of the corpus luteum, and the hormones of the anterior lobe of the pituitary gland seem unlimited. Acetylcholine has also been used with considerable success for the relief of arterial hypertension, and in the treatment of paralytic ileus.

Even since the introduction of vitamins into medical practice the B.D.H. has been associated with their production. Radiostol (Vitamin D), also known as calciferol, was first produced on a commercial scale in a pure crystalline condition in the B.D.H. laboratories. A process for obtaining Vitamin A in a condition of practical purity is the subject of a B.D.H. patent. Pure crystalline Vitamin C, isolated from paprika by the method originated by Szent-Györgyi, was first prepared commercially by B.D.H. chemists.

Highly-active and accurately-standardised vitamin concentrates for general medicinal use have been provided; a section of the B.D.H. Physiological Laboratories is devoted to the biological control of the well-known B.D.H. vitamin products including Avoleum (Vitamin A) in liquid form and in capsules, Radiostol (Vitamin D) in solution and in pellets, Radiostoleum (Vitamins A and D) in liquid form and in capsules, and Radio-Malt in which Radiostoleum is incorporated with Vitamin B and malt extract. Through the medium of preparations containing standardised quantities of the pure vitamins, the medical treatment of vitamin-deficient patients can now be practised with scientific accuracy. The physician is able to prescribe for his patients the vitamins he needs in the balanced proportions in which it has been found that each vitamin, individually and collaterally, produces the optimum effect.

Further Advances in Pharmaceutical Products

Boots Pure Drug Co., Ltd.

THE business of Boots Pure Drug Co., Ltd., was founded for the sale of drugs and proprietary articles, and when supplies could not be obtained at the most economical rates their manufacture was undertaken, at first, on a very small scale. By 1910, the company was manufacturing a wide variety of pharmaceutical preparations and already had a well-established analytical department for the control of all materials, both purchased and manufactured. This early insistence upon scientific control has always been a feature of Boots' organisation, and during the last twenty-five years some of the finest testing laboratories in the country have been established. The main analytical laboratories are at the Beeston works and the research, pharmacological and bacteriological laboratories are at the Island Street works, in order that they may work in close co-operation with the fine chemical department, not only in the testing of products but also in the improvement of manufacturing processes and in the development of new products.

On the outbreak of war, in 1914, the fine chemical department was founded. In conjunction with the anti-gas department of the Ministry of Munitions, Boots produced the first effective box respirators, supplying the whole of the chemical granules for filling the respirators used by the British and certain of the allied countries, and they fitted and supplied nearly 8,000,000 complete box respirators and also adsorbent material for 10,000,000 more. The manufacture of aspirin, acriflavine, chloramine-T and other products used in the war was also begun. The production of these substances necessitated the installation of extensive plant and equipment and a power house which was completed in 1916.

The first years of growth—1915-1920—were difficult years. Some idea of the position of the fine chemical industry generally at that time will be gathered from an extract from the "Times Trade Supplement," December 4, 1920: "The present position of the fine chemical industry must be defined as critical. Thus, British fine chemical manufacturers are struggling to consolidate their immature effort in establishing the industry upon a sure foundation, but, disappointed of the long-promised Anti-Dumping Bill which never comes, find their present position somewhat precarious."

By 1921, many of the difficulties experienced in the manufacture of new products had been overcome and the firm's technical and scientific staff was considerably enlarged, resulting in the production of many new compounds. In 1923, "Stabilarsan," an organic arsenical for the treatment of spirochaetal diseases, was introduced. This was the first of a series of products of clinical importance, now collectively known as Boots special medical products, and issued under such well-known names as "Bismostab" (injection of bismuth, B.P.), "Novostab" (Boots brand of neoarsphenamine), "Sulphostab" (sulpharsphenamine) and "Thiostab" (10 per cent. solution of sodium thiosulphate). The more recent additions are "Quinostab" (quinine iodobismuthate), and "Stabismol," an oil soluble bismuth preparation discovered in their own research laboratories. In 1932, Stabilarsan Veterinary was introduced, a solution of arsphenamine diglucoside in glucose for the treatment of "blackhead," a contagious and fatal disease affecting turkeys. Millions of sterile ampoule products are now manufactured in each year. All are filled under aseptic conditions and tested for sterility, both before and after filling, in laboratories specially equipped for the purpose.

Prince of Wales Visits Works

In 1923, H.R.H. The Prince of Wales, K.G., visited Nottingham and made an extensive tour of the works of Boots Pure Drug Co., Ltd. In the same year the firm commenced to manufacture a number of organo-therapeutic products, the first being Insulin. For the manufacture of Insulin on a large scale, the erection of suitable plant and the training of the staff occupied some considerable time. During the period of development, members of the firm's scientific staff visited the Toronto laboratories and learned much of their technique at first hand. Extensive research work is continuously being carried out with a view to decreasing the cost and maintaining a high standard. It is the policy of the firm to issue one quality of Insulin only—the highest obtainable.

The discovery, in 1926, of the treatment of pernicious anæmia by means of raw liver was followed by the use of dry or liquid extracts of liver, which are more palatable and convenient to take than raw liver. Products of this type are issued by Boots Pure Drug Co., Ltd., under the names of

Dry Extract of Liver (Extract Hepatis Siccum, B.P.), Liquid Extract of Liver (Extract Hepatis Liquidum, B.P.), and a special Compound Fluid Extract of Liver, which is very palatable. These have been followed by " Hepastab," which is a specially-prepared extract of liver for administration by intramuscular injection. The treatment with " Hepastab " constitutes one of the cheapest forms of therapy and the clinical results obtained have been exceedingly satisfactory. " Pepsac " (desiccated stomach substance), also used in the treatment of pernicious anæmia, was introduced in 1931 and " Livron," a palatable preparation containing iron in an easily assimmilable form, together with liver extract, malt extract, extract of yeast and other ingredients of therapeutic value, was issued in 1932. " Livron " is indicated in the treatment of secondary anæmias and also as a general tonic. Before issue, anæmia preparations are subjected to searching clinical tests, as at present this is the only available method of assaying potency.

New Antiseptic

Considerable research has been devoted to the development of antiseptics with a high disinfectant power. One of the most important of these, discovered by Boots Pure Drug Co., Ltd., is amyl-meta-cresol, with a Rideal Walker coefficient of 250. This is used in solution as a dental antiseptic and mouth wash and also administered orally in gelatin capsules and as an antiseptic throat pastille with compound glycerin of thymol.

In 1926, in connection with the British Medical Association's annual meeting in Nottingham, special arrangements were made for the many hundreds who attended to visit the works and laboratories. From this time onwards, much attention was given to accessory food factors or vitamins, and the production of pure vitamin D or calciferol is a definite landmark in the progress of the fine chemical industry. Vitamin D is made by Boots Pure Drug Co., Ltd., and used in their own vitamin products, such as "Vitamalt," Reinforced Cod Liver Oil and " Decrose " (glucose with vitamin D).

Turning to the developments which have been made in chemical engineering, it is of interest to note that the firm found it necessary, in 1932, to instal a special plant laboratory for the control and testing of chemical plant and to carry out research work as to the best materials which should be used for certain operations. In the fine chemical department it has been found that silver is the most suitable material for a particular operation, and all the essential parts of the apparatus are therefore made of pure silver. The plant used in this department is, wherever possible, of British manufacture, for experience has proved that British enamelled, stone and silver ware is extremely satisfactory. In 1929 it was seen that the space available at the original Island Street works was fully occupied and it became necessary to erect new buildings with room for expansion. The erection of a new factory at Beeston was commenced, chiefly concerned with the manufacture and packing of liquid pharmaceutical preparations. This building is almost wholly constructed of reinforced concrete and glass, and stands out as a first-class example of industrial architectural art, designed purely on a functional basis.

Revision of British Pharmacopœia

It is of interest to mention that in connection with the preparation of the British Pharmacopœia, 1932, members of the scientific staff of Boots Pure Drug Co., Ltd., served on the British Pharmacopœial Committee and helped materially in its production. They also assisted in the preparation of the new British Pharmaceutical Codex, 1934, and have contributed many papers of scientific interest in chemical journals.

From small beginnings, in 1914, the fine chemical department of Boots Pure Drug Co., Ltd., has been built up with modern plant and equipment. Many difficulties have been overcome and many remain; nevertheless, it is one of the most up-to-date chemical concerns in the Empire.

NEW Zealand chemical imports are chiefly from Great Britain, as working agreements entered into by the Imperial Chemical Industries, Ltd., with the major chemical manufacturers of the world reserve this Dominion for its exclusive exportation. The United States, however, is an important source of supply for sulphur, although competition from Japan is causing a sharp decline in this trade. Imports of American sulphur into New Zealand totalled 30,725 tons in 1932; 24,868 tons in 1933; and only 15,034 tons in 1934.

Continental Chemical Notes

Austria

A SCIENTIFIC EXPEDITION, under the leadership of Professor Mark, of Vienna University, has discovered that glacier ice on the Jungfrau (Switzerland) contains heavy water (deuterium oxide) in 1 : 2,500 concentration, which is double that present in normal ice.

Russia

IN THE MANUFACTURE OF HEXAMETHYLENETETRAMINE a temperature of 25° C. during the ammonia-formaldehyde reaction is recommended by I. A. Arkine (" Revue des Produits Chimiques," March 31). Losses during concentration are avoided by working in a vacuum with a three-stage evaporator.

Germany

BENZHYDRAZINE IS RECOMMENDED as a reagent for vitamin C (" Pharm. Zeitung " *79*, 1207).

COMPLEX COMPOUNDS OF INORGANIC SILVER SALTS and amido derivatives of carbonic acid are reported to offer advantages as silvering preparations. Unlike complex salts, hitherto used, they are stable both in solid and solution form and therefore do not deposit the lustre-diminishing dark silver sulphide. Suitable organic components are urea, thiourea and dicyandiamide, preferably in association with silver nitrate. Although complex bodies of this type have heretofore been applied in electroplating baths, their value as friction-silvering agents was not previously suspected. Admixture with a suitable filler (kieselguhr, talc., etc.) and a trace of acid (to oppose development of alkalinity) is recommended, a specified composition being made up from 15 parts by weight of complex silver nitrate-thiourea compound, 0.3 part tartaric acid, 27 parts kieselguhr and 57.1 parts talc (German Pat. 611,258).

Far Eastern Chemical Notes

China

WOOD CHARCOAL IS LIKELY TO COME into general use as a fuel on the Chinese long-distance motor-bus services, according to the " Chemische Fabrik."

Dutch Indies

ATTEMPTS TO DEVELOP a turpentine and rosin industry on the east coast of Sumatra have not proved successful although turpentine and crude rosin are produced on a moderate scale in the province of Atjeh (Northern Sumatra). The United States is the principal importer of rosin into the Dutch Indies. This trade is on a fairly large scale, nearly 15,000 tons being imported in 1933. Very little oil of turpentine is imported.

Japan

AMMONIUM SULPHATE is being made by a Japanese process by Showa Hiryo K.K. in their works at Ogimachi (Kawassaki district). The same firm produces carbide, oxygen, nitrogen and argon.

A HALIBUT LIVER PREPARATION in pill form containing vitamins A and D is now marketed by Tanabe and Co., under the name of " Haliva,"

AN ELECTROLYTIC PROCESS for extracting casein and lactose from skimmed milk, described by J. Kato (" J. Soc. Chem. Ind. Japan," 1934, No. 4), utilises a three-compartment dialyser. The two end compartments are filled with water and contain respectively a carbon anode and a brass cathode. Adjoining the anode is a chromated gelatine-impregnated silk membrane while the membrane at the cathode is made of similarly impregnated canvas. These membranes oppose passage of lactose towards the central chamber. Strict control is kept of the acidity in the central compartment. During electrolysis (100 volts, 1 amp.), a gradual reduction in hydrogen ion concentration is recorded as the various metallic ions (calcium, magnesium, potassium, etc.) migrate to the cathode compartment while the acidic ions pass into the anode compartment. On approaching the iso-electric point, casein begins to coagulate and is separated in a very pure form by filtration while the filtrate is a lactose solution likewise free from all but traces of mineral salts. Chemically pure lactose is isolated by evaporating in a vacuum, and centrifuging.

Annual Meeting of Imperial Chemical Industries, Ltd.

Sir Harry McGowan and the Arms Inquiry

So far as the present year has gone, said Sir Harry McGowan at the annual general meeting of Imperial Chemical Industries, Ltd., on May 1, business has been satisfactorily maintained, and from such indications as are available of general conditions in this country I am hopeful that we shall continue to see steady progress. Outside Great Britain there was another story to tell. Affairs were neither so settled nor so promising. The general monetary situation was not stable, and there was considerable doubt as to the outcome of the American experiment, which was a struggle between the advocates of monetary inflation and those who trusted to the restoration of enterprise in the course of nature. Until this uncertainty had resolved itself, there was little purpose in discussing measures for the stabilisation of the exchanges, although so long as these were free to move within such wide limits as at present, world trade must remain considerably handicapped. Powerful organisations like I.C.I. could take certain risks and afford a period of waiting, which was beyond the resources of smaller concerns, the aggregate of whose imports and exports, however, was of considerable importance. Sir Harry looked anxiously, therefore, for a new monetary conference at no far distant date.

During 1934, sales had been satisfactory without registering so marked an improvement as during the previous year. The sales machinery of I.C.I. had been overhauled, and closer contact effected between the selling machine and the technical side. The one setback during the year was the decline in the sale of fertilisers—a direct consequence of the poor condition of home farming.

Chemical Production in Japan

A further rapid enlargement of the productive capacity of Japanese chemical works had given rise to increased competition, not only in Japan itself but in other markets overseas. "Following my visit to Japan in the autumn of 1933," Sir Harry said, "I arranged for a mission to proceed there with a view to making arrangements with the Japanese chemical manufacturers to avoid uncontrolled competition with its attendant price-cutting and possibly violent price fluctuations, not only in export markets but in Japan itself. The mission remained in Japan for over three months, but in spite of protracted negotiations unfortunately failed to find a basis for agreement. This was largely due to the uncoordinated state of the industry in Japan and the consequent difficulty of finding a group of men who could speak for the industry as a whole.

"It may be a long time before agreement is reached and, meanwhile, there will be inevitable competition, but Imperial Chemical Industries, with its natural and technical resources, can look forward with justifiable confidence to the future. I must not disguise from you, however, the fact that if we are to hold our existing volume of trade we must meet firmly whatever prices may be quoted against us by the Japanese, notwithstanding the advantage which arises to them through the large depreciation in the value of the yen."

Prosperity of South Africa

Sir Harry announced that he had just returned from a visit to South Africa, where the business of the company was prosperous. The Union was enjoying a period of great prosperity, which depended, however, almost entirely on the gold-mining industry. This industry was most active, and in his opinion likely to continue to be so. It was never more efficient, and, with the lower working costs which followed scientific research, the industry would still be able to mine low-grade ore at a profit, even though the price of gold fell considerably. The improvement registered during 1933 was well maintained in Australia, though the heavy fall in wool prices and the decrease in the wheat yield were occasioning some anxiety.

Sir Harry said that I.C.I. had in hand some hundreds of active research problems, the results flowing from which continued to be satisfactory. Its activities included the production of a new transparent synthetic resin; the development of the successful resin finish, "Dulux"; a process for the removal of dust, smoke and acid constituents from boiler flue gases; measures to increase safety in the use of explosives, particularly in the coal mine; and the introduction of an instantaneous detonating fuse named "Cordtex." In association with other important companies, I.C.I. had taken part in developing the production in the United Kingdom of metallic magnesium, which was of vital importance to the British aircraft industry.

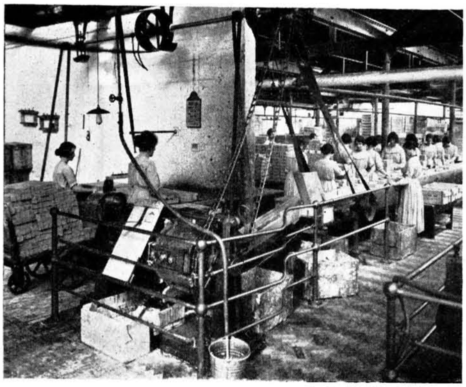
Petrol from Coal Developments

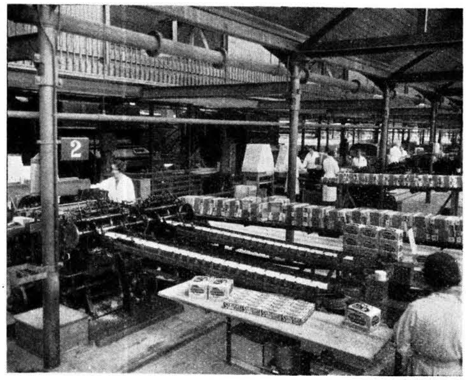
Satisfactory progress had been continued throughout 1934 on the production of petrol by hydrogenation. Up till early this year some four to five thousand men had been directly employed at Billingham on the plant, and a further 8,000 men had, it was estimated, been employed on the same work by outside manufacturers. Since then, the number of men on construction had been steadily reduced, though the operation of the plant itself would involve the direct and permanent employment of over 1,100 men, apart from the indirect employment of miners and others. The capital expenditure on the plant would amount to some £3,000,000 or £500,000 more than the figure given last year. Against this, the plant would have an output capacity of 150,000 tons of petrol per annum, or 50 per cent. in excess of the original estimate. Of this total tonnage, two-thirds would be produced direct from coal and the balance from high- or low-temperature tar oils. The first injection into the plant took place on February 7, since when there had been a steady production of petrol from creosote oil and low-temperature tar. This entry into production within eighteen months from the authorisation of the scheme reflected great credit on the Billingham works. The remainder of the plant was being brought gradually into operation, and the whole, including the stalls treating coal direct, should be working by the end of May. Distribution was being handled by the Shell-Mex B.P. and Anglo-American Oil Companies, and the first cargo of 300,000 gal., equal in quality to the recently improved No. 1 grade petrols, left Billingham on April 10.

I.C.I. and Arms Inquiry

Sir Harry referred to the Royal Commission into the private manufacture of armaments. The matter was *sub judice*, but without in any way anticipating the commission's inquiry or embarrassing its activities, he would like to correct the entirely false impression that I.C.I. was essentially an armaments firm. Only two out of the manufacturing groups of the company were concerned in the manufacture of munitions—military powders and small arms ammunition—and during the last seven years that trade had represented only slightly over one per cent. of I.C.I.'s total turnover and less than one per cent. of its profits. Many I.C.I. factories could be readily turned to the production of war material, and this provided a valuable means of supply in case of the country's need; but the best interests of I.C.I., as of other companies, were served by conditions of peace and not of war. The company was better off with the profits of normal industrial operations than with the sharp peaks of war emergency production. He looked forward to the inquiry with equanimity and confidence. The accusation that I.C.I. entered into arrangements with others for the purpose of provoking wars was too ridiculous for comment.

The sulphuric acid market in Shanghai is being supplied largely by local production. Imports into Shanghai of about 2,700 metric tons in 1928 fell to approximately 100 tons during the first 11 months of 1934. The plants of Major Brothers, Ltd., and the Kai Cheng Acids Manufacturing Company, are considered to be quite capable of taking care of the industrial requirements for Shanghai and its immediate vicinity, reported to be from 3,500 to 4,000 metric tons annually. Other sulphuric acid plants in China include one installed at Siayi in Honan Province, central China, in 1934, and a Government plant at Canton, which has a daily capacity of 15 tons. Total net imports of sulphuric acid for all China fell from 3,000 metric tons in 1932 to 1,300 tons in 1934.





Stamping and packing of soap at Port Sunlight: A contrast between the conditions prevailing in 1910 and 1935.

Progress of Lever Brothers Ltd., 1910-35

Manufacture of Soap, Glycerine and Edible Fats

THE last 25 years have seen marked developments in the industries in which Lever Brothers, Ltd., and their associated companies are engaged. In any general review of the progress made pride of place will naturally be given to soap itself, the principal product of the parent company, though reference must also be made later to many other interests of the firm which have been, and are even more to-day, dependent upon the chemist and upon the chemical engineer for the technical progress which has been made.

The method of soap boiling has not altered fundamentally during the last 25 years, a fact which is readily understandable if consideration is given to the comparatively simple and well-known underlying chemical processes involved. At the same time, scientific investigation has thrown considerable light on the hitherto little-understood physical and other changes which occur during and after the manufacture of soap, and the results have received full application in the general improvement of the product as regards quality.

Still more marked developments of recent years concern the production and pre-treatment of oils and fats, the improvement of plant, and the post-treatment of the finished soap. At the beginning of the twentieth century the control of the quality of oils and fats was a difficult matter, especially as most of these had to be imported into the country. The collection of the fruits and nuts, mainly of tropical origin, and the expression of the vegetable oils, were largely dependent upon untrained native labour. Oxidation of the oils was a frequent source of trouble, and standardisation of materials had by no means been attained.

Cultivation of Oil-bearing Nuts

In 1911 a concession was granted by the Belgian Government to Lever Brothers, Ltd., for the development of nearly two million acres of land for the cultivation of the palm tree (*Elaeis Guineensis*), and early step giving rise to raw material control by the manufacturer, which has since made continual progress. Transportation to-day of vegetable oils, and in certain cases the oil-bearing nuts, is effected in large bulk tanks on specially constructed oil-carrying ships, and mechanical weighing, and handling of these materials on arrival is an important modern feature.

The Bromborough Dock, on the River Mersey, was opened some four years ago, and enables vessels carrying raw materials to bring them practically to the very door of the Port Sunlight and adjacent factories.

The chief advances in oil milling during the last 25 years have been due to improved plant and the more efficient use of existing machinery. Much progress has been made in the efficient preliminary cleaning of seed for crushing, with the result that both the oil and cake are vastly superior to that produced in the early days. In the case of seeds having a very high oil content extended use has been made of expellers for preliminary pressure, and in the most up-to-date mills the use of hydraulic presses has been completely superseded by the extended use of this type of plant.

Synthetic raw materials in the form of fatty acids, which can compete with the natural oils, are not yet available in quantity to the soapmaker, and with one important exception his choice of soap materials has extended little since 1910. The exception is hardened whale oil, and to a lesser extent various hardened fish oils, which from a soapmaking point of view may be considered broadly in the same category. The underlying problem of hydrogenation, in the presence of a catalyst, of these oils, which in their natural state give rise to a soft or liquid soap on saponification, was known in 1910, but little commercal headway had been made at that time.

The Oil Hardening Process

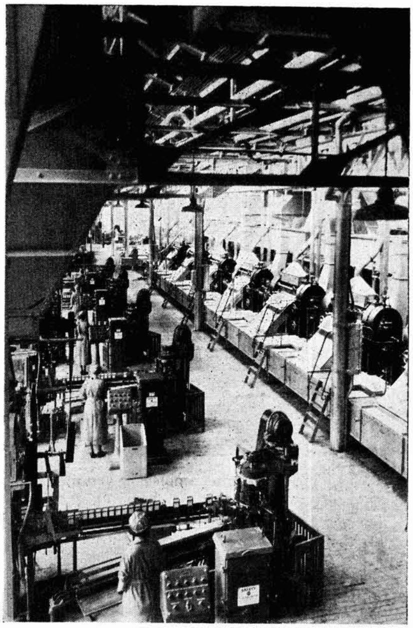
As the result of research work carried out in the company's laboratories, the conditions necessary for the manufacture of hardened oils for use in the soapmaking and edible industries were established. The three most important factors were shown to be the quality of the crude liquid oils, the condition of the catlyst, and the purity of the hydrogen. Whale oil may be cited as an example of a crude oil which has been vastly improved in quality. This has been brought about largely by the establishment of floating factory ships, operating in close proximity to the catching fields, on which the oil can be rendered with minimum delay from the whale by the use of modern machinery.

The chemical composition, the purity, and the physical characteristics of the catalyst for the hydrogenation have formed the subject of a wide field of investigation. Briefly, it may be stated that the usual catalyst employed is nickel in a finely divided state obtained by the reduction with hydrogen at about 400° C. of nickel carbonate, precipitated on kieselguhr from a solution of nickel salt. The purity of the hydrogen used in the hydrogenation is also as important a factor as that of the catalyst and oil, and where hydrogen other than that made by the electrolytic process is used it has to undergo thorough purification to render it free from catalyst poisons. By suitable variation in the condition of hydrogenation, the physical properties of the hydrogenated fat can be controlled to render it suitable for the many applications which are required by the edible and soapmaking industries.

In the matter of refining oils great advances have been made since the beginning of the century in plant construction for the purpose, and, in addition, the use of acid activated bleaching earths has enabled materials of a much higher degree of purity to be obtained. For the production of edible oils deodorisation of alkali neutralised and bleached oils has gradually been improved by the use of higher temperatures and lower pressures, so that a more complete removal of the volatile compounds is now possible. Reference may also be made to the process whereby simultaneous distillation under vacuum of the free fatty acids and of the odoriferous substances is achieved.

Turning now to plant developments directly associated with soap manufacture, the recently-constructed factory of Lever Brothers, Co., at Hammond, in the United States, has provided an opportunity for incorporating in one factory all modern improvements. In particular in the pan or boiling room itself, the ventilation is effected by delivering into it fresh air which has been filtered to ensure the removal of all dust and foreign matter, whilst the steam and vapour rising from the soap pans is withdrawn by means of exhaust fans.

Plant developments and the improved post-treatment of the "cleansed" soap after it leaves the soap pan almost necessarily go hand-in-hand. To a great extent the changes in soapmaking plant have related to the avoidance of impurities derived largely from mechanical contamination, and to improvements in process control. Machinery for the handling of the finished soap has undergone many refinements and improvements. One of the most important of these is the direct drying of the soap in the form of thin ribbons, either for the production of toilet soap or for the purpose of making fine flakes. Modern chemical and engineering research has rendered possible the production of the latter in a form which



Lux Manufacture at Port Sunlight, 1935

dissolves readily in cold water with resulting advantages to the consumer. Improvements in mixing, milling, plodding and stamping have enabled toilet soaps of outstanding quality and appearance to be made. The stamping and cartoning of household soaps has also been mechanised and improved, and a comparison of this operation in 1910 and 1935 is shown in the photographs. A modern milling lay-out is laso illustrated. Other directions in which great strides have been made are to be found in the mechanical handling, measuring, weighing, filling and cartoning of flake and powder products.

Before leaving the subject or soap, reference may be made to recent advances in the study of the physico-chemical properties of soap, both solid and in solution. Microscopic examination of soap by means of polarised light has shown that molten sodium soap solidifies on cooling from two main causes. Fibres grow into and through the fluid crystalline mass, and the fluid crystals, of which the liquid soap is composed, themselves take on a certain amount of solidity and rigidity.

Next to soap itself, glycerine is perhaps the most important product of the soapmaker, and here again technical advances are numerous, not only in the methods of recovery, but also in the quality of the product and the extension of the uses to which glycerine is applied. As an example of the latter, glycerine now forms the basis of a non-corrosive anti-freeze for use in motor car radiators and allows the motorist carefree use of his car throughout the winter. By the addition of 25 per cent. of the preparation to the water in the cooling system, the car can be kept, without fear of cracked cylinders, at any temperature likely to be met with in this country. Within recent years economic methods of production of the glycerol ethers, which form an important class of glycerol derivatives, have been worked out. These compounds are powerful solvents for nitrocellulose, gums, and other lacquer constituents.

Manufacture of Edible Fats

Turning now to edible products manufactured by associated companies of Lever Brothers, Ltd., no branch of the oils and fats industries has made greater progress during the 25 years since 1910 than has the margarine industry. In 1910 margarine was already an established product of recognised usefulness in the national larder, and the intervening years have been memorable for an expansion and progress which have been uninterrupted in every branch and phase of the industry. The process of manufacture has to-day reached such perfection that the materials in process and the final product are untouched by human hand.

One outstanding achievement by Lever Brothers in the margarine industry, is the inclusion of the fat-soluble vitamins in margarine. Already in 1910 there were indications that although all edible oils and fats were in themselves interchangeable so far as nutritive value went, some fats carried additional "accessory food factors" which later came to be called the fat-soluble vitamins A and D. The number of edible fats naturally rich in these vitamins was quickly found to be very limited and to exclude practically the whole range of vegetable oils and fats.

In the early years, knowledge was accumulated slowly, but the problem was not lost sight of even during the war period, though the main energies of the industries were concentrated in other directions. Suitable sources of supplies of the necessary vitamins had to be discovered. In 1925 the first indications of a practicable solution were obtained, and by 1927 certain brands of margarine marketed by an associated company of Lever Brothers, Ltd., were certified to contain both vitamins A and D in as high a proportion as in summer butter. In the early days the output of vitamin margarines was small, but progress has been steady, until at the present time vitamin margarines are the standard production of all the Unilever factories in this country.

Research Organisation.

Some reference to the research organisation of the company will be of interest. Research work is carried out in three stages, first the laboratory, then the semi-large scale, and finally the development stage, the latter stage representing actual factory conditions. Other sections of the research organisation comprise the sales service laboratory and the nutrition laboratory. In the former, the examination of products is conducted, with particular reference to their behaviour during use in the home and in the laundry. Domestic study, as well as scientific examination, is essential in order to provide information necessary for sales and advertising.

Finally, the progress made by the company in the last quarter of a century can well be illustrated by a few statistics. In 1910 there were 20 factories; in 1935 there are 118. The number of shareholders has grown from 8,643 to 173,000; the issued capital from £6,220,458 to £59,369,584; the profits from £637,239 to £6,302,875. The soap sales have mounted in value from £4,300,000 to more than eight times that sum; the money spent on the comfort, health and future of employees has multiplied itself ten-fold. Lever Brothers—in this Jubilee year—take pride in the fact that, in 1910, as soapmakers to their late Majesties Queen Victoria and King Edward VII, they received the honour of appointment to King George V, who, in 1914 with Queen Mary, paid the most memorable of all the Royal visits with which Port Sunlight has been honoured.

Meters and Boiler Control Equipment

Progress of George Kent, Ltd.

His Majesty the King visiting the works of George Kent, Ltd., November 1917.

To obtain a proper perspective of the progress of the firm of George Kent, Ltd., during the reign of His Majesty King George V, it is necessary to take a brief survey of the previous history of the business, which was started nearly one hundred years ago by Mr. George Kent, who died in 1890. Mr. George Kent was the pioneer of domestic labour-saving inventions, and his name is, or was, most widely known in connection with the rotary knife-cleaning machine, which he patented in 1842, and which enjoyed a wide vogue until the coming of one of the inventions of the last 25 years—stainless steel. He was also among the first to introduce the domestic refrigerator, or ice safe, in furtherance of which aim he chartered ships to bring cargoes of ice from Norway to England.

This business was started about the year 1838 and, with these and other developments, grew and expanded until 1883, when, by the initiative of the manager, Mr. J. W. Sutton, the scope of the business was extended by the inclusion of water meters. This, at first, consisted of an agency for the German firm, Meinecke, but, attracted by the excellence of a meter working on the rotary piston or semi-positive principle, its patent was bought from an American of the name of Walker, and a commencement was thus made of the engineering side of the business, which was destined before long to outgrow the domestic labour-saving side and eventually to become all-important.

It is rather difficult to give any intelligent description of the way in which several branches of science were drawn into the scope of the business without some brief reference to the marvellous change that has occurred in the scientific and mechanical expansion of the whole of our everyday existence. In 1910 the engineering side of the business was almost exclusively confined to the measurement of the flow of water, no matter in what volumes.

Measurement of Air by Venturi Principle

The Venturi meter, the invention of Mr. Clemens Herschel, of America, largely based upon the research work and discovery of nature's laws with regard to flowing water by Giovanni Battista Venturi, of Reggio (Italy), one of Napoleon's deputies in Italy, was added to the firm's manufacturers in 1893. In 1908 the attention of the research department of the business had been directed to the possibility of using this Venturi principle for the measurement of air. Despite the difficulties presented by the effects of temperature and compression, this was successfully accomplished, and the whole air supply to the Rand Mines from the Victoria Falls Power Co. was measured and paid for according to the records of Venturi meters, which automatically corrected for these disturbing factors, and recorded the quantity delivered in terms of volume at a specified temperature and pressure, no matter what these last two factors had actually been.

From this beginning, the measurement of many other gases, and also of steam, was successfully accomplished and a prospect of substantial trade was opened out. Then, in 1914, came the great war, when offers were made to the Government to utilise the manufacturing resources of the company to assist in the production of munitions. These offers were accepted, and the firm was among the first of those not previously engaged in the manufacture of armaments to help fill the void in the insatiable demand for more and more.

As the years went on, pre-war productions were dropped one by one until, by the end, the whole premises were occupied in helping to supply the great national need. In addition to the ordinary works at Luton, covering some eight acres, a filling works was provided, covering 28 acres of ground, and the total number of employees rose to 8,000. In 1917 the firm was honoured by a visit from H.M. The King, who toured the works and inspected the production of munitions.

Post-War Activities

After the war came the difficult problem of restoring normal trade. This had lain very largely abroad, particularly in South America, and the manufacturers of the United States and others had not been slow to avail themselves of the opportunity provided, and had annexed most of the markets which formerly were practically a monopoly of the firm. The oil industry called not only for the measurement of oil, the viscous nature of which introduced many new problems, but also for the control of flow, pressure and of temperature; the separation of the gases given off at a change of pressure also required special apparatus. For the control of temperature a very delicate piece of mechanism was designed which would control accurately within 1° F.

In boiler control, many contributory factors have to be taken into account: for instance, forced draught, induced draught and the rate of coal supply. All these are automatically governed through the instrumentality of the master controller, the result being that a constant steam pressure is maintained to within 1 per cent. in spite of all variations of load.

H.R.H. the Prince of Wales, during a visit to Luton in 1926, made a thorough tour of Kent's works and showed great interest in all the processes.

It would not be right to close this description without a brief reference to the great change that has occurred in the methods of manufacture. While, before the war, a form of mass production was employed for the purposes of the small meter output, the general method may be described as that of individual manufacture, and the machine tools employed were, with few exceptions, of corresponding general purpose type. To-day all is changed and nearly all productions are made on the mass system, with most scientific and up-to-date instruments and appliances.

Developments in the Making of Wooden Vats and Tanks

Carty and Son, Ltd.

THE history of Carty and Son, Ltd., the vatmakers, of Peckham, stretches back over the last 170 years. While this firm cannot claim any associations with royalty, it is of interest to note from a 1799 ledger in their possession that a complete set of brewing vessels was supplied to the Archbishop of Canterbury. A glance at the opposite side of the account reveals that His Grace helped himself to an exceedingly plural number of months' credit before paying for same, and that when he finally did so, he removed the odd 2½d. from the bill. In both actions he was, of course, only following the charming custom of the times!

In some respects Carty's business has been remarkably steady and unchanging. The same 1799 ledger shows business done with a number of customers who have continued to place orders steadily right up to the present day; for example, J. C. and J. Field, Ltd., of Lambeth. In this case the modest "back" of 1800 has become the 15-ton soap-splitting vat of 1935. In other ways the character of the business has changed. The most noticeable feature is the growth of the volume of wooden vats and tanks required by the chemical industry in all its many branches. Twenty-five years ago, Carty's chief business was with brewers and distillers, the chemical industry coming a bad second. Now the chemical department has been greatly swollen by the requirements of such essentially modern industries as artificial silk, which requires acetic acid vats; developer tanks for the film industry; brine tanks for water softening plant; paddle tanks for fur dressing; and new shapes in vessels for the dye trade.

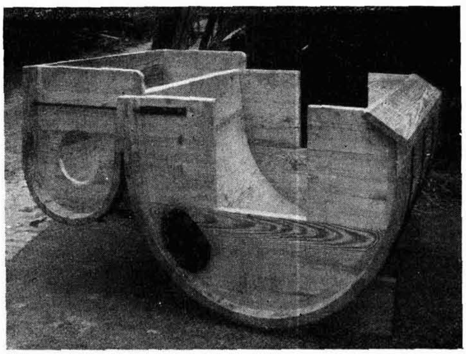


Fig. 1. Double U-Shaped vessel for paper trade.

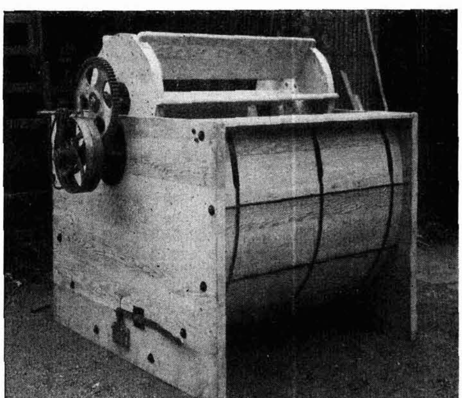


Fig. 2. Skin-dressers' paddle tank.

The colour and dye manufacturing industries have extended their activities in a remarkable way over the last decade, and a colour-making tank of 20,000 gallons capacity has been recently erected.

Wood vessels have now-a-days to stand up to drastic and intensive processes which would have been considered an impossible proposition not so very many years ago. For instance, unlined tanks as made by Carty's from heavy pitch pine timbers, bolted with acid-resisting bronze bolts, successfully withstand a 10 per cent. solution of sulphuric acid, continuously boiling, with a drastic inhibitor.

Empire timbers have claimed much attention in recent years for vat making. The vatmaker now-a-days is called upon to make watertight wooden vessels in all sorts of queer shapes to suit special processes. Such a vessel, when fitted up with gear, exceeds the normal function of a vat: it becomes part of a machine. It is not always realised what odd shapes of wooden vessels can be made, if necessary. Fig. 1 shows a special shape of vessel used in the paper-making trade. Fig. 2 illustrates a skin-dressers' paddle tank.

The one feature of Carty's vats and tanks that has not changed with the passing of the years is their high standard of quality. Primarily the vatmaker expects the liquid contents of a vessel to assist, by swelling up the timber, in making the joints tight. Now-a-days vats have to hold acids and alkalies which not only do not swell the timber but have a definitely astringent effect on it. Thus it is more than ever essential that the timber should be the best obtainable, thoroughly seasoned, and with all natural defects strictly eliminated. It is careful attention to this, together with experienced workmanship, that has gained and retained for Carty's their reputation and success.

Fine Chemical Manufacture

Howards and Sons, Ltd.

THE past 25 years have been remarkable for the impetus given to the fine chemical trade through the cutting off of supplies from the Continent during the world war. Aspirin and salicylates, formerly a monopoly of the German maker, have rapidly increased in volume and are to-day made by Howards and Sons, Ltd., in enormous quantities and sent all over the world. The fine chemical industry has progressed so much in this country that in Howards' factory alone during last year 2,151,751 lb. of products were manufactured, none of which were made previous to 1918.

During the last 25 years Howards have commenced the manufacture of numerous new products, among them salicylic acid and aspirin, which were first put on the market in 1916; hydroquinone (1920); hydrogen peroxide, isopropyl alcohol (1921); synthetic menthol (1922); calcium lactate (1923); synthetic thymol, cyclohexanol and methyl hexanol and their acetates (1924); cyclohexanone (1925); methylcyclohexanone (1926); diacetone alcohol (1927); ethyl lactate (1928); paraldehyde (1930); lactic acid B.P. (1931); edible lactic acid (1934).

Thomas Tyrer and Co., Ltd.

The high reputation of "Sterling Brand" chemicals manufactured by Thomas Tyrer and Co., Ltd., is the result of ninety years' manufacturing experience. Special attention has always been paid to the manufacture of carbonate, subnitrate, salicylate and other bismuth salts, as well as to the manufacture of preparations in scale form. For the analyst and the research chemist the company produces analytical reagents to pass any required specification, whether it be an existing recognised standard or a specific requirement for a special purpose. Among the chemicals manufactured by Thomas Tyrer and Co., Ltd., for the oil and colour industry, special mention should be made of cobalt siccatives, aluminium stearate, manganese and lead salts and the nickel salts used for the catalytic hydrogenation of oils for soaps and edible fats.

From Week to Week

MR. WILLIAM JAMES PARKER, of Winsford, general manager of the Salt Union, Ltd., at Winsford, left £8,752.

ALDERMAN THOMAS RICHARD HEWLETT, founder of the Anchor Chemical Society, died in Manchester on April 29, aged 79.

MR. A. MCKINSTRY, managing director of Babcox and Wilcox, Ltd., has joined the board of Utilities Corporation (Poland), Ltd.

A NEW VITAMIN has been discovered by two workers at the Biochemical Institute, Copenhagen University, Mr. H. Dam and Mr. F. Schönheyder, and is to be called vitamin K.

A FIRE BROKE OUT on April 29, at the chemical works of Major Bradley and Co., Miles Platting, Manchester, and destroyed a large part of the premises.

THE POST of the Government Industrial Surveyor, Delhi, has been abolished and a new post has been created under the designation of the Superintendent of Industries, Delhi.

THE MOND NICKEL CO., LTD., will on August 1 redeem the whole of its outstanding 5½ per cent. mortgage debenture stock at the rate of £103 for every £100 stock held, plus accrued interest.

MR. J. L. MENNELL, a well-known Canadian consulting engineer, died on April 14 at Toronto. Mr. Mennell was a member of the Institutute of Mining and Metallurgy and of the American and Canadian Institutes of Mining Engineers.

THE PHOTOGRAPHS reproduced in the article by Mr. J. B. Green, on "Filter Papers for Laboratory Use," in THE CHEMICAL AGE last week (page 370) are the copyright of J. Barcham Green and Son, and were published by their special permission.

THE HOME BEET DEFENCE COMMITTEE, which was recently appointed at the Sugar Beet Conference, has elected Lord Cranworth as chairman and Mr. S. O. Ratcliff as vice-chairman. Mr. F. S. Graff was appointed secretary, with Mr. G. F. N. Battle as assistant secretary, with offices at 45 Bedford Square, London.

LORD BARNBY has tendered his resignation as chairman of the Wool Industries Research Association. The Council has elected in his place, Mr. Henry S. Clough, of Robert Clough (Keighley), Ltd., who has been chairman of the research control committee of the Association since its formation in 1918.

PROFESSOR PETER KAPITZA, formerly a member of the Cavendish Laboratory team of scientists working with Lord Rutherford, and latterly director of the Royal Society Mond Laboratory, has been "retained" by the Russian Government and appointed director of a new research station which is being built at Moscow.

IT IS REPORTED that all rights in the "Coley Process" for the treatment of zinc and other ores, at present shared by the Zinc Manufacturing Co. and the N.C. Metal Co., will in future be vested in one company. Mr. H. M. Brand, secretary of both Zinc Manufacturing and N.C. Metal, neither confirms nor denies this report.

THE ANNUAL CONFERENCE of the Working Association for Combating and Preventing Corrosion, of which the Society of German Chemists (Verein deutscher Chemiker e.V., Berlin W 35, Potsdamer Str. 103a) has the secretarial direction for this year, will be held at Berlin on November 18 and 19, 1935. The subject chosen for discussion is "Corrosion from Water." In connection with this subject the question of corrosion from salt sea-water will also be discussed.

THE EXHIBITION OF WELDING, which is being held at the Science Museum, South Kensington, May 2 to 15, has been organised by representatives of companies engaged in the welding industry in Great Britain. The exhibition is accompanied by demonstrations of welding, which will be held between 11 a.m. and 1 p.m., and 3 p.m. and 5 p.m., weekdays, and films of welding will be shown every afternoon in the museum lecture theatre.

THE IRISH FREE STATE GOVERNMENT has announced that the sites of its first five industrial alcohol distilleries will be at Cooley (Co. Louth), Carrickmacross (C. Monaghan), Carndonagh and Letterkenny (Co. Donegal) and Ballina (Co. Mayo). Plans for the erection of these factories are now being drawn up and work will start in June. The cost of industrial alcohol production in the Irish Free State cannot yet be ascertained since the Government does not propose to fix a price for potatoes until shortly before the distilleries begin to operate.

APPARATUS FOR PURIFYING the chimney gases of the new power station at Fulham has been approved by the Government Chemists' Committee appointed to examine it. A pilot plant, on which the final installation is to be based, was erected at Billingham, and a number of tests conducted to decide its efficiency for absorbing sulphur fumes from flue gases. The committee reports that "little or no smell of sulphurous acid could be detected at the top of the scrubbing-tower—a delicate test. While we are satisfied with the performance of this pilot plant, it is clear that care will have to be taken to ensure uniform division of the gas in a large block of absorbers consisting of many units."

THE BRITISH ALUMINIUM CO. has given £250 to King George's Jubilee Trust.

MR. CALVIN FROST, of Newport, Mon., for many years manager of the Newport Chemical Works, has died, in his 80th year.

MR. ALFRED I. DUPONT, formerly head of the firm of Dupont de Nemours and Co., died at Jacksonville on April 29.

OIL-FILTRATION for the small user was described on April 30, at the Waldorf Hotel, London, when the stream-line filter of Dr. Hele-Shaw was demonstrated.

THE KING has conferred his Patronage on the 54th annual meeting and conference of the Society of Chemical Industry which takes place in Glasgow from July 1 to 6.

THE AMALGAMATED SOCIETY OF DYERS, BLEACHERS, FINISHERS, AND KINDRED TRADES is to hold its 27th annual delegate meeting at Blackpool on May 11.

THE SUGAR BEET INDUSTRY DEFENCE COMMITTEE has formed a sub-committee for the York area, and it is intended to organise a mass meeting of protest against the suggested withdrawal of the subsidy.

ENTRIES for the fifth annual CHEMICAL AGE Lawn Tennis Tournament closed this week, and the draw for the first round was being made at the time of going to press. Full particulars of the draw will be published next week.

SIR JOHN CADMAN, chairman of the Anglo-Persian Oil Co., is to give a lecture before the Institute of Fuel on "The History and Construction of the Iraq Pipe Line," at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, on May 21, at 6 p.m.

THE HONORARY LL.D. degree of Liverpool University is to be conferred on Professor Arthur Harden, F.R.S., until recently director of the biochemical department of the Lister Institute, and Dr. Nevil Vincent Sidgwick, F.R.S., president-elect of the Chemical Society.

THE IMPORT DUTIES ADVISORY COMMITTEE has received an application for the addition of iodine to the free list. Representations should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, Westminster, London, S.W.1, not later than May 23.

THE PHARMACEUTICAL SOCIETY announces that in the examination for the Diploma in Biochemical Analysis, held at Edinburgh last month, the following candidates were successful:—Bain, Mary M'Dougall; Benzie, A. C.; Campbell, C. H.; Dalziel, C.; Gibbon, G. R.; Johnson, E. J.; Robertson, J. A.; Watkins, R. S.; Young, C. B.

LIEUT.-COLONEL J. B. BUTLER, a director of William Butler and Co. (Bristol), Ltd., chemical manufacturers, died at his residence, The Grove, Stoke Bishop, Bristol, on April 30, in his 78th year. Colonel Butler was a Deputy-Lieutenant of Gloucestershire, a former member of the Bristol Town Council, a magistrate for the city of Bristol and a prominent Freemason. The funeral takes place to-day (Saturday).

PROFESSOR H. BRERETON BAKER, F.R.S., who was president of the Chemical Society in 1926 and 1927, died at his home at Gerrards Cross on April 27, aged 72. Professor Baker, who was Lee's Reader in Chemistry at Oxford and Emeritus Professor of Chemistry at the Imperial College of Science and Technology, did a good deal of chemical research during the war, particularly in regard to defence against gas attacks.

THE BOARD OF TRADE has appointed a committee consisting of Sir Geoffrey Ellis (chairman), Brig.-Gen. Sir Harold Hartley, Mr. W. Benton Jones, and Sir Allan Powell, to consider the position that will arise on the expiry, on August 19, 1936, of the duties imposed under Part I of the Safeguarding of Industries Act, 1921, as amended by the Finance Act, 1926. Mr. W. H. L. Patterson, Board of Trade, Great George Street, London, has been appointed secretary to the committee.

THE RAMSAY MEMORIAL FELLOWSHIPS TRUSTEES will consider at the end of June, applications for a Ramsay Memorial Fellowship for Chemical Research. The value of the Fellowship will be £250 per annum, to which may be added a grant for expenses, not exceeding £50 per annum. Particulars as to the conditions of the award are obtainable from the Secretary of the Ramsay Memorial Fellowships Trust, University College, London.

THE FIRST TEAM of Johnsons and Sons, Ltd., manufacturing chemists, Hendon, were successful in winning the Bristow Cup (London Business Houses A.S.A. Netball Section) (16-9) in the second division on April 27. The runners-up were Standard Telephones (Woolwich). This is the first year the team has entered. The team was Miss F. Fine (capt.), H. Greaves, E. Fine, D. Cain, L. Gowlett, K. Weyda, N. Hosier. Miss W. Wright, who is the hon. secretary of the London Section of the British Association of Chemists, is chairman of the netball section of Johnson & Sons' recreation association.

INTERNATIONAL COMBUSTION, LTD. (Grinding, Screening and Filtering Division), report having received orders for England covering a 3 ft. dia. Raymond air separator for withdrawing wood charcoal dust from existing shaker; 150 sq. ft. Rovac filter to deal with a by-product from a cement works; two 4 ft. by 5 ft., 1 surface, type 31, Bummer electric screens for screening clay; Ro-tap testing sieve shakers for testing purposes. Orders for abroad include a number of 3 ft. by 18 in. and 4 ft. 6 in. by 16 in. Hardinge ball mills for grinding gold ore; a 3 ft. by 18 in. Hardinge ball mill and 2 ft. dia. Andrews deslimer to grind and overflow gold ore; a 5 ft. dia. Andrews deslimer and 3 in. acid type grit pump for handling phosphate; a 3 in. grit pump for pumping quartz sand.

THE PORTUGUESE CHEMICAL INDUSTRY continued its expansion in 1934, and progress was especially good in the production of fertilisers and cosmetics, according to Consul John B. Faust at Lisbon. The output of fertilisers increased by 19 per cent. over 1933. Little attempt is made to manufacture fine chemicals, but the local industry will probably continue to produce an increasing percentage of the nation's requirements of heavy chemicals. Production of matches amounted to 7,322,266,000, of pyrites to 205,670 metric tons, fertilisers to 225,285 tons, and copper sulphate to 7,741 tons, in 1934. No figures for the year 1934 are available on production of rosin and turpentine but exports showed considerable expansion, to 32,509 tons and 6,193 tons, respectively.

Prices of Chemical Products

The Week's Market Conditions

WITH the exception of the items mentioned below, the prices of chemical products remain as reported in THE CHEMICAL AGE last week (pages 382-383). Unless otherwise stated the prices quoted cover fair quantities net and naked at sellers' works.

After a quiet spell over the greater part of last week the Manchester chemical market is now more or less normal and a moderate volume of new business, some of it extending over the next two or three months and covering a fairly wide range of products, has been reported. The improvement in the unemployment position has created a fairly cheerful undertone and there is a disposition to take a favourable view of the outlook. On the whole, sellers have little of which to complain from the point of view of deliveries of the leading heavy materials against contracts, although an expansion in the textile position both in this area and in West Yorkshire would be welcome. Meanwhile, prices are steadily maintained in most directions. Among the by-products, carbolic acid and creosote oil are firm and fairly active, but in most other respects quiet conditions are reported this week in this section of the trade.

There is a definite improvement for the better in the Scottish heavy chemical market.

General Heavy Chemicals.—SODIUM BISULPHITE POWDER, 60/62%, £20 per ton.

Pharmaceutical and Photographic Chemicals.—MENTHOL, synthetic, 10s. per lb.; synthetic detached crystals, 8s. 3d. to 10s.; liquid (95%), 6s. 6d.. SODIUM SULPHITE, anhydrous, £26 to £28 per ton.

Perfumery Chemicals.—AMYL CINNAMIC ALDEHYDE, 6s. 9d. per lb. ANETHOL, 21/22° C., 4s. 6d. per lb. CITRAL, 8s. 3d. per lb.; ETHYL PHTHALATE, 2s. 6d. per lb. HELIOTROPINE, 6s. 6d. per lb. MUSK AMBRETTE, 16s. per lb.; KETONE, 15s. per lb.; XYLOL, 5s. per lb.

Essential Oils.—ANISE, 2s. 6d. per lb. CITRONELLA, Java, 1s. 7d. per lb.; Ceylon, 1s. 5d. per lb. LEMON, 5s. 9d. per lb. OTTO OF ROSE, Bulgarian, 50s. per oz. PEPPERMINT, Japanese, 4s. per lb.; Wayne County, 13s. per lb.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Australia.—The British Trade Commissioner at Melbourne reports that the Melbourne City Council is calling for tenders, to be presented in Melbourne by June 17, 1935, for the supply, delivery and erection of boiler plant, consisting of water tube boiler, superheater, pulveriser, etc. (Ref. G.Y. 15088.)

Belgium.—A firm of importers and exporters established at Liége wishes to obtain the exclusive representation, on a commission basis, of United Kingdom manufacturers of scientific instruments and apparatus (medical, physical, chemical and meteorological); resistance measuring equipment. (Ref. No. 392.)

United States.—A firm in New York desires exclusive agencies, on a commission or outright purchase basis, according to commodity, for the States of New York, New Jersey, Connecticut, Delaware and Pennsylvania, of United Kingdom exporters of raw chemicals and raw materials for the paint, varnish, bakery and confectionery trades—especially shellac, waxes, oils, greases, glycerine, gelatine, fruit, nuts and essences. (Ref. No. 400.)

Canada.—A firm of importers and manufacturers' agents selling colours and chemicals to the wholesale and retail trade throughout the Dominion are prepared to represent United Kingdom manufacturers of heavy chemicals of all types, either on a commission, purchase or consignment basis. (Ref. No. 386.)

Company News

Tomaszow Artificial Silk Works.—Payment of 7 per cent. on account of the profits for 1934 is announced against 4 per cent. last year.

Rubber Regenerating Co.—An interim dividend of 2½ per cent., less tax, in respect of the year to September 30, 1935, has been declared.

A. Boake Roberts and Co.—Payment is announced of a fourth interim of 1 per cent. net, making 6 per cent. to date. Last year's interims totalled 8 per cent. net and the final was 2 per cent.

Broken Hill South.—A dividend of 7½ per cent. has been declared payable in Melbourne on June 15, making a total of 25 per cent. to date. For the year to June 30 last, a total of 25 per cent. was paid.

Tate and Lyle, Ltd.—It is announced that a scrip bonus is to be distributed among the ordinary shareholders of the company. An extraordinary meeting is to be held on May 9, at 11 a.m., at Southern House, Cannon Street, London, to consider resolutions to increase the capital from £4,500,000 to £6,200,000, by the creation of 1,700,000 new ordinary £1 shares, and to capitalise part of the general reserve.

Eastman Kodak Co.—The report for the year to December 29, 1934, shows an income from operations of $22,668,650, against $18,576,983; interest, etc., $1,256,664; net profits on sales of securities $470,214; other income $182,151, making a total income of $24,577,679. After allowing for depreciation $6,022,173; tax reserve $3,173,929; other charges $878,328, there is a net profit of $14,503,247, excluding net gain of $1,550,045 on delivery of silver bullion to U.S. mint, earned surplus at beginning of year $76,595,940, and adding net profit, deducting preferred and common dividends, there is a surplus of $80,600,101.

British Oxygen Co., Ltd.—A final dividend on the ordinary stock of 11 per cent., making 15 per cent. for the ear, is announced. Last year the final was 6½ per cent., making 9 per cent. Profits, after providing for depreciation, were nearly doubled in 1934 at £359,979, compared with £186,399 for the previous year. General reserve is increased by £75,000, against £25,000 a year ago. The directors state that they are satisfied that the investments in subsidiary companies in the aggregate are worth considerably more than the figure at which they appear in the balance-sheet, but in view of the fact that some of the company's holdings were acquired at a premium, it is the intention of the directors that such shares shall be written down, and it is proposed that a sum of £25,000 be provided for this purpose. The amount carried forward is reduced from £45,171 to £21,983.

Forthcoming Events

May 7.—Institution of Civil Engineers. "Geophysics." Professor Owen Thomas Jones. 6 p.m. Great George Street, Westminster, London.

May 8.—Institute of Metals. Annual May Lecture. "Atomic Arrangements in Metals and Alloys." Professor W. L. Bragg. 8 p.m. Institution of Mechanical Engineers, Storey's Gate, London.

May 9.—Oil and Colour Chemists' Association. Annual general meeting. 30 Russell Square, London.

May 9.—Institute of Chemistry. Annual general meeting. Belfast.

New Companies Registered

Knapman Brothers, Ltd.—Registered April 1. Nominal capital £5,000. Manufacturers of and dealers in paints of all kinds, varnish, enamel, polish, lacquer, shellac, cellulose, size, pigments, compositions, oils, colours. Directors: Theophilis B. Knapman, Philip R. Knapman, 8 All Saints Road, Clifton, Bristol.