The Chemical Age 7 March 1953

WITH METALLURGICAL SECTION

The Chemical Age

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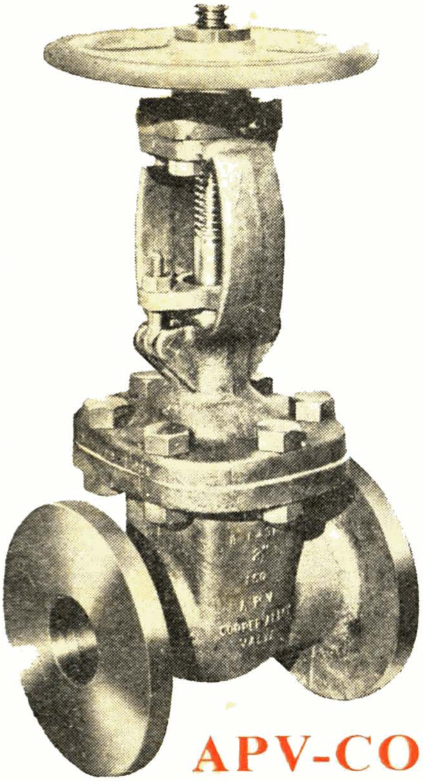

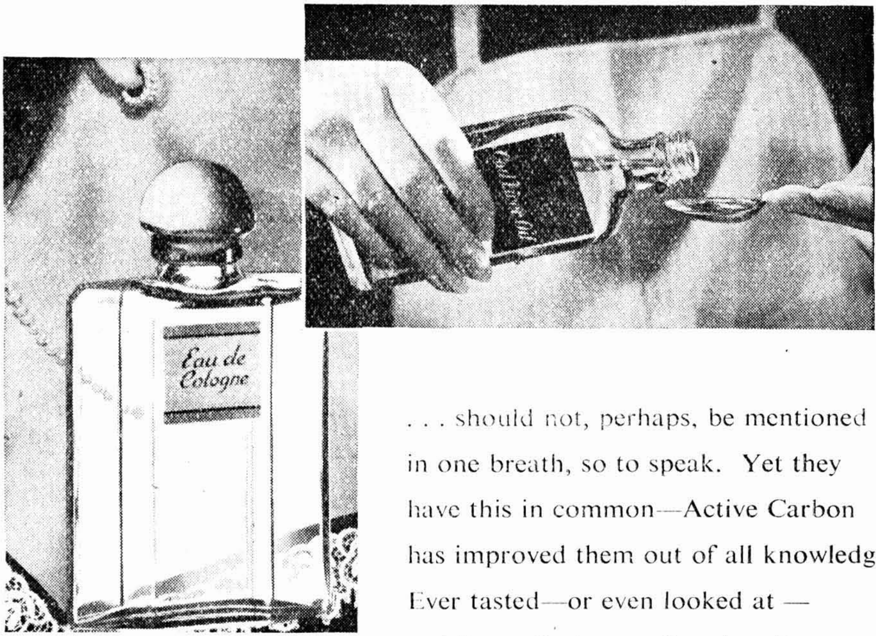
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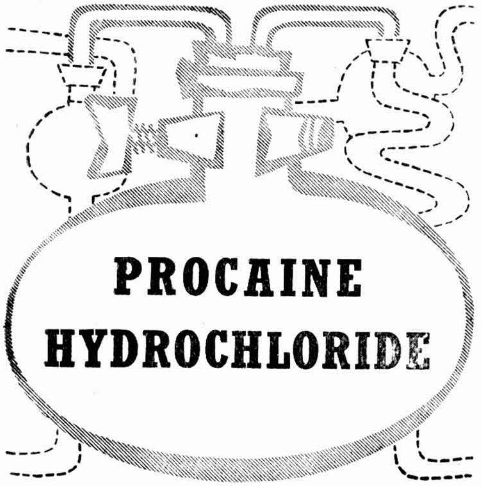
INDEX TO ADVERTISERS IN THIS ISSUE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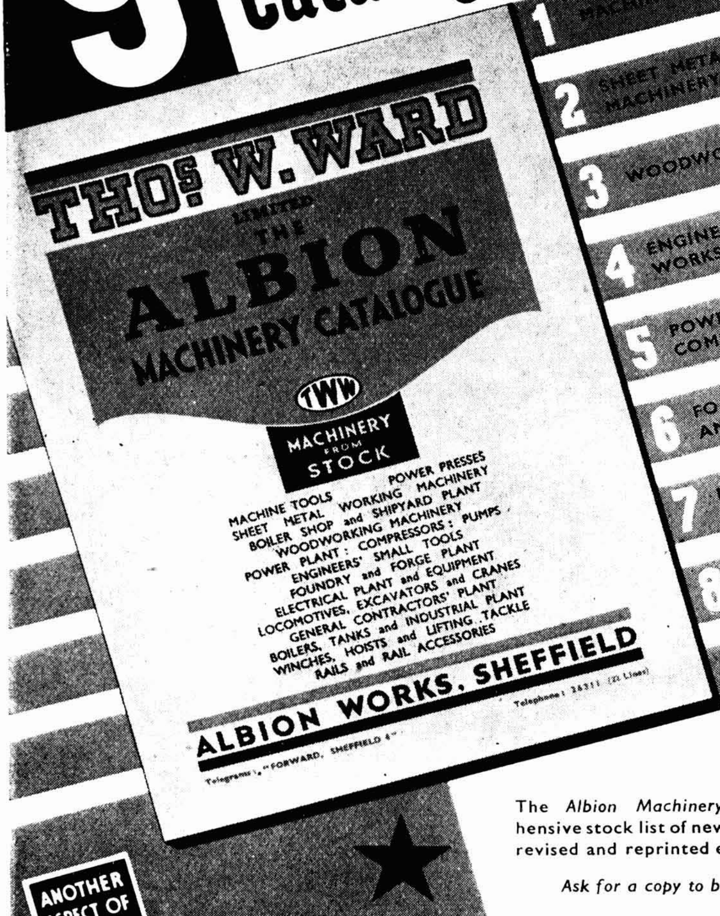

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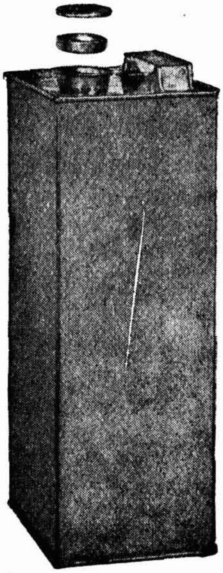

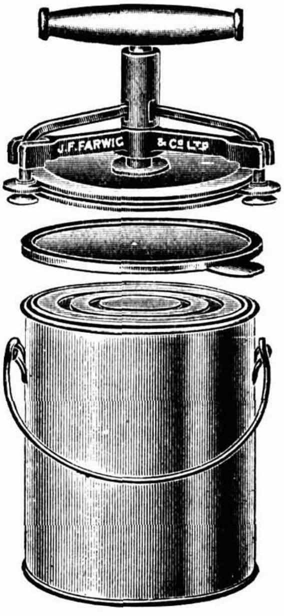
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The
Chemical Age

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The American Picture

ANY one attempting to assess the progress of the British chemical industry is obliged to deal in broad terms and hopeful guesses. As the 'Heavy Chemicals' team of the Anglo-American Council in Productivity has said, statistical information is not readily available here. The difference in outlook on the two sides of the Atlantic is shown very sharply by a new article in *Industrial and Engineering Chemistry* (1953, **45,** 2,322), a survey of current trends in the U.S. industry. It is said by the author, Frank J. Soday, that 'the chemical industry is so large and has become such an intimate part of our great industrial machine that accurate statistics cannot be had.' That may be true enough from an American viewpoint, but to an English reader the article seems replete with data and percentages. No one in Britain could make a similar survey without the most exhaustive research and many resistant gaps would have to be bridged by assumptions.

The American chemical industry now accounts for at least 20 per cent of all industrial production in the U.S. The principal period of expansion was not during the war but after; assets, sales, output, and profits all increasing by 100 per cent or more in 1946-49. Today another phase of expansion, stimulated considerably by the Korean spark to re-armament, is in vigorous swing. Synthesis holds the throne. Over 75 per cent of drugs and medicinal chemicals are synthetic. Only 5 per cent of the 2,300,000,000 pounds of plastics produced in 1952 was based on natural gums or resins. Sixty-five per cent of the rubber used and over 20 per cent of the textiles used are synthetic. The estimated production of synthetic detergents in 1952 was almost 1,200,000,000 pounds; by 1954 it should be 3,000,000,000 pounds and accounting for 80 per cent of the domestic market. 'Some 50 per cent of sales in many chemical companies comprises products developed during the past 10 years.'

Some chemicals are making particularly spectacular advances. From 1951 to 1953 chlorine production capacity will have jumped from 2,100,000 to 3,400,000 tons per year. Benzene, in serious undersupply for some time, is expected to be used by 1955 at an annual rate of 400,000,000 gallons. From 1951 to 1952 production rose by 50 per cent mainly through the rapid development of petroleum processes for benzene. Though 1952 total output was only about 270,000,000 gallons (one-third from petroleum and two-thirds from coal), it is confidently expected that by 1955 supply and demand will be in balance; if so, the output of benzene from oil will have risen to at least 200,000,000 gallons. Phosphorus is the fastest growing inorganic commodity. Petrochemicals already form 25 per cent of all chemicals being produced in America, yet the industry is only 25 years old. Within 10 years it is predicted that the 25 per cent will become 50! Much of the new expansion in U.S. chemicals has taken place in the South because it pays better to be close to the petroleum fountainhead for chemical intermediates. Will the oil last? What would happen to the massive and still fast-growing chemical invasion of the South if oil supply became a hardening influence in its main artery? The situation seems safe for as long ahead as accountants and shareholders usually calculate, for at present petrochemical production uses only 1 per cent of the petroleum and 5 per cent of the natural gas totally produced in the U.S.

But the American industry shares an economic *cri de coeur* with us. Expansion at this overwhelmingly rapid rate cannot be financed out of profits so long as taxation takes so big a slice. On this side of the Atlantic, indeed, the continuing drain of taxation has helped to put expansion plans into cold-storage. A financial survey of the U.S. industry has indicated that during 1952 67 per cent of companies would still finance expansions entirely out of profits, 22 per cent would borrow part of the funds needed, and 11 per cent would offer stock. Longer-term surveying suggests, however, that by 1955 the 67 per cent will be down to 56, the 22 down to 19, and the 11 will have risen to 25 per cent. The rapid expansion of productive capacity is safe enough so long as it is mainly paid for out of current earnings. Is it so safe if based upon more and more capitalisation? A depression in America can be caused by little more than a general halt in the demands of re-armament and inflation. Inasmuch as expansion plans are genuinely based upon ploughed-back profits, there is a strong case for liberal concessions in tax relief. It is stronger here than in America.

On Other Pages

The annual subscription to THE CHEMICAL AGE is 42s. Single copies, 1s.; post paid, 1s. 3d. SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3954/5). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784/5). LEEDS OFFICE: Martins Bank Chambers, Park Row, Leeds, 1 (Leeds 22601). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers Limited.

Notes & Comments

Abstract Finance

THOUGH it reflects the baser side of human nature it is always comforting to learn that other people are also facing similar difficulties to one's own. In *Chemical & Engineering News* (1953, **31**, 7, 690) it has been revealed that *Chemical Abstracts* and the *J.A.C.S.* have been suffering from monetary malnutrition. The size of these publications has been rising annually with no likelihood of stabilisation. The American Chemical Society cannot rely on its own resources to balance larger and larger annual deficits. This parallel with our own problems here makes comparison timely rather than odious. One element of distinction stands sharply out—the £ s. d. crisis is much worse than the $ crisis. Here the annual requirement to balance the budget of *British Abstracts* has been officially stated to be £120,000. The additional revenue that the ACS has secured for meeting deficits on publications is of the order of £60,000 and it would seem to be healthily adequate, a sum that can be used as a 'nest-egg' as and when needed rather than immediately expendable income. It is possible to deduce from this that the ACS has grappled with the problem of 'Abstract' economics at an earlier stage of insolvency than our own societies; but this may be speculative rather than wholly just comment.

The American Way

THE first step the ACS took was to treble the non-member subscription rate to *Chemical Abstracts*. This was helpful but inadequate as a total solution. The next and more recent step has been the development of 'corporation associate' membership. The problem of companies as members has been disposed of simply enough by denying the corporate associate any privileges of membership. Subscriptions were set on a sliding scale between $250 and $1,000, the determining criterion being the number of chemists and chemical engineers employed by the company in question. Larger firms were encouraged to apply for multiple 'associate-ship.' The response to this scheme is described as splendid. By the end of 1952, 296 companies (including 11 outside the U.S.) had made 365 enrolments, and a few other companies which declined to enrol had made substantial grants. The total yield was rather over £77,000 and of this sum £15,000 has been set aside to cover the cost of sending sets of publications for each enrolment. The balance is left to be drawn upon for meeting publication deficits. While it is clear that the ACS scheme for associate enrolment is only an appeal to industry in another form, there is much to be said for its systematic approach. It enables companies to feel that what is expected of them is equated according to their chemical size. Industry's willingness to help has been given a practical and stimulating pattern. The scheme has been so rapidly effective that it demands the closest attention here. Our problem in finance is unhappily larger but the scale could be set to meet the actual needs or some defined portion of them.

Antibiotic Antiquity?

HOW old are antibiotics? Nineteen-twenty-nine is generally regarded as the date of birth though even then penicillin was but named and recognised, and it was not until the 'forties that isolation was achieved at Oxford. Just before Christmas we read an article from Ireland in an English newspaper, the *Southern Weekly News*. The writer, Skim Coulter, said this: 'In Eire, long before the microscope was invented, there was a certain way of buttering bread and leaving it in a damp cupboard till a green mould formed that produced a healing plaster more potent than the antiseptics of Lister. Recently some of the medical boys from Dublin went down to the west and investigated the whole matter. The healing mildew turned out to be the mould penicillium itself.' We must confess we digested this a trifle sceptically. Events can often achieve a modern reconstruction that is unconsciously apocryphal. However, we were sufficiently impressed to keep the cutting and now it can be matched with a very similar report from America. In *Chemical Week* (1953, **72,** 7, 14) the following item has been published: 'Away back in 1900, long before Fleming, antibiotics were old stuff in Fort Madison, Iowa. Here are some recently unearthed notes by Dr. A. C. Richmond on one of his cases: "Sept. 9—Robert S., aged 18, acute tonsilitis, temp. 104, very septic sore throat . . . Sept. 10—Still very ill, giving him mouldy bread with aspirin in capsules, three capsules four times a day . . . Sept. 11—Improvement is unbelievable. I shall give all my patients with fever and infections, mould. If I should tell the other doctors about this, they would think I'm crazy."' We can make no other comment but the tritest, that there is nothing new under the sun. But it would be exceedingly interesting to know whether Dr. A. C. Richmond who was practising in Iowa in 1900 had come from Ireland or possessed any contacts with Ireland that would have given him the mouldy bread idea.

Synthetic Binders

Northampton Group Hears Paper

A MEETING of the Northampton Group of the Society of Leather Trades' Chemists was held on 12 February at the College of Technology, Northampton, when a paper was read by Dr. H Loewe on 'The Preparation and Application of Leather Finishes with Special Reference to Synthetic Binders.'

The author first summarised the various types of pigment finishes, and their variations to meet particular requirement. With the patent leather finish, finishing effect could be regulated by the degree of polymerisation of the linseed oil attained in the boiling process. This could be judged by viscosity coupled with experience.

With cellulose-pigment finishes, there was a greater range of variations, depending upon the degree of nitration of the nitrocellulose, the nature of the plasticiser, and the volatility of the solvents, etc. Reference was also made to the possibility of supplying cellulose finishes in emulsion form, which could be diluted with water.

Basic variations with casein pigment finishes were practically impossible, and adaptation for particular needs was arrived at by suitable additions such as resin products and wax emulsions. The natural waxes, etc., formerly used had been largely replaced by more uniform synthetic products. Film formation with these finishes was different to that of a linseed oil finish, and commenced with glazing, when heat and pressure gave a smooth surface. Mechanical operations were therefore of importance. Hardening of the film was usually done with formation.

Synthetic binders came next for treatment, the most important types being obtained by the polymerisation of monomers, and the properties of the polymeride depended on the chemical nature of the monomeride and the degree of polymerisation.

Copolymerisaton of two or more monomerides gave products which the author considered specially suitable for resin-pigment finishes. Most plastic binders were in the form of dispersions; by incorporating hydrophillic groups into copolymers, binders are obtained similar in character to casein. Pigmentation of polymeride dispersions presented difficulties owing to their labile characters.

Some polymeride dispersions, e.g. acrylates could be diluted with casein, while others were more limited in this respect.

With regard to combinations, acrylates were first used as bottoming agents for cellulose finishes, preventing the plasticiser from sinking in, giving elasticity, etc. Next came mixtures of the acrylates with casein finishes to give high elasticity.

Other combinations were possible such as a polymeride-casein finish first coat followed by a cellulose lacquer or pigmented finish.

From the practical standpoint, casein finishes were still the most important for willow calf, sides and glace kid, whereas cellulose finishes generally used where extra rub-fastness was required, e.g., furniture leathers. For buffed leathers, plastic binder-casein finishes were in general demand, while the pure plastic finish in the opinon of the lecturer would find greater application to split and lining leathers.

Sulphuric Acid Production at Silvertown

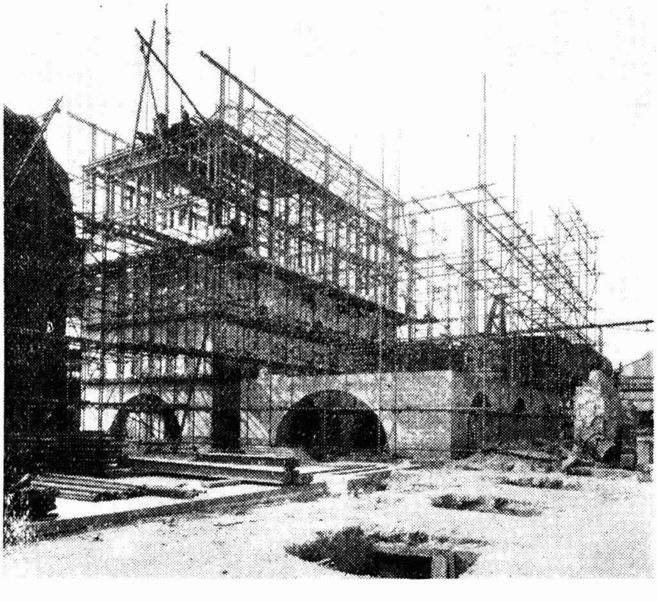
Chemical Firm's Post-war Reconstruction Progress

THE conversion of existing contact units to burn pyrites forms part of an extensive programme of reconstruction of Spencer Chapman & Messel, Ltd., which specialises in the manufacture of sulphuric acid. The company's works were obliterated by enemy action in September, 1940, and during the past 12 years the work of site clearance and plant construction has been pushed forward as rapidly as possible. It is anticipated that by the end of this year manufacturing capacity will have been restored to pre-blitz level.

One of the oldest firms in the chemical industry, Spencer Chapman & Messel, Ltd., were among the first manufacturers in Britain to make sulphuric acid by the contact process and to develop the production of oleum in all its strengths. The foundation stone of an early set of chamber plants has survived the destruction. Dated 3 April, 1899, it bears the names of H.R.H. Princess Mary Adelaide, Duchess of Teck, Princess Victoria May of Teck, and Prince Francis of Teck. The company's earliest records have been lost and its exact age is therefore uncertain, but there is evidence that for many years the offices and works were situated at Stratford. Its existing nine-acre site at the east end of Silvertown, between the Thames and North Woolwich Road, has been occupied since 1874.

When the last war began the business was still being steadily expanded, the principal activity being the manufacture of sulphuric acid. After destruction of the works, production was completely suspended till March, 1942, a period of eighteen months. All the services were out of action and there was a tremendous amount of debris to be cleared away. To meet the Government's urgent need of sulphuric acid, it was essential that production should be resumed with minimum delay, so that instead of being able to take advantage of the opportunity to replan the works on modern lines, makeshift plant and equipment had to be installed. Since the war, however, considerable reconstruction and modernisation have taken place, although the site has not yet been completely cleared.

Units now available for operation comprise four contact plants and one Mills, Packard chamber plant. Originally the company always used pyrites as the starting material, but for some years before the war



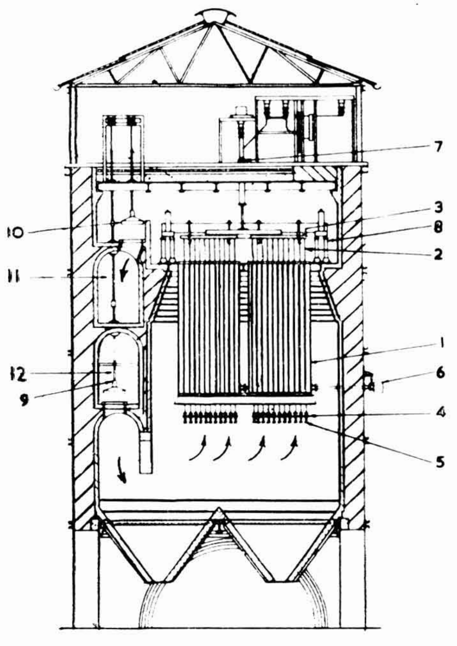
General view of two Sturtevant electrostatic dust precipitators under construction

it had been changing over gradually to elemental sulphur in accordance with the general trend. In 1951, when the sulphur shortage in the United Kingdom was serious and the long-term outlook seemed unfavourable, it was decided to go back to pyrites despite the considerable expense involved, in order to ensure continuity of manufacture.

All contact units are at present burning elemental sulphur, but two of them are being converted to burn pyrites and will shortly go into production. Other units will be completed by the end of the year. When this programme is completed the total capacity of the sulphuric acid plant will be considerably increased.

The contact units are built in pairs and the gas is supplied by a battery of 20-ton Herreshoff type multiple-hearth pyrites roasting furnaces supplied by Huntington Heberlein & Co., Ltd. The first furnaces are at present being dried out and are scheduled to come into operation in the near future.

As the gas obtained by roasting pyrites must first be cleaned, before reaching the acid plant it is passed through an electrostatic dust precipitator supplied by the Sturtevant Engineering Co., which is of the tubular collecting electrode type housed in a brick casing with external steel framework. Each structure is approximately 53 ft. long and 35 ft. wide. The precipitators are designed to give a very high collecting efficiency.



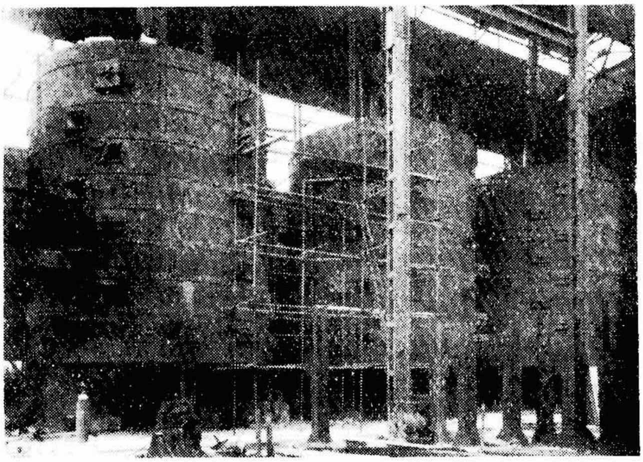
CROSS SECTION OF PRECIPITATOR

1. Tube banks; 2. Discharge electrodes; 3. Top grids; 4. Bottom grids; 5. Electrode weights; 6. Receiving electrodes rapping gear; 7. Discharge electrode rapping gear; 8. Support insulators; 9. Inlet dampers; 10. Outlet dampers; 11. Outlet flue; 12. Inlet flue

Cleaned gas from the precipitators passes on to the wet scrubbing plant, which consists of two towers operating in series. It enters the first tower at the bottom and rises counter-current against the downward flow of scrubbing acid, the acid circulation being broken up by a series of brick arches. The gas leaves at the top and is taken down to the bottom of the second tower, which is packed with cylindrical packing. On emerging from this plant it is not only clean, but also comparatively cool. Gas from the first three furnaces is taken from the second scrubbing tower through a lead trunking to an existing pair of contact plants, which will embody electrostatic mist precipitation.

Sulphur dioxide from both the pyrites and elemental sulphur processes is brought under vacuum from the purification plant and is discharged from high pressure blowers into a converter and absorption plant of the company's own design. Each of these plants is equipped to make oleum in addition to the more usual production of sulphuric acid.

Lay-out of the factory is being arranged to eliminate manual labour as far as possible at every stage. The jetty has been reconstructed and incoming pyrites is grabbed from barges by an electric crane capable of handling up to 400 tons per day. The crane discharges it on to a belt conveyor distribution system incorporating automatic weighing and recording apparatus, which delivers it into various stores as required. Mechanical shovels will be used for charging the pyrites into low-level hoppers, from which it will be weighed into



Part of the Herreshoff pyrites roasting equipment under construction

trucks and bogies and conveyed by lifts to the high-level feeding gear of the Herreshoff furnaces. The cinders from the furnaces and the dust from the precipitators will pass through a cooler and thence by a conveyor system to a large riverside storage silo, equipped with means of loading coastal steamers of about 500 tons capacity. The capacity of this equipment is about 100 tons per hour.

For acid storage the company has more or less standardised on a vertical cylindrical tank mounted on a steel understructure at a convenient height for loading tanks by gravity. Each tank holds 300 tons of concentrated sulphuric acid and it is planned to raise the storage capacity eventually to a total of 5,000 tons. The various strengths of acid have all been brought to a central loading point for the whole works, road or rail, so that any strength can be loaded conveniently into the company's own tankers or those of its customers. The company were among the pioneers of road-tanker transportation of acids. Their own tankers are fitted with a self-contained air compressing unit for discharging the acid into customers' stores. There is also a large demand for sulphuric acid in carboys, drums and jars.

The company specialises in the packing and dispatch of acids to customers abroad. Consignments for export are packed in a variety of containers ranging from glass jars to steel drums of various sizes. The packing sheds have been centralised and mechanical handling installed as needed.

The Path To Prosperity

IT would be a complete waste of time to send productivity teams to America to find out the latest methods of production if the better methods which they brought back could not be made effective because of trade union restrictions, said Sir Andrew McCance at the first annual dinner in Glasgow on 25 February of the Glasgow and West of Scotland Management Association.

He went on to say that the effects of those harmful practices were only too clearly shown in the price we had to pay for coal, and those in touch with export markets saw them, one by one, now starting to fall away because our competitive position was being strangled by our costs.

Sir Godfrey Ince, Permanent Secretary to the Ministry of Labour, who proposed the health of the association, said that management was highly skilled on the technical side and in the science of management, but was not so highly skilled in the art of management—the art of handling men. It was the primary object of management associations to foster the kind of leadership that brought the best out of men.

Dr. W. J. Jenkins, chairman of the Nobel Division of Imperial Chemical Industries, Ltd., in his reply, said that prosperity could not be made by legislation. It had to be earned and it could only be got by efficiency and co-operation, in other words good management.

Brazil's Expanding Chemical Industry

Import Restrictions Being Eased

COMPARISON of the 1940 and 1950 Census returns shows that the number of establishments manufacturing chemical and pharmaceutical products in Brazil increased during the decade from 1,780 to 2,648 and the value of production rose from £28,480,000 to £177,568,000. The rate of development shows no sign of slowing down and the following are now being produced in sufficient quantities to meet local needs: Bisublimate of iodine; polystyrene; many aniline dyes; ethyl acetate; trisodium phosphate; insulating varnishes; trichloro ethylene; nitrotoluene; sodium chlorate, sulphates of sodium, alumina and magnesium; lead arsenate, sodium silicate; hydrochloric, nitric and sulphuric acids; lead and iron oxides; ammonia, liquid and compressed; hexachloro benzene and butyl acetate.

In S. Paulo a factory, with a capacity for 450 tons annually, has begun producing hydrogen peroxide. Two works are supplying the local market with nitro-glycerine and two are manufacturing potassium chloride, using imported raw materials. Two others, with a joint capacity of 12,000 tons annually, are making sodium sulphite.

To Produce DDT

Another is turning out BHC and a company has been formed with mixed American and Brazilian capital to produce DDT from chlorine and caustic soda. The factory will begin operating in 1954, with an initial output of 4,000,000 lb. of DDT annually and 10 tons of chlorine and caustic soda per day. Lubricating greases, with calcium, alumina and soda bases, are made in adequate quantities for the local market and special types, based on lithium and barium, are about to be manufactured.

In 1952, *Rhodia Brasileira,* working with cotton linters and employing anhydrites and acetic acid began the production of cellulose acetate.

Brazil's growing importance as a market for chemical and pharmaceutical products is reflected in her expanding imports. Between 1945, when hostilities ended in Europe, and 1951, Brazilian imports increased in volume from 148,787 tons to 696,433 tons, while the value rose from £8,925,000 to £51,640,840. Of these totals the value of chemical imports was 6.94 per cent in 1951 as against 5.10 per cent in 1945.

Considering values during the last five years, organic chemical products have accounted for 7.2 per cent of the total imports; mineral salts, for 12.6 per cent; other inorganic chemical products, for 24.7 per cent; pharmaceutical products, 24.7 per cent; fertilisers, for 30.7 per cent.

Brazil's Principal Supplier

The U.S.A. has been Brazil's principal supplier since the war, followed, until 1952, by Great Britain. In 1950, 43.0 per cent of the total imports came from the U.S.A., 22.0 per cent from Great Britain; 6.2 per cent from Chile; 6.1 per cent from France; 5.4 per cent from Benelux; 4.1 per cent from Switzerland and 2.6 per cent from Germany. In 1951, however, when Brazil's programme of building up reserve stocks was in full swing the United States percentage rose to 56.5, and although Britain retained second place, her proportion of total imports had dropped to 10.7 per cent. Meanwhile, Germany had moved up to third place with 5.9 per cent.

Full details for 1952 are not yet available, but imports of chemicals dropped 12 per cent during the first nine months of the year, owing to the drastic curtailment of licences, particularly for imports payable in dollars. The Free Exchange Law, which came into force on 21 February, should ease the situation appreciably. In accordance with the new law high-priced Brazilian products, which can no longer be exported at the official rate of 52.41 cruzeiros to £1, may be sold abroad at the free rate.

Recent import restrictions have slowed down production in factories and laboratories, particularly affecting the plastics industry, and cannot be much longer maintained without serious industrial upsets. The Export-Import Department is fully alive to the danger and is now facilitating imports of essential goods from countries with which Brazil has trade agreements. It is also inviting applications to import a number of products, regardless of agreements, including methylene chloride; organic compounds of mercury; and synthetic resins.

B.A.C.'s New Headquarters Opened

Hinchley Medal Address by Dr. Levinstein

TWO notable events, likely to stand out in the history of the British Association of Chemists, occurred in London on Friday, 27 February, 1953. The first was the official opening of the association's new headquarters at 14 Harley Street, W.1, and the second the presentation of the Hinchley Medal for 1952 to Dr. Herbert Levinstein, senior past-president and a founder member.

In a brief speech declaring the building open and welcoming a distinguished gathering of past-presidents, members and their friends, the president, Mr. F. Scholefield, M.Sc., F.R.I.C., said that the B.A.C. was the first society of chemists to possess its own freehold property. He gave a summary of the work of the association since its foundation in 1917 with the primary object of looking after the economic interests of the chemist.

An unemployment scheme had been developed for the benefit of its members and this, through sound administration, had enabled as much as £10 10s. a week to be given to members who were temporarily out of employment due to circumstances beyond their control. The fund had accumulated until there was a credit balance of £50,000.

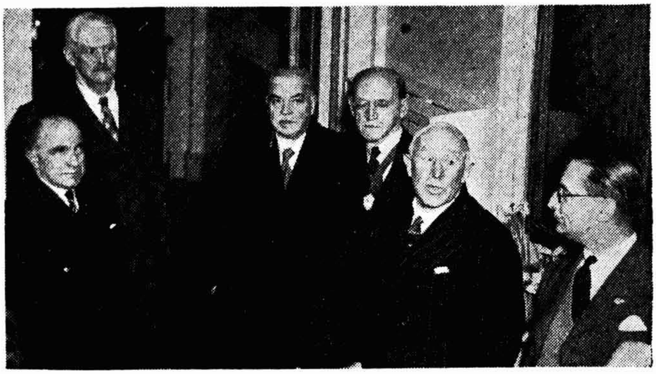
After considerable discussion and thought as to how to make the best use of this sum it had been decided to invest part of it in the purchase of this freehold property which would not only provide the association with its own permanent home, but would also provide a good return for the money. There was ample room for its own administrative needs, while other floors had been let as offices and the top part of the house converted into two tastefully decorated and furnished flats. He congratulated all those responsible, particularly Mr. Norman Sheldon and Mr. Langdale, on the truly magnificent results of their labours in getting everything so successfully completed.

Dr. Levinstein, senior past-president, then unveiled an Honours Board in the entrance hall bearing two panels with the names of the presidents inscribed on one, and those of the Hinchley Medallists on the other. The board was given in memory of Colin Alfred Wylie (president, 1951-52) by his family and friends in the association. Dr. Levinstein said that he knew all present would share his pleasure in the presence of Mrs. Wylie and her son on this occasion, and that it was good to know the boy was following in his father's footsteps.

A pleasant little 'unofficial' incident followed with the presentation of gifts to members of the B.A.C. staff and 'Nobby' and 'George' who had done much valuable work in getting everything ready.

Members and guests then went round to the Royal Society of Medicine where the official presentation of the Hinchley Medal and the delivery of the address took place.

Dr. F. Kay, honorary secretary, gave a short account of the foundation of the award and some details of the life and character of the first president of the



The president and past-presidents after the unveiling of the honours board. Left to right: J. Vargas Eyre, M.A., Ph.D., F.R.I.C. (1936-39); Norman Sheldon, A.R.C.S., F.R.I.C. (1946-49); C. S. Garland, B.Sc., A.R.C.S., F.R.I.C., M.I.Chem.E. (1925-26); F. Scholefield, M.Sc., F.R.I.C. (1928-30 and 1952-53); Dr. H. Levinstein (1923-24 and 1949-50); Major R. P. Porter, T.D., B.Sc. (1950-51)

Association, Professor H. W. Hinchley.

The president introducing H. Levinstein, M.Sc., Ph.D., M.I.Chem.E., F.R.I.C., said that he could think of no worthier recipient for the Hinchley Medal. Dr. Levinstein was too well known to list his many achievements to an audience of chemists, but he would briefly recall that Dr. Levinstein had been president of the Society of Dyers and Colourists (1928-29); president of the Society of Chemical Industry (1929-30) and its Gold Medallist in 1931; president of the Institution of Chemical Engineers (1935-36), and, of course, twice president of the B.A.C.

He had had the good fortune to know this genial personality for 40 years. His father, the late Ivan Levinstein, had done much towards the creation of the modern college of technology.

Dr. Levinstein had associated with many great names in science and chemistry, including W. H. Perkin, Mackworth, and Rutherford and his school. He had given great service to the dye industry including the encouragement of James Faraday and Cecil Cronshaw. Apart from dyestuffs Dr. Levinstein had accomplished valuable work on cellulose acetate, salt and alkalis, and carried out a successful campaign for modification of the patent laws. He had taken a full share in the social, artistic and scientific life of Manchester.

After thanking the president for the honour conferred on him in the award of the Hinchley Medal, Dr. Levinstein then delivered his address on 'Our Changing Chemical Industries: An Appraisement,' from which the following account has been summarised:—

Hinchley Medal Address . . . .

CHEMICAL industry in England is growing but changing in character, while abroad it has perhaps changed more quickly and developed at a greater rate. The changes here are mainly the following: The oil companies have, after mature consideration, decided to put down large refineries in this country. On these £150,000,000 is being spent, of which £32,000,000 to £35,000,000 is on chemical plant. Olefins have arrived and we can obtain from oil greater quantities of aromatic substances than we had before, as well as olefins. Acetylene is also now made in England but is rather expensive owing to the high cost of power.

When I.C.I. was formed 25 years ago it was the only British company with sufficient capital and range of products to compare with the great companies in Germany and America. Recently the Distillers Company has entered the industry with great resources and has spread its manufacture far beyond the industrial solvents with which it started. The British Petroleum Chemical Company, in which the Anglo-Iranian Oil Company are their partners, makes industrial alcohol from ethylene and many other products made by cracking petroleum will follow. The Esso Petroleum Company Refinery at Fawley will be the largest in Europe. Petrochemicals, Ltd., have now developed their novel cracking process and can obtain, in addition to gases, aromatic bodies of unusual purity. They also convert ethylene through ethylene chlorhydrine into ethylene glycol, a substance of wide utility.

It is interesting to note that before 1914 the Badische Anilin und Soda Fabrik at Ludwigshaven manufactured ethylene chlorhydrine to make ethoxy aniline and from this, indigo by fusion with caustic soda. When hostilities began, in the same plant, ethylene chlorhydrine was turned into thiodiglycol. This was sent to Leverkusen and by replacing the hydroxyl by chlorine was quite simply turned into mustard gas. All the mustard gas used by the Germans in the war was made in this way. This is a good example of the flexibility of a dyestuff plant in peace or in war.

The Ethyl Corporation are putting up a large plant at Stanmore for anti-knock fluids containing tetraethyl lead. This requires bromine obtained from sea water and metallic sodium and chlorine from salt, two of our few abundant raw materials. Of course, this was done by them in the U.S.A. on a very large scale many years ago. Lastly, the Monsanto factory in Wales is noteworthy because of the products they make and because, like most of the oil companies, they too have large research organisations in America.

There are now half a dozen companies in England with large capital, making chemicals, while formerly there was only one. These changes will increase the opportunities for chemists and therefore benefit the British Association of Chemists. Undoubtedly these companies strengthen our chemical industry substantially, will diminish dollar imports and help exports.

Britain thus has more raw materials and more big companies engaged in chemical enterprises than formerly. I.C.I. also has developed much in the war and post-war years. In Germany and America too, companies which were strong before 1939 have grown during the late war. With these Britain must compete to secure the proportion of world export that she requires and much depends on her capacity to do this.

In his important Messel lecture given to the Society of Chemical Industry (SCI) last summer, Sir Henry Tizard said that he was puzzled and disquieted by what appears to be Britain's 'lack of success in competing in the world's markets for chemicals.' This polished and thoughtful lecture entitled the 'Strategy of Science' is, in my opinion, one that cannot be dismissed as merely expressing the views of a brilliant man of science, whose experience of applied science is confined to the application of science for war. It should rivet the attention of every thinking person, layman, scientist or politician in this country.

The following figures are taken from his lecture:—

Percentage of World Trade in Chemicals

	1913	1929	1937	1950
United Kingdom ..	22	19	17.5	18
U.S.A.	10	17.5	16	36
Germany	37	33	36	11.5
Switzerland	2	4	5	7

Dwindling Share of Trade

Thus, Britain's share of world trade in chemicals has gone down steadily since 1913. Germany has been out of the world's markets twice in this period during two great wars, and her share fell from 36 per cent in 1937 to 11.5 per cent in 1950.

American figures, on the other hand, rose from 16 per cent in 1937, to 36 per cent in 1950, just double our own. If you look back to 1913, you will observe that her percentage was then less than half our own. Although we appear to be stronger than before, these figures suggest that, relatively to other countries, this is not the case.

It is, however, important to note that we have not yet had the full advantage of the operations of the big companies referred to earlier, who have increased their stake in the British chemical industry. Sir Henry Tizard points out that the share of Switzerland in 1950 is 3½ times what it was in 1913; that Switzerland has no natural advantages over us and has not the formidable government organisations for research which we have. Yet Switzerland has an export trade in chemicals about 'five times as valuable as our own per head of the population.'

Limited Usefulness

It may well be that the Department for Scientific and Industrial Research (DSIR), admirable as it is, does not contribute substantially to increased exports. Industrial research, in my view, is for the individual firm if it is to be profitable. Research work, of which the results are open to the whole industry, can scarcely contribute to the export trade of an individual concern. I have known the Shirley Institute from its beginning and it has given to the cotton trade a scientific basis. Unquestionably this is of value both to spinners and manufacturers. On the other hand, the discovery of a method for making cotton fabrics creaseless is more useful, simply because it came from a single company which knew how to market its invention and how to use research results profitably. Research itself pays no dividends. Successful laboratory work is followed by patenting; then come the design and erection of plant and finally the all important sales.

May I return to the German chemical industry? This, as we all know, was concentrated until recently in the I.G. Farben. One gets an impression of its size if we note that during the war 218,000 pepole were employed, and its share capital was worth from about £350,000,000 to £400,000,000. The I.G. properties in Western Germany have been split up by the Allies. The three major successor companies to the I.G.'s properties in Western Germany, Bayer, Badische and Hoecht had:—

in 1949 a combined turnover of about	£8,500,000
,, 1950 ,, ,, ,,	£125,000,000
1951 ,, ,, ,,	£185,000,000

Of this £185,000,000 exports account for £55,000,000.

The German I.G. Farben is based on dyestuffs, as indeed is the Swiss chemical industry. The dyestuff industry is the foundation of organic chemical industry. Industrial research started with it. If we consider the beginning of this industry, the causes why it left this country, its birthplace, and its growth to really gigantic proportions in Germany, we get the answer to much that disturbs Sir Henry Tizard.

Isolation of Mauveïn

It begins with William Perkin, later Sir William Perkin, while he was a student of the great Hofmann at the Royal College of Chemistry. When oxidising impure aniline he obtained a highly coloured mass from which he isolated Mauveïn, as he named it, a dyestuff later shown to be of the Safranine type. With great courage and enterprise he started to manufacture it, the money being found by his father, a builder in a modest way. England was then the Eldorado for German chemists. It is not surprising that Heinrich Caro, subsequently the most brilliant of all inventors in the industry, afterwards at BASF, was at Roberts, Dale & Co. in Manchester in 1859; Martius, afterwards von Martius, the joint creator of Act. Ges für Anilin-Fabrik (Agfa) was here too. Peter Griess, the remarkable man who discovered the azo dyes, was at Alsopp's in Burton where Dr. Böttinger, the father of Heinrich (later Heinrich von Böttinger) was the manager. Already in 1860 Roberts, Dale & Co. started to make Mauveïn based on a patent taken by Caro. The discovery of other dyestuffs followed quickly after the success of Mauveïn.

In 1869 Caro, jointly with Graebe and Liebermann, took out an English patent for the production of synthetic alizarin. One day later Perkin applied for protection for a process of his own for making this product. The important point is that in 1869 there was no patent law in Germany. Consequently, alizarin like all other dyes, patented or not elsewhere, was free for all to make in Germany. After 17 years of competition against these aggressive, capable and utterly unfair German dyestuff makers, determined on expansion, Perkin sold his works and left the industry. A spate of discoveries followed in unceasing stream. Research increased under the stimulus of increased sales. The German competition was very harrassing in Free Trade England. Perkin certainly would not have sold out at 35 years of age if there had been a Dyestuff Act prohibiting the importation of German dyes in 1873, or if the Government had given him to enlarge his works, a tenth of the millions that they gave to their own creation, British Dyes, Ltd., 42 years later.

Where does one suppose that Perkin could have obtained the money required to develop his works so that he could carry on? There was no risk money to be had in England from banks or from finance houses as there was in Germany; nor had there ever been since, until the formation of the Finance Corporation for Industry a short time ago. The FCI and their small associate, the ICFC, have indeed played a helpful part in financing new undertakings in the present difficult times. It is a common place to say that we lost the dyestuff industry (a) because of the superior education of the German chemist, or (b) because of the neglect of the research of the British manufacturer as opposed to the love of science of his altruistic German competitor. But this is not factually true.

(a) Education in organic chemistry in Germany and also in Switzerland was, in truth, better than here in early days. The first large and distinguished school of organic chemistry in Britain was at the Manchester University, then part of the Victoria University, where W. H. Perkin, junior, the son of Sir William Perkin, was professor of organic chemistry. There was, however, never any difficulty in obtaining good German, Swiss or British chemists who had been educated or had finished their education abroad.

(b) I went to Blackley in 1899 and naturally went into the research laboratories for a year or two as was usual, to acquire a knowledge of dyestuff chemistry. From my own knowledge we in Blackley did more research long before that date than our sales justified. Compared with that of the Germans it was on a modest scale but we did far more research work than any firm in England.

Less Adventurous Leaders

In the 'Strategy of Science,' Sir Henry Tizard says he does not like to feel that 'British leaders of industry are becoming less adventurous and that a government committee has to be appointed to manage the adventure for them.' No man would call

Sir William Perkin, nor indeed his successors, unadventurous. H. Yarrow (*Chem. and Ind.,* 1952, pp. 882/883) in an interesting, cogent reference on this point adds that if it is today considered unethical to make considerable profits, even if one takes considerable risks, there remains only the taxpayer to take the risks and make the profits. This certainly adds one more difficulty to the unfortunate Civil Servant. I need not tell you who know, the great difficulties of selecting laboratory experiments for development on the large scale. The mistakes made by even the practiced dyestuff people are fairly numerous. A salesman is frightened of the responsibility of urging the manufacture of something for which no demand yet exists. How is the Civil Servant to deal with this?

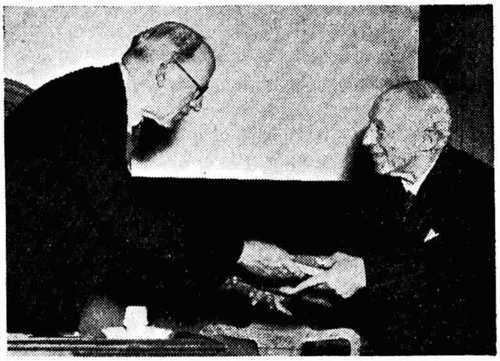
When war broke out in August of 1914 the import of German dyes was suddenly cut off to the great bewilderment of the textile trade. They discovered the meaning of 'key' industry. The withdrawal of German dyestuffs threw a great responsibility on the very few people in this country who had the necessary knowledge and experience to cope with the difficulties of replacing them quickly.

Importance of German Dyestuffs

The importance of the German dyestuff industry as a weapon of war and the adaptability of the plant to war, is clearly described in the Hartley Report (1919). Only the civilian side will be referred to here. The complexity of the problem lay in the large number of different dyes used for various purposes. Of some the constitution was unknown to us and the complicated intermediate products were mostly made in Germany.

Consumers, like most people, thought that the war would be over by Christmas, 1914, before the stocks of dyes were used up, but at Blackley production of dyestuffs required for uniforms and equipment, of both services, was immediately increased, and extensions were quickly carried out, based on the supposition that the war would last not less than three years.

High policy was also involved, for early in the war the Government of which Asquith was Prime Minister agreed to the Paris Resolutions. Under these Great Britain, still a rigidly Free Trade country, undertook to abstain after the war from buying from Germany anything we could do without. The conspicuous deficiencies were two: German potash and German dyes. There are rich deposits of potash in Alsace, which it was one of our war aims to restore to France. For the second purpose the Government established a new company financed with Government money and with a Government chairman. This company was called British Dyes, Ltd. It acquired the old-established works of Read, Holliday & Sons at Huddersfield. It spent a lot of money there but under the guidance of its Government chairman it was not very successful in making the dyestuffs required. At Blackley we were not embarrassed by any Government backing, money or chairman.



Dr. Herbert Levinstein (right), receiving the Hinchley Medal from the president, Mr. F. Scholefield, before delivering his address 'Our Changing Chemical Industries: An Appraisement,' to members of the B.A.C. in the hall of the Royal Society of Medicine

By united efforts a great change was made in the war years as the imports of German dyes immediately after the war clearly show.

This did, in fact, prevent the Germans from using their stocks of dyes for bargaining at the Peace conference. You will note too that we had already in 1919 become considerable exporters of British dyes. Although the figures in 1919 were very different from those of 1913, our range of dyes was complete, not that the volume of exports satisfied us, nor that the plants employed were necessarily the best for peace conditions. They were the best for war conditions, the quickest to erect, consuming the least possible quantity of steel and other scarce commodities. With this qualification, however, it is true that the back of the task was broken.

The greatest research laboratories known at that time in this country had been erected at Blackley and placed under brilliant direction. A few more years of peace would have been enough to complete the job had the Government of the day provided the protection promised and kept its hands off the people engaged on it. Unfortunately, it did neither. The Board of Trade used great pressure to force Levinsteins, Ltd., to amalgamate with British Dyes, Ltd., with the result that the British Dyestuff Corporation was formed on 23 May, 1919. The ostensible reason for the pressure was the impossibility, in the opinion of the Board of Trade, of securing the passage of the Dyestuff Act unless these two companies were fused into one. In spite of this, the Board of Trade tried to secure the promised protection by an Order in Council, in order to avoid having to face the House of Commons.

Order Declared Illegal

The Sankey Judgment on 17 December, 1919, declared that this Order in Council, prohibiting the import of German dyes under this aegis of the Customs Consolidation Act, was illegal. A month later a Colour Purchasing Commission went to Germany and purchased a large quantity of German dyes. The Germans did well out of this for they got an average price of 6s. 10d., nearly eight times the average price they got in 1913. The promised Dyestuff Act was then brought in but not passed until the end of 1920. Some of you will remember that 1921 was the year of the great post-war slump. You can imagine the consternation caused to the newly formed amalgamation by the sudden inrush, during 1920, of these large German imports on to a market already saturated. The British Dyestuff Corporation was a semi-national concern with government and other directors. Apart from government money the BDC had a number of outside shareholders who had invested their money in it, when the company was floated.

We who had endured the German competition before the war without protection were determined to use this Act to complete an organisation on the German scale; able to supply a full range of dyes at a price low enough to compete with the German I.G. in the export markets. The public who had subscribed to the BDC did not share this interest. They naturally were looking for the large profits which, when they invested their money, they thought could be obtained from an industry protected so heavily as the dyestuff industry. The new directors, some of great distinction, knew nothing of this very specialised industry. Consequently, the technical people who had built up the industry did not appreciate the change and left. A complete change of policy ensued.

In the slump year of 1921, a number of plant chemists with knowledge of many lucrative processes which had been kept secret, as in all dyestuff works, were dismissed. They were, of course, at once snapped up by other firms here or in America.

In a booklet called '25 Years Ago, the Story of the I.C.I. Merger,' issued by the company, it is claimed that the formation of I.C.I. led to the 'rebirth' of the British dyestuffs industry. I.C.I. was formed in 1926 by the amalgamation of four large firms. (1) Brunner Mond & Co., (2) Nobel Industries, (3) United Alkali Co., and (4) the British Dyestuffs Corporation. The dates are therefore against this contention which is incorrect. I.C.I. has done many things of great value to this country and made a number of outstanding discoveries. It has no need, and, I am sure, no desire to claim as its own things it never did. Its propaganda department seems, at times, to run away with itself 'intoxicated with the exuberance of its own verbosity.' Unfortunately, such propaganda gets the widest publicity, with which a correction such as this seldom catches up.

Danger Confronting World

Propaganda is one of the dangers confronting this world. Its object is to deceive people, who ultimately become unable to believe the truth when they hear it. Truth, indeed, seems to be a shabby person today, a thing of no importance, the poor relation of Propaganda, who can pretend like the social climber to be anybody or anything she wishes; if there is anything to be gained by it. It sends out a smoke screen which makes it difficult for thoughtful people to find out our real position. If we do not know the facts, how can we take the measures necessary to save ourselves in our present critical economic position.

Recently in *The Financial Times* 'Survey of the British Chemical Industry,' which seems to be inspired by the Association of British Chemical Manufacturers, it is claimed that the passage of the Dyestuff Act was one of the first achievements of the ABCM after its formation. The ABCM has rendered great service to the chemical industry. It is therefore with regret that I must correct its statement that the Dyestuff Act which it claims to have fathered was only intended to protect the home market and not, by securing the home market, to build up exports. Apart from what I have said on this point, a moment's thought would show the absurdity of such a plan. The Germans were presumed at this time to make 200,000 tons of dyes. The home market took about one-ninth of this tonnage. There are about 2,000 different dyes.

The object of the Dyestuff Act was to secure for the home market a wide, substantially complete range of dyes. If exports were to be neglected, the overheads would be so high as to defeat the whole object. The question of sales is the paramount factor. Particularly in the dyestuff industry, overheads leap up extravagantly with low production. I am sorry to say that the ABCM also make the categorical statement that the highest export of British dyestuffs before the 1939 war was in the year 1937 and amounted to 6,000 tons. In 1937 the export of British dyes was, to be precise, 5,728 tons and, in fact, this tonnage was exceeded in 1929. The important point concealed is that already in 1919 Great Britain had exported 5,446 tons of dyestuffs, and 6,157 tons in 1920.

Industry Inactive

Thereafter, exports went down in most years excepting 1929 and 1937. In 19 years of the Dyestuffs Act the highly protected dyestuff industry did literally nothing to increase British exports of dyes.

Publicity regarding the effect of the Dyestuff Act, in cutting down the quantity of foreign dyestuffs imported prior to 1939, is also quite misleading. In the four years of war, 1914-18, we had increased our production of dyestuffs so much that we were able in 1919 to import only 3,234 tons against a figure of over 18,000 tons in 1913. The average weight of foreign imports went down to 2,325 tons in the years 1919-26. These years include 1920 where the imports were abnormally high because of the Sankey Judgment.

During the years from 1927-1938, the last year before the war, the average weight of foreign imports was almost precisely the same figure. Thus from the end of the 1914 war to the beginning of the next one, with the advantage of complete protection, neither the weight of imported nor exported dyes materially changed.

Profitable Arrangement

The price of dyestuffs went up. The arrangement seems to have been profitable to the British dyestuff makers, who, according to official figures, seem now to have grown to 37 in number. It was certainly a profitable and satisfactory arrangement for the German dyestuff makers.

This brings us to the post-1939 war period. Here a great improvement is shown in the export figures in 1950 and 1951, the latest available years.

Imports of dyestuffs in 1951 was abnormally high, according to the propaganda, owing to the Korean war. Why the Korean war should cause a great increase of dyestuff imports into Great Britain is not obvious. There seems to be no connection between the Korean war and the manufacture of dyestuffs into Great Britain, Germany or Switzerland. In fact whatever the reason, our imports of dyestuffs in 1951 are rather more than double the 1950 figures.

It is surprising that 31 years after the passing of the Dyestuff Act, Britain should import £2,785,471 of dyestuffs, £1,000,000 more than in 1913. Even more surprising are the countries of origin. Germany, the only country against which protection was formerly required, supplies only one-third of the weight obtained from Switzerland and the U.S.A. together.

The balance was made up of quantities imported from a variety of countries. Some were re-exports from countries where dyes are not made.

Britain is not short of knowledge of dyestuff making. After the last war, all German patents were invalidated and all German processes thrown open to inspection. There are thus no more German dyestuff 'secrets.' Yet in 1951 Britain paid to Switzerland and the U.S.A., both hard currency countries, as much for dyes as was paid Germany in 1913. The sum paid to Switzerland, our chief supplier, was £1,536,134. The average price per lb. was 20s., or was three times the average price obtained for our own exports. The Swiss have two large dyestuff factories in Manchester.

Details of the chemical industry of Russia which caters for the requirements of one-tenth of the world's population are not known. I will refer only to the Russian dyestuff industry because the Russian patent position closely resembles that of Germany prior to 1877.

Russian Dyestuff Industry

Before the Revolution in 1917 the dyestuff industry in Russia was small, the large dyestuff firms had branches in Russia, but made as little as possible, preferring to import. There was one, perhaps more than one, Russian manufacturer, but his output was unimportant. The textile trade in Poland and in Russia on the other hand was large. To this the work of families like the Hubbards and the De Knoops contributed greatly. There were four large factories in Lodz, now in Russia, ahead of anything in Lancashire. They had strong finance, a completely vertical structure, then unknown in Lancashire, comprising spinning, weaving, bleaching, designing, dyeing, calico printing, finishing and selling directly to the consumer. In St. Peterburg was the largest and one of the best calico-printing works in the world.

In 1921 Lenin started the first five-year plan. In this the manufacture of dyestuffs figured. The USSR claimed to be the third greatest dyestuff producers in the world by 1940. The current five-year plan called for a production in 1950 of 43,000 tons of synthetic dyes. There is no doubt that the new plants will be up-to-date and erected with exact knowledge of German practice.

Russia is rapidly filling up the range of fast dyestuffs of which she is still short. The Russians have the brains of the world's inventors at their disposal for nothing. They publish nothing, take out no patents, pay no royalties and have the sole selling rights in a great market. That all the world should publish their scientific discoveries and patent them for the free benefit of Russia which contributes nothing in return, is one form of the cold war which is both effective and difficult to deal with.

Patenting inventions is now a double-edged procedure. There is no alternative that we know of, so that we must reckon that Russia will retain this advantage so long as the present, or similar, regime remains in power. Russia will obviously become a formidable competitor in dyestuffs and other chemicals when it suits her.

The figures referred to at the beginning of this paper do not give much confidence that the big units in the chemical industry will enable Britain to regain her share of the world export markets. It is therefore interesting to look into the possibilities of the small producers in industry.

There are no less than 140,000 British industrial undertakings. Of these only 4,200 employ more than 250 people. Seven hundred establishments in all employ more than 1,000 people. These figures are based on the Industrial Survey for 1935, the latest one available, but it is understood that no great changes in these figures have occurred subsequently.

Most of the academically trained chemists and chemical engineers who enter industry are employed in these larger works. We all know that there is a great shortage of these young people and that steps are being taken to increase their number. Indeed, the number of academically trained people employed in American factories (Report Anglo-American Council on Productivity, Heavy Chemicals, January, 1953), is far higher, namely, one to every six untrained workmen while in Britain there is one to sixteen. The hourly output per man in money value is higher in America by a similar factor, three to one.

Nearly all Britain's large undertakings were built up in the past from small beginnings by young men who had not received a rigid academic training. They had strong individuality, self-reliance and enterprise, three great qualities of our people.

Science Training

Owners and the staff of these numerous small establishments, require better grounding in the sciences touching their industry. These young men, like most of us, have to earn their living and acquire knowledge in the hard way. In the training of these young people the City & Guilds of London Institute directly and indirectly is largely concerned, for their examinations cover every subject, from craftsmanship and art to each branch of scientific or industrial knowledge.

The number of entries for these examinations had rapidly increased year by year, reaching no less than 82,689 in 1951. Entries come not only from all parts of Great Britain but from the Empire. It is good to know that the City & Guilds have been asked to suggest a suitable examination for general culture to precede these examinations on technical subjects. I regard this great desire of our youth to receive technical training, while employed, to be a most heartening feature in our national life. A great increase in the capacity of technical schools or colleges is clearly required and fortunately this has the support of the Ministry of Education. National Certificates in Chemistry have also proved of inestimable benefit to such students and are now becoming recognised in industry. This question is of great interest to the BAC, as it should bring them a succession of young associate members, who should later on qualify for full membership.

To secure the required exports our industries must be revitalised. We have in our inexhaustible youth, which only seeks the opportunity, an asset to give the spark and inspiration required for our creative industries. We may hope with this renaissance to surprise the world once more with what Britain can achieve under the pressure of events. The British Association of Chemists can play a valuable part in this movement, by which we may extract ourselves from the morass in which we are sinking, and I regard the opening of our new headquarters, Hinchley House, this day as an indication of the virility of the BAC and of the part it is about to play, in increasing measure, in looking after the economic interests of chemists. There is much to be done, and this work deserves the support of the whole profession, if it is to achieve the aims of its founders.

Flame Radiation Research

Discussion on Joint Committee's Work

INTRODUCING a discussion before the Institute of Fuel in London on 24 February, on the work of the Flame Radiation Research Joint Committee, Professor O. A. Saunders (chairman of the British Committee) said that the aim of the investigations at IJmuiden, Holland, was to improve the efficiency of industrial furnaces. Results obtained to date by the team of young British, French, Dutch and Swedish scientists had led to a better understanding of heat transfer processes—in particular of heat transfer by flame radiation.

Heat transfer by radiation from luminous flames was mainly due to suspended carbon particles. We lacked knowledge of the number and size of these particles, and their rate of formation. The problem was a complex one, and could not be studied satisfactorily in the laboratory; investigations were needed on a scale approaching that of the furnaces actually used in industry. Such investigations had been carried out at IJmuiden over the past four years.

The Earlier Experiments

Mr. H. W. Thring (General Superintendent of Research to the Committee) said that the earlier experiments were of two types—'performance trials' and 'combustion-mechanism trials.' In the performance trials the effect on the flame radiation of the following pairs of variables was compared: (*a*) oil and creosote pitch; (*b*) rate of fuel energy input, 76 and 106 therms per hour; (*c*) air and steam as atomising agents; (*d*) an increase of 20 per cent in the quantity of atomising agent; (*e*) an increase of 25 per cent in the quality of combustion air. In the combustion-mechanism trials the object was to measure in great detail the conditions inside the flame, with a view to finding an explanation of the results of the performance trials. The structure and distritution of soot particles had been studied by means of the electron microscope.

In the second series of experiments (the 'burner trials') the effect on the flame characteristics of using various types of burner was studied. At first the experiments were confined to oil fuel, but later comparison was made between coke-oven gas and oil as fuel. It was shown that (1) in the early part of the flame the radiation from coke-oven gas is much lower than for oil; (2) in both cases the most important effect on flame radiation is that of jet momentum; (3) the emissivity of the flame depends on the square of the soot concentration, if the soot is formed by two molecules meeting.

The next stage in the work would be to apply the new knowledge concerning the effect of jet momentum on flame length, and the relative effects of air and steam as atomising agent, to improving burner design.

Metallurgical Section

Recovery of Metals from Industrial Wastes

Long-term Importance of Increasing Supplies of Indigenous Materials

EARLY in 1951 some of the primary metals used in industry became extremely scarce and the available information suggested that many of the shortages would remain acute throughout the entire period of rearmament. It therefore became urgently necessary to examine every possibility of economising in the consumption of scarce metals, in both civil and defence production. In May, 1951, the then Minister of Supply appointed Mr. D. A. Oliver as Metals Economy Adviser, and in August of the same year a Metals Economy Advisory Committee was set up. Its term of reference were: 'To bring under review, in consultation with the various Government and industrial authorities concerned, ways of economising in the use of scarce materials in the design, specification and the manufacturing process of metal goods for both rearmament and civil purposes, and to advise the Government how it can best assist in promoting such developments.'

The field covered by these terms of reference was very wide. After reviewing forcasts that had been made of the supply and demand prospects for all the main metals in the United Kingdom for a period of some years ahead, the committee therefore decided to concentrate on economies in the use of copper, zinc, metal, tungsten and molybdenum. For each of these metals a serious shortage during the next three years was then in prospect.

Economy in Scarce Metals

From the outset it was clear that the problem of securing greater economy in the use of scarce metals was not an easy one. Industry had learnt much during the war about methods of conserving materials and there were few obvious cases where further large economies were possible. Moreover, the impact of the metal shortages had already led to the initiation of much new work on economy by industries and public bodies. Major new economies could only be effected by important changes in established industrial practice, the economic consequences of which would have to be taken into careful consideration both by the Government and by the public or commercial interests concerned.

Nation-Wide Co-operation

Despite these difficulties an encouraging picture of nation-wide co-operation in economy measures was presented by the Advisory Committee in a report which was published in September of last year. Many research bodies have been actively investigating problems associated with metals economy. In addition to fundamental work on metals and alloys with the object of extending their range of usefulness, much attention has been devoted to the substitution of alternative but more readily available materials and also to the recovery of valuable metals from industrial wastes. The departments responsible for defence production have been conscious of the need for reducing the consumption of scarce metals to a minimum, while industry generally has had to pursue economy vigorously in order to reduce the effects of shortages on production.

Many important metals economy measures, applicable to civil production, defence work, or both have been introduced by the various committees set up by the Steel Rearmament Panel, established early in 1951 under the chairmanship of Mr. E. W. Senior, commercial and technical director of the British Iron and Steel Federation. This panel was dissolved in July last year, its functions being taken over by the British Iron and Steel Federation, but some of its committees are still in being and are now responsible direct to the Ministry of Supply. Much valuable work has also been accomplished by the Inter-Service Metallurgical Research Council, with its five committees dealing with ferrous and non-ferrous metals, heat-resistant materials, basic properties, and corrosion and electrodeposition.

The Department of Scientific and Industrial Research has devoted much attention to problems of conservation and substitution. For example, work carried out at the National Physical Laboratory has shown that the possibility exists of reducing the consumption of steel alloys by improving the standard of purity of the steel. Valuable long-term economies should result from the work of the Chemical Research Laboratory on the corrosion of metals when immersed in liquids, buried, or exposed to the atmosphere. Work conducive directly or indirectly to economies of metals is a permanent feature of many research associations, and another direction in which they are assisting is by demonstrating to industry the correct use and maintenance of tools. The British Standards Institution has also played an important part in the economy drive, while some professional institutions have taken a keen interest in the general problems of metals economy.

TIDU Shortage Surveys

During the period when shortages were critical the Department's Technical Information and Documents Unit (TIDU) carried out surveys of particular problems which arose. It reviewed, for example, the German work on recovery and substitution of non-ferrous metals and alloy steels. Two bibliographic surveys, 'Development and Use of Substitute Materials for Non-Ferrous Metals and Alloy Steels in Germany,' and 'German and Japanese Experience in the Extraction of Low Grade Non-Ferrous Ores and the Recovery of Non-Ferrous Metals and Compounds,' have been published by H.M. Stationery Office. Machinery has been established by the Department for putting inquirers in touch with the experts who know the answers to any particular query of a scientific or technical nature.

It is stressed by the Metals Economy Advisory Committee that it is through the initiative of private industry that most economies can be made. Most firms are fully alive to the importance of using their materials as economically as possible and many of the larger organisations have set up metals economy committees or have appointed metals economy officers.

Since the Advisory Committee began its work there has been a radical change in the supply position. Although no metal is plentiful and some restrictions on demand must be maintained, the acute shortages have eased and supplies are sufficient to meet essential needs. This is attributed to two main causes. First, the expansion of world production and the operations of the International Materials Conference resulted in bigger supplies of certain non-ferrous metals to Britain than had been anticipated, and in the second place industrial requirements were restricted by voluntary and enforced economies.

It is only in the cases of lead and zinc, however, that the shortages have entirely disappeared. Nickel, cobalt and copper in particular still give cause for concern, while supplies of certain other metals are at present adequate to meet essential needs only because of the restrictions that are being maintained on their use. Industry's requirements cannot be met in full, and there is little margin to meet unforeseen new demands or a possible deterioration in the supply situation. The need for metals economy thus remains, even though the shortages are no longer critical.

Possibilities for economy measures continue to be examined. The Report of the Metals Economy Advisory Committee refers, for example, to possible methods of increasing supplies from indigenous sources of vanadium and selenium, and the possibility of recovering non-ferrous metals from pyrites cinders.

Highest Priority for Sulphur

When sulphur became acutely scarce the highest priority was accorded to the conservation and recovery of this material. The shortage of sulphur is no longer critical, but work in this field has directed attention to new possibilities for the conservation of non-ferrous metals. One of the most important measures for reducing our dependence on elemental sulphur is the conversion of sulphuric acid plants to use pyrites as the starting material. In Germany, non-ferrous metals have long been recovered from pyrites cinders. Much of the pyrites now being used in this country for sulphuric acid production contains small percentages of copper. zinc and lead sulphides, as well as small amounts of gold, silver and cobalt, and traces of other metals.

At one time copper used to be recovered in Britain from pyrites cinders, but the suppliers improved the quality of the raw material, with the result that the copper content declined and recovery ceased to be economical. At the same time, the production of sulphuric acid was expanded by burning pure sulphur and the quantity of pyrites used in this industry became comparatively small. Evidently it is considered that the prospects of economically recovering non-ferrous metals from the cinders might repay further investigation. Before industrialists would be prepared to sink capital in recovery plants of this nature, they would require to be satisfied that the long-term outlook was reasonably secure. Since prices of many non-ferrous metals have fallen considerably in recent months—particularly those of lead and zinc—the prospects of economic recovery have obviously become less favourable.

Another consideration which cannot be overlooked is the possibility that the suppliers of pyrites might improve their product still further, with the result that non-ferrous metal contents would become even smaller.

The extended use of vandium could effect savings in the use of other alloying materials such as tungsten. Although the supply of vanadium itself appears to be quite satisfactory, increased production of this metal from indigenous sources would therefore be of value. Certain iron ores used for producing pig iron and steel contain a certain amount of vanadium, which might be recovered during the manufacture of pig iron and steel. This would involve some changes in existing processes, and it is possible that it might be more expensive to recover vanadium by the proposed method than to import it.

Valuable Addition to Resources

In the event of another emergency, however, it is conceivable that the vanadium so produced might be a valuable addition to the national resources. Even if the investigation referred to in the report yields nothing of immediate value, it is therefore desirable that information on recovery methods should be available as an insurance against future needs.

Selenium is a scarce material which is used extensively in the electrical industry, the main outlet being in metal plate rectifiers. Unfortunately it is never found as a separate ore but is always associated with other metals, mainly those which occur as sulphides. Silenium is present in small quantities in pyrites cinders, but the principal sources of supply are copper sulphide ores. No ores of this nature are found in Britain, so that supplies of this useful material are beyond the scope of her control.

Third of Selenium Recovered

Perhaps a third of the selenium present in copper sulphide ores is recovered, and it is known that technologists in the countries of supply are endeavouring to improve the efficiency of their recovery processes. The selenium is associated with the sulphur section of the ores and the bulk of the losses occur when the ore is roasted to produce blister copper. The blister is purified by electrolysis and the anode slurries contain the remaining selenium, some 90 per cent of which is recovered by the most efficient companies. Any selenium found in imported ores is evidently present because it could not be economically extracted in the country of supply, but conceivably there might be some stage during processing at which some degree of concentration might occur. The possibility that selenium might be economically recovered from some pyrites or copper sulphide ores may not be very great, but it should not be excluded without thorough investigation.

These facts show that it is therefore desirable to explore the possibilities of a substitute for selenium. There are a considerable number of materials which are semi-conductors, among them being germanium. The work of the DSIR on germanium was reviewed in THE CHEMICAL AGE of 23 August, 1952 (**67**, 267).

Difficulties that arise in promoting metals economy spring mainly from the practical problems a manufacturer faces when changing materials or designs in his production. When metal supplies become easier and prices fall, the prospects of establishing economic processes for recovering useful materials from industrial wastes become less favourable and interest in metals economy generally tends to decline. According to the Paley Report, however, large increases in the world consumption of metals are expected during the next 25 years.

Metal Extraction in Canada

New Techniques Evolved by Chemical Company

MANY aspects of the new metal recovery plant of Sherritt-Gordon Mines, Ltd., at Fort Saskatchewan, Alberta, costing $17,500,000, are of considerable interest to the chemist and the chemical engineer.

New methods of metal extraction, combined with the recovery of sulphur in the form of ammonium sulphate for fertiliser are being used. Many details are still confidential or the subject of pending patents, but some general information is available.

Some 25,000 lb. a day of metallic nickel of the highest purity in the form of powder will be produced, together with 250 tons of complex nickel-copper-cobalt concentrate and 75 tons of ammonia or 70,000 tons of ammonium sulphate a year.

A Combined Effort

The scheme was mainly the idea of Professor Frank Forward, the company's consultant, and worked out jointly between him and the engineers of the Chemical Construction Corporation which is building the plant.

In dealing with these particular concentrates, containing not only Ni but usually also Cu, Co and S, it is fairly common practice to leach them at high temperatures and pressures in ammoniacal or acidic slurries, with oxygen or air. Conditions are such that the valuable metals are dissolved, and most of the iron, arsenic and so on, is left in the residue. Gold, silver and other valuable metals may be recovered from the leaching residue by the usual methods, including cyanidation. The leaching liquor is usually a mixture of the metal sulphate and some impurities.

In the new methods most of the metals can be separated fairly cleanly and precipitated in pure powder form by treatment with a reducing gas, such as hydrogen or carbon monoxide. The concentrates are, of course, complex, and include arsenical cobalt which is the most difficult. Despite these problems the Chemical Construction Corporation has evolved a special technique and it is claimed that copper, cobalt and nickel powders have been produced satisfactorily on a commercial scale.

So far as the production cost of nickel and cobalt can be separately accounted the corporation should be in a position to compete with any nickel producer in the world, with possibly a good margin in the value of the fertiliser also available. The whole plant is very compact and will not occupy more than 150,000 sq. ft. of floor space, including the ammonia and ammonium sulphate units, and will turn out metal and fertiliser products worth about $11,000,000 per annum, at current prices. The cost of the fertiliser plant is about $5,000,000.

Other similar but smaller schemes are being established in the U.S.A. by the Chemical Construction Corporation. One is in conjunction with the National Lead Co., on which work was begun in 1949 at Fredericktown, Mo., with cobalt concentrates containing appreciable amounts of nickel and copper. Cost of plant is $7,500,000, and production is scheduled to begin about the end of this year (1953). It is a 50-ton a day refinery, using the acid leach system, and will produce copper, nickel and cobalt powders. Small amounts of ammonia will have to be purchased outside in this case to deal with the residual sulphur and form ammonium sulphate.

A third plant is that of Howe Sound Co., costing $2,500,000, which is also producing ammonium sulphate—partly from purchased ammonia; and more than 2,000 tons cobalt metal powder per annum. Recoveries in all these cases are claimed to be 96-99 per cent, with relatively low operating costs. A fourth plant on similar lines is that of Chemetals Corporation, for dealing with low grade manganese ore—abundant in the U.S.A.—and yielding presumably manganese metal powder. Some further details have been given by Major-Gen. Wm. N. Porter, president of the Chemical Construction Corporation, in *Min. Congr. Journ.*, **38** (11), 44-47.

Telephone Number Changed

The telephone number of the new headquarters of Semtex, Ltd., at Semtex House, The Broadway, Welsh Harp, N.W.9, will be Hendon 6543.

Analysis of Zirconium

Part I—Detection, Separation and Estimation of Hafnium Content

by T. O. PORTCASTLE, Ph.D.

AMONGST the 'new metals' of metallurgy, zirconium undoubtedly stands well to the fore. Unlike the development of the classical materials, progress in the production of the metal has taken place in very marked stages, and only recently has commercial production even on a limited scale commenced in the United Kingdom. The oxide was first isolated by Klaproth from the mineral zircon in 1789, but the metal was not won till Berzelius demonstrated its preparation by fusion of potassium fluozirconate with metallic sodium (1824). Subsequent attempts to devise a simpler and more feasible means of production included treatment of the fluozirconate with aluminium, zirconium tetrachloride with sodium and zirconia with calcium metal in vacuum. None of these methods succeeded in producing a specially pure form of the metal, and the embrittling impurities were not removed till the development of the 'Iodide' process by van Arkel and de Boer (1925-30). By this method, a pure ductile form of zirconium was at last produced, but even though zirconium is as common as carbon, it still remained expensive and, to all intents and purposes, a rare metal. Essentially the 'Iodide' process is very simple depending on the dissociation

$$ZrI_4 \rightleftharpoons Zr + 2I_2$$

of the tetraiodide in the vapour phase. The thermal conditions necessary for the dissociation were achieved by passing an electric current through a thin wire or filament of zirconium in the presence of the iodide vapour. The wire gradually grew to a rod of zirconium by deposition of the metal. In practice the avidity of zirconium for oxygen and nitrogen delayed production, and still makes it difficult and expensive. The original work was carried out in evacuated glass vessels, because it was found that the oxide and nitride formation was responsible for the embrittling of the metal. Many other practical considerations, with which we need not concern ourselves here, held up production.

The Kroll Process

The next phase in the production of zirconium was ushered in by the appearance of the Kroll process. This quickly replaced its rival, and development was rapid. As in the previous instance the method is simply illustrated by the

$$ZrCl_4 + 2Mg \rightleftharpoons Zr + 2MgCl_2$$

equation. Zirconium tetrachloride in the vapour phase reacts with liquid magnesium to form solid zirconium and liquid magnesium chloride. Whereas the iodide process yielded zirconium free from the other reaction products, the Kroll process produced an intimate mixture of zirconium and solid magnesium chloride containing a little magnesium metal. The mixture was heated in vacuum till magnesium chloride was completely removed and the magnesium volatilised. The zirconium sponge was melted in vacuum or an inert gas such as argon and was cast into ingots. Kroll used a graphite crucible to contain the charge; molten zirconium reduces all normal refractories. Various attempts to produce zirconium by the electrolysis of fused salts and various aqueous solutions have been unsuccessful, but recently a patent has described the electrodeposition of zirconium from a medium made by adding an excess of ammonium carbonate to a solution of zirconium oxychloride.

Varied Uses

The uses of zirconium metal and its compounds are varied. Of prime importance is the resistance of the metal to chemical corrosion. Concentrated hydrochloric and phosphoric acids show practically no attack, but hydrofluoric acid, aqua regia and strong sulphuric acid are very active although the dilute acid has little action. Alkalis even in the fused state show little attack. These corrosion resisting properties in conjunction with its good mechanical strength make it a useful material in the field of chemical engineering. Reports suggest that it may also achieve popularity as a constructional material in the future development of atomic energy, owing to its remarkably low neutron absorbing powers. Its avidity for oxygen and nitrogen make it an excellent 'getter' and foreshadow important applications in the electronics industry. As would be expected, zirconia is a very efficient refractory material. Other uses of zirconium compounds are found in increasing the strength and chemical resistance of glass, as a mordant in the dyestuffs industry and in the production of paints, although in this respect it is said to be inferior to titanium. Zirconium carbide is important as an abrasive, and is a good polishing agent. The metal is used for the manufacture of electrodes and for coating welding irons. The nitrate has been used as a food preservative and in fireproofing certain fabrics. Hafnium compounds are virtually inseparable from the corresponding zirconium compounds, and so far no important separate application of it has been proposed except that it is frequently added to tungsten lamp filaments where it exerts a controlling action on the grain size of the tungsten metal.

Detection of Zirconium

Zirconium oxide is amphoteric, for although insoluble in aqueous alkali it forms zirconates on fusion with alkali. The tetrafluoride does not hydrolyse in solution and can be formed by solution of freshly precipitated hydroxide in dilute hydrofluoric acid. This differentiates the metal from thorium which remains insoluble. The nitrate is usually of indefinite composition, while the sulphate is readily soluble, forming an insoluble double salt with potassium salts in sulphuric acid solution. In some instances this has been used to test for potassium in the presence of sodium which forms a soluble double sulphate. From an analytical point of view, however, the most useful of its common salts is undoubtedly the phosphate which is insoluble in hydrochloric acid, but soluble in hydrofluoric acid. This serves to distinguish zirconium from most metals. Zirconium is not precipitated by sulphuretted hydrogen and as mentioned previously, can be separated from titanium, aluminium and other metals with soluble sulphides by precipitation with phosphate. The sequestering action of perhydrol may be used to prevent the simultaneous precipitation of titanium.

Several dyestuffs have been used for the detection of zirconium, as for example, Alizarin S. This yellow dye which is conveniently water-soluble and forms lakes with many metals in an alkaline medium, notably aluminium, gives a brilliant red lake with zirconium which persists even on acidification. The test is capable of identifying zirconium in a concentration of one part in 2,500,000 parts of solution. Large amounts of magnesium, cadmium, mercury, lead, zinc, silver, tin, beryllium and the alkaline earths do not interfere, but large amounts of aluminium, bismuth, copper, cobalt, nickel, antimony and manganese are harmful. Fluoride, sulphate, phosphate, organic hydroxyacids, molybdate and tungstate interfere more seriously. 2-Nitroso-1-naphthol and 1-nitroso-2-naphthol are also used commonly for the detection of zirconium although they are by no means specific. The 1-nitroso compound forms a green-yellow colour, while the β isomer forms a deep red colour in acid solution, and is generally more applicable. Sulphate and fluoride again interfere by forming complexes with the zirconium. The insoluble nature of zirconium salts of arsenic and organo-arsenic acids has been used for the detection of the metal, but superior results stem from the introduction of a chromophoric group into the organic molecule as in the case of *p*-dimethylaminoazobenzenearsonic acid. This compound gives a brown precipitate with zirconium. The qualitative test is best carried out on filter paper since this allows of washing out the soluble red dyestuff while the zirconium ‘ spot ’ is retained by the paper. Phosphates, fluorides and sulphates interfere as usual. Quinquevalent antimony also forms a brown spot which is fortunately soluble in dilute hydrochloric acid in distinction from zirconium. Thorium also forms a brown spot, but this too can be erased by hot dilute hydrochloric acid. The red-brown spots from molybdate, tungstate, and titanium compounds are acid resistant, but submit to treatment with hydrogen peroxide. The brown stannic compound is not formed in strongly acid solution. Other reagents for the detection of zirconium are carminic acid which changes colour from yellow to red in the presence of the metal and gallocyanin (pink to blue).

Separation from Hafnium

The problem of separating zirconium and hafnium, and of determining one in the presence of the other is one that is rivalled in complexity only by one or two other such as the separation of the rare earth elements, or of isotopes. However, there have been several attempts to solve the problem, and some procedures evolved for the determination of one in the presence of the other appear to be fairly reliable. In general, the separation methods are inferior in the respect that while they may achieve the separation of two fractions of 99.9 per cent purity, they do so only to a certain extent, and are therefore of little value as a basis for quantitative work.

The separation of the two elements is usually performed by fractional crystallisation of the double fluorides formed with ammonium, i.e. $(NH_4)_2\ ZrF_6$ and $(NH_4)_2\ HfF_6$. The latter is more soluble. The other classical methods depend on fractional precipitation of the arsenates and phosphates. None of these methods is used analytically, being extremely tedious. In 1932 Prandtl[1] put forward a separation method using sodium ferrocyanide. He found that a mixture of zirconium and hafnium sulphates, in a solution of dilute sulphuric acid, acetic acid and ammonium sulphate, yielded a precipitate, on addition of sodium ferrocyanide, which contained zirconium and hafnium ferrocyanides and in proportions such that the ratio of hafnium to zirconium was considerably higher than before. From a starting material containing 99 per cent zirconia and 1 per cent hafnia he was able to obtain, by repeated crystallisations, a fraction containing some 90 per cent of hafnia. Schumb and Pittman[2] repeated this work in the early years of the war and were unable to reproduce such favourable results. They systematically studied the effects of variation of the various experimental conditions, and by their final procedure were able to obtain a mixture containing 80 per cent hafnia from a starting product containing only 12 per cent, in a series of four precipitations.

Fusion with Agents

In Japan, Fujiwara[3] has recently studied the fusion or sintering of pure zirconium pyrophosphate with agents such as sodium sulphide, sodium sulphide and ammonium chloride; calcium carbonate and sodium hydroxide; magnesium chloride, barium chloride and magnesium carbonate; magnesium carbonate and ammonium chloride. The fusion products were treated with dilute hydrofluoric acid and the zirconium determined in the residue and in the extract. Similar experiments were made on hafnium pyrophosphate. With sodium sulphide and the mixture of magnesium carbonate and ammonium chloride, about 90 per cent of the zirconium was present in the filtrate while about 50 per cent of the hafnium was retained by the residue. This was suggested as the basis of a method for separation.

Another method emanates from the same source,[4] and is based on the difference in solubility of the two hydroxides in sulphuric acid. The mixed pyrophosphates of hafnium and zirconium were dissolved in 1: 1 hydrofluoric acid and the hydroxides thrown down by addition of 1 per cent sodium hydroxide. The precipitate was washed briefly and immediately treated with concentrated sulphuric acid. A large amount of water was added and the solution thus formed was heated in a platinum dish on the water bath after addition of a small amount of hydrofluoric acid. By this treatment, Fujiwara found that almost all the hafnium remained insoluble, while the zirconium passed into solution.

Basis of Separation Method

Extraction with thenoyltrifluoracetone was used as the basis of a recent separation method reported by Huffman and Beaufait.[5] The distribution ratios for zirconium and hafnium on extraction from 2M perchloric acid with benzene solution of thenoyltrifluoracetone were found. At the acidity employed, the equilibrium constants for the zirconium and hafnium extraction were 9.4×10^7 and 4.6×10^6 respectively. From this information, it was shown that two extractions with a 0.025M reagent from a solution containing 59 per cent as much zirconium as hafnium, yielded 27 per cent of the original hafnium with less than 1.2 per cent zirconium contaminating it. Three extractions with a 0.02M reagent of a solution containing 5 per cent zirconium (based on the hafnium content) gave a recovery of 50 per cent of the hafnium with zirconium contaminating to 0.4 per cent.

One of the most efficient separations reported to date, is that of Street and Seaborg,[6] using an ion exchange column. By elution with hydrochloric acid of a mixture of the oxychlorides of the two metals absorbed on a cation exchange resin (Dowex No. 50), a 66 per cent yield of 99.9 per cent hafnia was obtained from a mixture originally containing 30 per cent of hafnia. The process was adaptable to gramme amounts. The method was re-examined by Newman[7,8] and found to be very satisfactory. From a two gramme amount of the mixed oxides containing 20 per cent hafnia a fraction of 99.9 per cent purity was obtained.

Fujiwara[9,10] has used a phosphate/oxide method for the determination of hafnium in zirconium salts. To a solution of the sample in sulphuric acid, 30 ml. of 40 per cent diammonium hydrogen phosphate were added and the solution was diluted to 200 ml. with 3.6 N sulphuric acid. The solution thus obtained was maintained at 60-70°C. for 4 hours, allowed to cool for 30 minutes and then filtered. The precipitate was washed with dilute sulphuric acid containing a little diammonium hydrogen phosphate and hydrogen peroxide, and finally with 5 per cent ammonium nitrate. The phosphate was ignited at 1,050°C. for 30 minutes and weighed as MP_2O_7 ($M = Zr + Hf$).

A known amount of the pyrophosphate was converted to the oxide by solution in 20 per cent hydrofluoric acid on a steam bath and precipitation of the hydroxide using sodium hydroxide in 20 per cent solution. The hydroxide was dissolved, re-precipitated and ignited to the oxide MO_2. From the difference in weight $\Delta = MP_2O_7 - MO_2$ the ratio $Hf/Zr + Hf$ was easily found.

Similar Methods Evolved

Similar methods have been evolved using precipitation of the selenite and conversion to the oxide and analysis of the mixed chlorides or bromides, but the most recent development here has been the use of the new *p*-bromomandelic acid precipitant by Hahn.[11] *p*-Bromomandelic acid was shown to be an excellent precipitant for zirconium by Oesper and Klingenberg[12] and was shown to be one of the few substances which forms a compound of definite composition with zirconium. It was also easily converted to zirconia. Hahn showed that by careful control of experimental conditions, a definite hafnium precipitate was also obtained. As a result he worked out a method for determining the hafnium/zirconium ratio by weighing the mixed *p*-bromomandelates dried at 120°C. and re-weighing after conversion to the mixed oxides. From this data, the hafnium/zirconium ratio was easily found and the hafnium determined with an absolute accuracy of ± 0.5 per cent on samples containing 10 per cent hafnia. These results were claimed to be superior to those obtained by the selenite methods of Claassen[13] and Schumb and Pittman[14] in that comparable results were obtained in one-fifth of the time. At the same time, it was said that the selenite method gave more accurate results in dealing with lower percentages of hafnium.

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(*To be continued*)

British MIT at Birmingham?

A RECENT leading article in the Birmingham Chamber of Commerce Journal recommends a centre of advanced engineering education and research for Birmingham University. The article refers to the appeal by the Vice-Chancellor of the University for £80,000 to expand the present science and research departments. The article goes on to say that this could only be a temporary measure and suggests that a long-term plan should be formulated which would make Birmingham the British equivalent of the Massachusetts Institute of Technology.

Birmingham was one of four claimants for a university college of technology to be built by the Government. Although no official decision has been reached, it is felt that because of the number of provincial claimants the college will ultimately be built in London.

Tinplate Works Closing

OLD-TYPE tinplate works in South Wales owned by Richard Thomas & Baldwin's, Ltd., and the Steel Company of Wales, are closing down. A statement to this effect was issued after Mr. E. H. Lever (chairman of the two companies) had addressed a meeting of trade union representatives at Swansea on 25 February. About twelve works employing 5,000 men are involved, spreading from Gloucestershire to Llanelly in the west. The reason given for the closure, which Mr. Lever hoped would be temporary, was that there had been a falling off in demand for tinplate, and stocks were accumulating to such an extent that it was not practical to keep on producing at all the old-type works.

Analysis of Metals

Use of Spectroscopy Demonstrated by Dr. A. C. Menzies

DEVELOPMENT of emission instruments from the earliest times to the present day was traced by Dr. A. C. Menzies in a talk delivered to a joint meeting of the London Section of the Royal Institute of Chemistry with the London Section of the Society of Chemical Industry, and the Institute of Metals held at University College, London, on 21 January.

Dr. Menzies, whose lecture was illustrated with both lantern slides and practical demonstrations, outlined and demonstrated the production of spectra by gratings and prisms, using as his practical subject mercury vapour.

Modern developments are now principally concerned with improved and more rapid methods of line density measurement, said the speaker, but improved source units such as the triggered arc circuit are being developed.

Difficulties attending accurate determinations of certain elements were discussed and examples such as phosphorus and sulphur in steel, quoted. In extreme cases resort may have to be made to evacuated and short path instruments to reduce absorption.

Emission and Absorption

The theory of emission and absorption of special lines was described in some detail. A study of the electronic changes in energy level accompanying emission of radiation enables the optimum line pairs for analysis of particular combinations of elements to be selected and the factors influencing such a selection were discussed.

A practical demonstration given with a three electrode arc served a twofold purpose. It showed migration of ions in a D.C. arc and the preferential emission of radiation requiring a lower excitation potential; in the example used emission from copper was partially suppressed by potassium.

Finally the newer direct reading instruments were described. A demonstration of the possibilities of this type of instrument was given, using a medium quatz spectrograph with photo multiplier equipment.

Dr. N. Booth was in the chair, supported by Dr. Ramsay, chairman of the London Section of the Institute of Metals, and Dr. Cameron, chairman of the London Section, SCI.

During the subsequent discussion Mr. Birkingshaw asked for more information on the difficulties encountered at lower wave lengths, for example below 2,200 Å. Dr. Menzies stated that photographic materials were responsible for some losses in this region; however, the main difficulties were absorption by oxygen and quartz, the last effect becoming appreciable at wave lengths below about 1,950 Å. These absorptions can be partially overcome by the use of short path instruments.

Advantages of Electronic Methods

Questions were asked on the advantages of electronic methods of measurement as opposed to the older photographic method. In replying, Dr. Menzies compared the two and said at the moment for qualitative work photography was to be preferred. Electronic methods could give some improvement in accuracy usually with a slightly decreased sensitivity. Their enormous advantage was high speed analysis which on routine work is better than three times that of a photographic method.

In many industries this high speed of working would effect substantial economies in the works, hence the great industrial interest in these instruments. For qualitative work scanning methods are being developed, but these are still in their infancy and broadly speaking the results obtained are not comparable with a photographic record.

The advantage claimed of photographic records for future reference was put forward by Mr. Airey. Dr. Menzies said this should not be overrated; a permanent record from an electronic instrument could be obtained. Furthermore the high speed of working rendered possible the rapid complete repetition of analysis.

Mr. Pembury referred to a recent statement that phosphorus in ferrous metals could be determined better by direct methods than photographically. Dr. Menzies said he would not comment directly on this; he knew that on the Continent photographic methods were preferred for this particular determination.

Interest in the availability of direct reading instruments was shown by questioners, including Dr. Ramsay, who commented on the absence of British-made apparatus of this type. Taking up this challenge, Dr. Menzies said that it was confidently expected that British apparatus would be available, within a year, at prices comparing favourably with imported instruments.

Dr. Ramsay proposed a vote of thanks to the lecturer and expressed the gratification of all the members present. In these times it was a refreshing change to attend a lecture where practical demonstrations had been put to such good use.

Factory Explosion Fatal

Methylal Cause of Death

OF an explosion at a West Bromwich chemical factory where one of two process workers engaged with a lubricant washer was so badly injured that he died from burns, the Birmingham City Coroner (Mr. G. Billington) said at the inquest on 18 February: 'The probability seems to be that someone left the steam tap on.' The inquest was on Dennis Freeman, aged 20, who was employed by Robinson Bros., Ltd., of Ryders Green, West Bromwich. He died in Birmingham Accident Hospital on 14 February. The jury returned a verdict of 'accidental death.'

Mr. F. C. Rostron, of Bromsgrove Road, Hunnington, works manager, said that in his opinion the steam tap was left on causing the methylal which was being used to boil. Vapour issued and being heavier than air it came into contact with a naked flame in another section of the works. That naked light could only be the pilot jet of a machine in another section. The first explosion broke the sight glass of the vessel and ignited the liquid as it came away.

Mr. W. E. Sweet chief fire officer of Smethwick and West Bromwich, said he would like to see the use of naked lights near such an inflammable liquid as methylal excluded, and they were cooperating with the management with that in view. The process worker who escaped serious injury said he did not touch the washer controls and added 'Denis Freeman was more experienced at it than I was.' 'The firm is taking immediate steps to ensure that steam is not used in this process again,' the Coroner told the jury.

Organic Finishing Group

Inaugural Meeting Planned for 19 March

THE inaugural meeting of the Organic Finishing Group of the Institute of Metal Finishing will be held at the Charing Cross Hotel, London, on 19 March. The meeting will be open to all who are interested in the application of organic finishes and non-members will be welcome.

Following a luncheon which is to be served at 1 p.m. in the Regency Room, a short business meeting will be held at 2.30 to elect the committee which is to organise the first year's activities.

The guest of honour at the luncheon will be Mr. J. W. Cole, president of the National Paint Federation and immediate past president of the British Paint, Oil and Varnish Manufacturers; Mr. H. Silman, B.Sc., F.R.I.C., A.M.I.Chem.E., F.I.M., president of the Institute of Metal Finishing, will preside during the meeting.

Commencing at 3 p.m. a technical session will be held presided over by Mr. L. O. Kekwick, B.Sc., F.R.I.C., president of the Oil and Colour Chemists' Association. A paper, 'Problems of Paint Application,' will be presented by Mr. A. A. B. Harvey, M.Sc., A.R.I.C., of Briggs Motor Bodies Ltd. Another entitled 'Problems of Dip and Spray Painting' will be given by Mr. D. H. Lloyd, F.R.I.C., F.I.M., of Fisher and Ludlow, Ltd. Tea will be served during the interval and discussions will take place following each paper.

Composition of Committee

The group committee is to consist of eight members in addition to the president and honorary secretary of the Institute of Metal Finishing who will be members *ex officio*. In order to extend the scope of the group's work as widely as possible, nominations for membership of the committee are invited from interested parties who need not necessarily be members of the Institute of Metal Finishing in the first instance but will, of course, be expected to become members in the event of election.

Each nominee must be nominated by two persons whose names, business address and status should be given on the nomination form. This form is obtainable from the Institute of Metal Finishing, 32 Great Ormond Street, London, W.C.1, and must be returned not later than 12 March.

Oxygen Determination

Belgian Method of Direct Micro-Analysis

DIRECT micro-determination of oxygen, based on the thermal decomposition and iodiodometric titration of the carbon monoxide formed, was introduced by Dr. J. Unterzaucher at the Bayer works, Leverkusen. First described by the author in 1940, it has since become standard practice in the Bayer laboratories.

Some improvements on the original method have been made and a detailed account, supplementing the first report, has recently been published. (*Ind. Chim. Belge*, **18**, 15-21).

The material is thermally decomposed in a pure nitrogen current, and the gas mixture obtained passed over carbon heated to 1,120°C. The carbon monoxide formed, after passing over potash to eliminate gaseous contaminants, is converted to dioxide by iodine pentoxide. The free iodine is converted to iodate, and the iodine titrated with 0 02 N thiosulphate, 1 ml. of which in solution corresponds to 0.1335 mg oxygen. Apparatus now used ensures more complete purification of the nitrogen, so that gas of ordinary commercial grade may be used.

Nitrogen from a cylinder is passed to a purifier tube (quartz) filled with 1.2-1.5 kg. reduced copper wire, heated to about 500°C. in an electric furnace. This tube has a three-way valve at each end, so that the copper oxide formed after long usage may be reduced *in situ* by hydrogen. On leaving the purifier the nitrogen passes through a bubble-gauge containing paraffin oil to a U-tube drier containing soda-asbestos and phosphorus pentoxide on pumice stone.

The whole apparatus and conditions of working are described in detail and illustrated by a diagram.

Difficulties Explained

It is noted that certain difficulties met with hitherto in other laboratories using this method may largely be attributed to the use of insufficiently pure iodine pentoxide. The author therefore devotes considerable space to elaborating this point; also to the type of carbon employed, for example, lamp black, such as grade VA 416.

In practice the method is said to have proved easier and more simple than is usually the case with micro-analysis. The reaction tube is first swept with a counter-current of nitrogen to remove all traces of air, while at the same time the absorption tube containing soda solution is connected with the oxidation tube. The nitrogen current is reversed and passes normally through the apparatus. The sample is vaporised in about 15 minutes, and the gas passes for about another five minutes. Contents of the absorption tube are washed in an Erlenmeyer of 200 ml., the iodine oxidised to iodate and free iodine titrated. Total time for titration is about 30 minutes.

In a series of tests periodical blank tests are necessary. The standard amount of test material used is 2 to 5 mg, and results are accurate within 0.2 per cent. The method may be used for determining traces of oxygen as impurity, as Chambers has found with rubber (*Rubber Chem. Techn.*, 1950, **23**, 727-732).

U.S. Chemical Prices Decline

PRICES in the American chemical industry declined in almost every month of 1952, according to a statement issued from New York by the Manufacturing Chemists' Association on 18 February.

The wholesale price index of chemicals and allied products as compiled by the U.S. Bureau of Labour Statistics is only 3 per cent higher than before the Korean war. The index for all commodities, as distinguished from chemicals, is almost 11 per cent higher than before Korea. The cost of antibiotics has been brought down to a fraction of their introductory costs as these products have entered the mass production phase. The costs of the new chemical textile fibres have also declined sharply.

The chemical industry has been able to hold down price increases because of new and improved processes developed and because of large investments in new and more efficient plants and equipment. The industry is at the half-way mark in its $6,000,000,000 expansion programme scheduled for completion by 1955.

Wage costs have soared in the chemical industry as well as other manufacturing industries. Government data show that the rise in average hourly earnings for manufacturers of chemical and allied products since Korea has been almost 16 per cent.

• HOME •

Kent Refinery in Operation

Despite the recent flooding at Anglo-Iranian's oil refinery, Isle of Grain, Kent, the distillation unit is now 'on stream' and the first products have left the refinery, thus completing the first stage of bringing the refinery into operation. The next stage will be the completion this summer of the catalytic cracker and its associated plants.

Naphthalene Cause of Fire

Water-cooling plant was put out of action for a time on 25 February when a fire broke out at United Coke and Chemicals Company's factory at Orgreave near Sheffield. United Steel Companies, the parent concern, stated that the fire broke out in a stock of 700 tons of naphthalene in solid form, which melted and was destroyed. A temporary arrangement for getting water enabled the coke ovens to work at half production. Although £60,000 damage was incurred it was hoped that the coke ovens would be working fully in five days' time.

Long Service Awards

Three men with between them over 165 years' service at the chemical works of Messrs. E. P. Potter and Co. Ltd., Hall Lane, Little Lever, nr. Bolton, Lancs., are to receive watches from the firm. Watches are also to be presented to another 12 employees, each of whom has a record of over 30 years' work with the same firm; their combined service totals 582 years. Herbert Greenhalgh has over 59 years' service, William H. Santley has 56 years and Joe Ormes has 50 years service. Owing to the illness of Col. C. K. Potter the presentations were recently postponed.

Annual Golf Meeting

The annual golf meeting of the Society of Cosmetic Chemists of Great Britain has been fixed for Thursday, 30 April, and will be held at Walton Heath Golf Club. All members who are interested in this event are asked to make application as soon as possible to the hon. secretary for full details and entry forms. The competition is open to all members of the toilet and cosmetic industry and to members of firms who are actually suppliers of materials for the industry.

Growing Chemical Industry

Estimated numbers of employees in each industry in Great Britain and in the United Kingdom at the end of May, 1952, compared with the corresponding figures for the years 1948 to 1951 are summarised in the February, 1953, issue of the *Ministry of Labour Gazette* (Vol. LXI, No. 2). A steady rise in figures is shown in the chemical and allied trades, totals being: 1948: 445,560; 1949: 456,700; 1950: 473,610; 1951: 485,020; and 1952: 494,290.

U.K. Petroleum Exports

Mr. Geoffrey Lloyd, Minister of Fuel and Power, stated in Birmingham on 27 February that exports of refined petroleum from Britain in 1953 would almost certainly exceed in value the export of coal. He went on to say that in the last few years Britain's oil industry had undergone an amazing development, particularly on the refining side. Output of refined petroleum had increased by £230,000,000 compared with pre-war and last year the export of refined petroleum from Britain totalled £60,000,000.

Director Issues Warning

Presenting long-service awards to employees of Imperial Chemical Industries, Ltd., Billingham-on-Tees, Mr. W. D. Scott, joint managing director of Billingham works said that increased competition from Germany and U.S. chemical works would have to be faced during the next year or two. Controls were disappearing and the ordinary rough and tumble of competition in world markets was returning. Prosperity depended not only on sales in this country but upon world conditions. They had to see that their goods were of a uniformly high quality and that prices were right. He did not believe that the old depressed days would return on Teesside and Tyneside.

Notice Given to Workers

It is understood that 70 process workers of Messrs. John and James White, chemical manufacturers, Rutherglen, received 14 days' notice on 27 February because, it was officially stated, of a serious falling-off in orders which is attributed to increased German and Japanese competition.

· OVERSEAS ·

Swiss Chemical Exports

There was a marked falling off in Swiss exports of certain chemical products during 1952, says a current report from Lausanne. The value of dyestuffs exported fell from 276.4 to 179.5 million francs, and that of chemical products for industrial use from 136.7 to 94.8 million francs. These figures, however, are still three times as large as those of the last year before the war.

To Produce Citric Acid

Kemball, Bishop & Co. (Canada), Ltd., which has been established at Cornwall, Ontario, since 1951 will shortly produce citric acid in Canada. Twelve buildings on a 25-acre site are already occupied and shortly the company intends to expand its processes to manufacture other fine chemicals. When production is completely under way the firm will be in a position to supply all Canada's citric acid needs. Previously, much of the citric acid used in Canada came from the parent company in England and none was produced domestically.

Barter Deal with Belgium

According to a press report Chile has completed a barter deal with Belgium involving the exchange of 20,000 tons of nitrate for a similar amount of phosphate.

Venezuela Oil Production

Oil production in Venezuela has steadily increased and the daily average in 1952 reached the record figure of 1,800,000 barrels and a further increase is expected this year. Reserves are estimated at 9,000,000,000 barrels, approximately 12 per cent of the world's total.

Fertiliser Plant Progress

It has been announced in Istanbul by the Minister of Exploitations that progress has been made with the scheme for establishing a plant to produce 100,000 tons a year of nitrogenous fertilisers and 6,000 tons of nitric acid for defence requirements. Preparations have been made for the formation of a company with a capital of £T60,000,000 for the purpose, of which £T32,500,000 will be provided by local capital. A commission has been appointed to make contact with foreign capital.

New Canadian Subsidiary

Sterwin Chemicals, Inc., a subsidiary of Sterling Drug Inc., has organised a new company in Canada known as Sterwin Chemicals of Canada, Ltd. The new company will serve 'more efficiently and economically' the concern's expanding business in Canada said Mr. P. Val Kolb, the firm's president. Sterwin's increased business in Canada is attributed to inauguration of a nation-wide flour enrichment programme in Canada.

Record Earnings

A new record in sales and earnings was set by Mathieson Chemical Corporation, Baltimore, Maryland, in 1952. Consolidated net sales were $147,109,581 compared with $91,234,076 in 1951, and net income, after taxes, was $13,553,368 compared with $9,652,993 in the previous year. The merger with E. R. Squibb and Sons became effective on 1 October, 1952, so that sales and income of this division's domestic operations are included in the Mathieson report for only three months, and all its overseas operations for the two months ended 30 November. Sales, net assets, and the income of the Brazilian subsidiary are not consolidated, as they previously were by Squibb, due to unsolved currency problems in that country.

Nitrogenous Fertilisers

Montecatini, the largest chemical organisation in Italy, has begun to produce nitrogenous fertilisers at Novara using methane gas as a basic raw material. This is the first factory in Italy to use this process, but another Montecatini plant, nearing completion at Ferrara, will also use methane and will be on an even larger scale. The Novara plant will produce 450,000 tons of ammonium sulphate per year as well as large quantities of various other nitrogen compounds.

Sulphur Output in Turkey

Turkey's present sulphur output of 7,500 tons a year will be doubled when the new plant at the Kechiborlu sulphur works commences production in 1954. When a figure of 15,000 tons a year has been reached Turkey will be in a position to export sulphur.

Personal

DR. H. L. HASLEGRAVE, principal of the Leicester College of Technology, since 1947, has been appointed the first principal of Loughborough College of Technology. The college was set up last September under the direct control of the Ministry of Education.

The Council of the Institute of Metals had made two awards, of 10 guineas each, for essays submitted in connection with the Institute's annual Students' Essay Prize Competition. The awards are to MR. R. D. STACEY, of the University of Birmingham, for an essay on 'Some Experimental Evidence for Dislocations' and Mr. G. Thomas, B.Sc., of Cambridge University, for an essay an 'Martensitic Transformations in Non-Ferrous Metals and Alloys.' Both are student members of the Institute.

MR. ROBERT BARNABY has been appointed a director of Brown Bayley Steels, a subsidiary of the Iron and Steel Corporation of Great Britain.

SIR ARTHUR SMOUT retired from the board of Imperial Chemical Industries, Ltd., on 2 March. Sir Arthur was appointed to the board in 1944 and in the same year became metals group director. In July, 1951, he also took over responsibility for the Nobel Division. Sir Arthur joined Elliotts Metal Company in 1905 and from 1934 till 1942 was chairman of the delegate board of I.C.I. (Metals), Ltd. From 1942 to 1945 he was Director-General of Ammunition Production at the Ministry of Supply and was knighted for his services in 1946.

Obituary

Mr. James Bellerby

The death has occurred at Redcar of MR. JAMES BELLERBY, who had been works manager for Sadler & Co., Ltd., chemical manufacturers, Middlesbrough, for a number of years.

Mr. S. P. Trench

MR. STEWART POWER TRENCH, president and publisher of the daily *American Metal Market*, died recently in New York at the age of 60. He dedicated himself to the maintenance of the standards and prestige of the paper which is one of the leading journals for the metal industry.

Flavour Assessment

FLAVOUR assessment will be the subject of an afternoon and evening symposium to be held next week in London at a joint meeting of the Food Group of the Society of Chemical Industry, the Biological Methods Group of the Society of Public Analysts and Other Analytical Chemists, and the Biometric Society (British Region).

The meeting will be held on Wednesday 11 March at the Wellcome Research Foundation, 183 Euston Road, N.W.1, and will begin at 2.30 p.m. The programme will be as follows:—

2.30 p.m. Chairman: Professor H. D. Kay, C.B.E., D.Sc., F.R.S. Two papers: 'The Physiological Background of Flavour Assessment,' by E D. Adrian, O.M., P.R.S., and 'Basic Considerations in Regard to Flavour Assessment,' by H. G. Harvey, M.Sc., A.R.I.C.

4 p.m. Buffet tea.

4.30 p.m. Chairman: H. O. J. Collier, B.A., Ph D., 'The Objective Approach to Sensory Tests,' by A. S. C. Ehrenberg, B.Sc., and J. M. Shewan, B.Sc., Ph.D., A.R.I.C.: 'Sensory Tests and Consumers Acceptance,' by J. M. Harries, B.A.

6.05 p.m. Chairman: J. W. Trevan, F.R.S., 'A Biometrician's Viewpoint,' by J. O. Irwin, M.A., Sc.D., D.Sc.

Coryton Back on Stream

Last week Vacuum Oil Company announced that its refinery at Coryton, Essex, flooded a few hours after it came on stream, was again in action.

The new refinery, still in the final stage of construction, was completely flooded on the night of 31 January. The spontaneous co-operation of the Army, R.A.F., the Police and civil organisations with the company's staff and contractors made it possible to achieve this result.

An interesting booklet, which briefly tells the story, has been prepared and Vacuum Oil have distributed this to its employees, to all men on the site at Coryton, and to many of its friends in industry and trade, as a tribute to all who worked so hard. It contains some excellent photographs of the flooded refinery.

The Chemist's Bookshelf

THE CHEMISTRY OF SYNTHETIC DYES. By K. Venkataraman. Volume II. New York: Academic Press Inc.; London: Academic Books, Ltd. 1952. Pp. xv + 738. 120s.

The great complexity of the modern dyestuff industry and the bewildering number of its commercial products that are now available makes a chemical treatise such as the present one extremely valuable to all those engaged in the production and use of colouring matters. Much of the information that has been discovered about dyestuffs is veiled in secrecy for commercial reasons, but the patent literature and, in the last few years, the post-war reports on the German dyestuff industry are capable of providing much useful information. Both these sources have been used by Professor Venkataraman to the fullest extent possible, and with his task completed as marked by the issue of the second and final volume he is to be congratulated on the masterly manner in which he has surveyed the chemistry of the many classes of synthetic dyes.

Although there are certain points on which the treatise might be criticised there can be little doubt that for some time to come it will be recommended as a standard reference book on dye chemistry. One point on which most criticism seems likely to be based is that it seems to be implicitly assumed that the reader will be in possession of both volumes of this work. Thus, in the numbering of the pages and chapters, and in the provision of indices (author, subject and dyestuff) at the end of the second volume only, the two volumes are treated as one. In view of the high combined price of the two volumes it seems probable that many British and other readers will find it necessary to consult this work in some library, where difficulties are likely to arise if both copies are required by the same reader. In future editions it might be advisable to make the two individual volumes more self-contained, unless economic considerations make it possible to effect a considerable reduction in the prices of the two volumes.

Volume I was reviewed in this journal (THE CHEMICAL AGE, **66**, 587). Much of the content of the second volume is concerned with derivatives of anthraquinone. These compounds may be employed as acetate, acid, mordant and vat dyes. The anthraquinone vat dyes are of outstanding importance for the production of fast shades on cellulose textiles, and particularly detailed treatment is given to them. The other important class of vat dye, that containing the indigoid or thioindigoid structure, is also discussed. Both the latter and the anthraquinonoid vat dyes can also be prepared in the form of stable water-soluble compounds (sulphuric acid esters of the leuco vat dye), which have special application in the dyeing and printing of textiles. A full account is given of these products, and also of sulphur dyes and sulphurised vat dyes. Various other types of dye are described which are not so readily classified. These include diphenylmethane and triphenylmethane dyes; xanthene and acridine dyes; azines, oxazines and thiazines; benzaphenone, benzoquinone and naphthoquinone dyes; cyanine dyes; and phthalocyanines.

The last three chapters in the volume are devoted to certain subjects of fairly general interest. In one of these a useful account is given of the fading of dyes and of the photochemical degradation of dyed textile materials. The other two chapters deal with the constitution of direct cotton dyes and their substantivity on cellulose, and the affinity of dyes for wool, and with the identification, analysis and evaluation of dyestuffs.

A list of minor corrections to the text of Volume I is given at the front of the present Book.—G.S.E.

Publications & Announcements

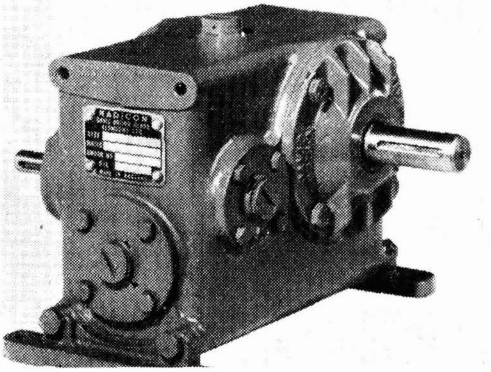
NUMBER 19 of *Wiggin Nickel Alloys*, contains a description of the Fawley Petroleum Refinery, and short articles on oil refinery pumps, medical research cage units, 'Santon' industrial immersion heaters, coke oven corrosion problems, improving Diesel engine efficiency, recording thermometers, furnace belts and precision dispensing. Copies of this journal may be obtained by writing to Henry Wiggin & Co., Ltd., Wiggin Street, Birmingham.

* * *

FIRST production in Great Britain of propylene glycol in commercial quantities is announced by Petrochemicals, Ltd., 170 Piccadilly, London, W.1. Until now the propylene glycol available in the United Kingdom has been of American or, to a lesser extent, of Canadian origin. Supplies have, therefore, been restricted by the exchange problem. Technical, foodstuffs and BPC grades of propylene glycol can now, however, be supplied in quantity. Full information may be obtained from the manufacturers at the above address.

* * *

LATEST addition to the well-known range of David Brown 'Radicon' worm reducers is a 1⅝ double reduction unit, designed to transmit very small horsepowers at low speeds. Developed from the 1⅛ and 1⅝ single reducers, these compact double reduction units are so designed that many component parts are interchangeable with those of the single reduction types. By utilising the standard worms and worm wheels a wide range of output speeds is achieved with standard ratios ranging from 65: 1 to 3,600: 1. Special units, with non-standard ratios up to 10,000: 1 reduction, can be supplied. Reductions varying approximately from 5: 1 to 60: 1 are obtained with each pair of worm gears, and input speeds range from 500 to 3,000 r.p.m. All gears in the standard units are right hand, giving the same direction of rotation of both input and output shafts. Splash lubrication is employed for both gears and bearings, and once filled, no attention is required other than occasional oil level verification, which is indicated by a screwed plug suitably positioned according to the disposition of the units when running.

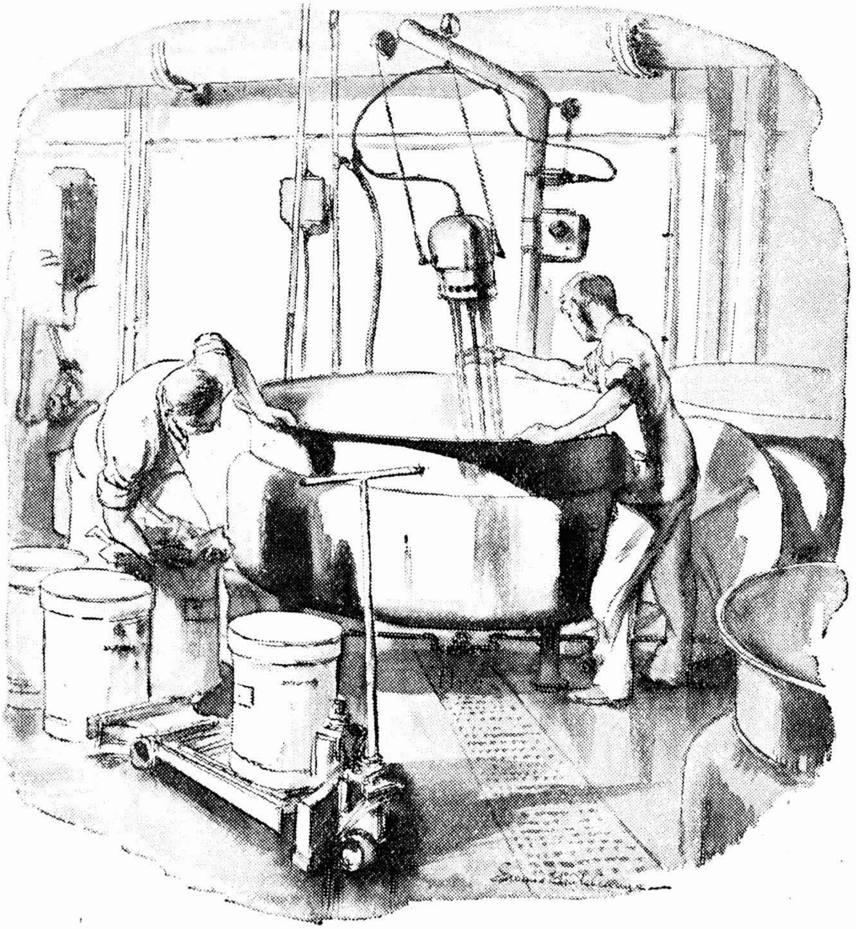

' Radicon ' worm reducer

* * *

SAFETY rules and regulations for handling, storing, shipping and disposing of ethyl chloride are outlined in the latest safety data sheet published by the Manufacturing Chemists' Association, Inc. While ethyl chloride vapours are highly flammable and tend to form explosive mixtures with air, the data sheet points out that the material can be handled with safety if employees are properly educated and are familiar with its hazards. Included are regulations regarding loading and unloading and first aid procedures to follow in case of exposure to excessive vapours or excessive contact with skin. Copies of the 16-page sheet, SD-50, may be obtained for 25 cents from the Manufacturing Chemists' Association, Inc., 246 Woodward Building, Washington 5, D.C.

* * *

CHEMICAL properties of sodium aluminate and the manner in which it is used in various types of water treatment, are described in a revised second edition of the 'Alfloc' booklet 'Sodium Aluminate' now issued by Imperial Chemical Industries, Ltd. Some 2,000 industrial undertakings in Great Britain have adopted the 'Alfloc' methods of water treatment. While sodium aluminate may be applied to a number of industrial processes, other than water treatment, it is pointed out that some processes are still in the development stage, and in certain instances its employment is protected by letters patent.



Next Week's Events

MONDAY 9 MARCH

Royal Institute of Chemistry

London: Woolwich Polytechnic, S.E.18, 6.45 p.m. Dr. A. G. Maddock: 'Developments in Experimental Techniques of Radiochemistry.'

Institution of Works Managers

Manchester: Grand Hotel, 6.45 p.m. R. Craig Wood (managing director, T. Hedley & Co., Ltd.): 'Human Relations in Industry.'

TUESDAY 10 MARCH

Society of Chemical Industry

London: Burlington House, Piccadilly, W.1, 6.30 p.m. Plastics and Polymer Group. Lecture by Professor F. S. Dainton (University of Leeds).

Institution of Chemical Engineers

London: Burlington House, Piccadilly, W.1, 5.30 p.m. J. M. Coulson (Associate Member): 'Climbing Film Evaporation.'

WEDNESDAY 11 MARCH

Society of Public Analysts

London: Wellcome Research Foundation, 183 Euston Road, N.W.1, 2.30 p.m., joint meeting with the Food Group of the Society of Chemical Industry and the Biometric Society (British Region). Symposium on: 'Flavour Assessment.' Chairmen: Professor H. D. Kay, Dr. H. O. J. Collier, and J. W. Trevan. Papers by Dr. E. D. Adrian and others.

THURSDAY 12 MARCH

The Chemical Society

Aberdeen: The University, 7.30 p.m. Official meeting and Pedlar Lecture. Members of the RIC and SCI invited. Professor R. P. Linstead: 'Discoveries Among Conjugated Macrocyclic Compounds.'

Bangor: University College of North Wales, 5.45 p.m. Joint meeting with the chemical societies of the University of Liverpool and University College of North Wales. Professor M. Stacey: 'The Deoxysugars and their Significance as Constituents of Natural Products.'

Sheffield: The University, 7.30 p.m. Sir Robert Robinson: 'The Biogenesis of Plant Products.'

Royal Institute of Chemistry

London: Acton Technical College, High Street, W.3. Dr. A. G. Maddock: 'Developments in Experimental Techniques of Radiochemistry.'

Institute of Metal Finishing

Manchester: Engineers' Club, Albert Square, 7.30 p.m. B. Jones: 'Barrel Polishing.'

The Royal Society

London: Burlington House, Piccadilly, W.1, 11 a.m. J. Z. Young will open a discussion on: 'The Function and Location of Enzymes in Cells.'

FRIDAY 13 MARCH

The Chemical Society

Birmingham: The University, Edgbaston, 4.30 p.m. Professor W. E. Garner: 'Changes Occurring in the Surface of Solids During Chemical Reactions.'

Dublin: Trinity College, 7.45 p.m. Joint meeting with the Werner Society. Professor J. M. Robertson: 'Crystal and Molecular Structure—X-Ray and Electron Microscope Studies.'

Glasgow: The Marlborough Hotel. Ramsay Chemical Dinner.

Newcastle-on-Tyne: King's College, 5.30 p.m. Bedson Club Lecture. Dr. F. Fairbrother: 'Catalytic Inorganic Halides and the Friedel Crafts Reaction.'

Southampton: The University, 5 p.m. Joint meeting with the RIC. Professor N. K. Adam: 'The Mechanism of Detergent Action.'

Swansea: University College, 5.30 p.m. Joint meeting with the RIC. Professor M. Stacey: 'Acids Containing Fluorine.'

Society of Dyers & Colourists

Manchester: College of Technology, afternoon and evening symposium on 'New Fibres.'

Oil & Colour Chemists' Association

Liverpool: Engineering Society Rooms, 6.30 p.m. A. D. Hargreaves: 'Geological Aspect and Uses of Whiting.'

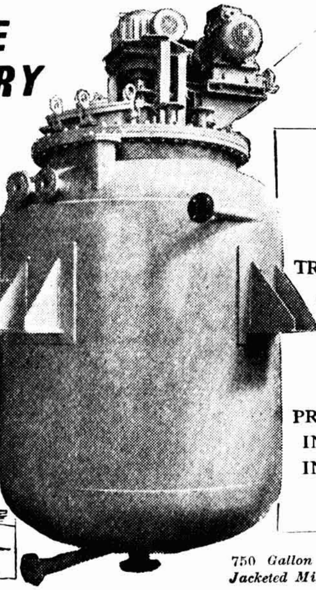
Institute of Welding

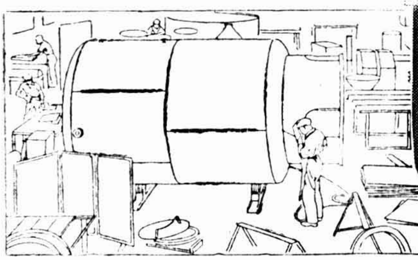
Lincoln: The Technical College, 7.15 p.m. East Midlands Branch. Dr. H. G. Taylor: 'Developments in Welding Research.'

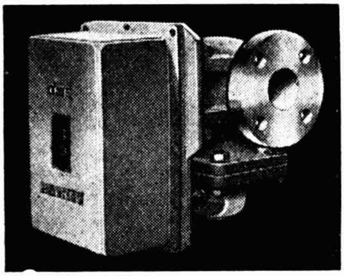
SATURDAY 14 MARCH

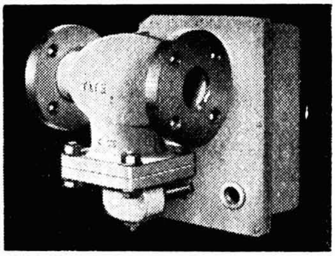
Institution of Chemical Engineers

Birmingham: The University, Edmund Street, 3 p.m. Midlands Branch. Professor D. M. Newitt (past-president), J. F. Richardson, R. H. Clark, and D. E. Charles: 'Pneumatic Conveying, Part I—the Pressure Drop During Horizontal Conveyance.' Repeat of a paper delivered in London on 14 October, 1952. (THE CHEMICAL AGE, **67**, 567-569.)









Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur

Mortgages & Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary but such total may have been reduced.)

INDUSTRIAL CHEMICALS, LTD., London. (M., 7/3/53.) 2 February, £2,000 debentures, part of a series already registered. *£11,250. 20 February, 1952.

LANGLEY ALLOYS, LTD., Slough. (M., 7/3/53.) 28 January, to Westminster Bank, Ltd., securing all moneys due or to become due to the Bank; general charge (subject to, etc.). *£268,749. 28 January, 1952.

SAMUEL BROS. (PLASTICS), LTD., Manchester. (M., 7/3/53.) 28 January, charge, to Barclays Bank, Ltd., securing all moneys due or to become due to the bank; charged on 18 and 20 Chester Road, Hulme, Manchester, and any rent charge/s created on sale thereof, etc. *——. 28 September, 1951.

THERMO PLASTICS, LTD., Dunstable. (M., 7/3/53.) 26 January, £31,000 mortgage, to Eagle Star Insurance Co., Ltd.; charged on factory premises at Luton Road, Dunstable. *£27,000. 26 December, 1952.

Satisfaction

WINDMILL RUBBER & CHEMICAL CO., LTD. (old company), Manchester. (M.S., 7/3/53. Satisfaction, 30 January, of debentures registered 7 January, 1946.

Receivership

H. Keate, of Century House, St. Peters Square, Manchester 2, ceased to act as Receiver on 16 February, 1953, of W. F. Metcalf, Ltd.

New Registrations

V.C.A. Pharmaceuticals Ltd.

Private company. (516,410.) Capital £500. Manufacturers of chemicals and chemical substances. First directors to be appointed by the subscribers. Reg. office: Kirkewhite Street, Nottingham.

Company News

Eaglescliffe & White Merger

Full details of the merger of the Eaglescliffe Chemical Group, Ltd., and John and James White, Ltd., have now been sent to stockholders. The merger, which was made known on 2 January, is being effected through Eaglescliffe as it is a holding company. Prior to the issue of Eaglescliffe shares to shareholders of White's under their offer, it is planned to change the name of Eaglescliffe to British Chrome & Chemicals. Ltd. The board of the parent company is to be reconstituted with Mr. E. F. Wright as chairman when the merger is completed.

Dominion Tar & Chemical

Operating profit on Dominion Tar & Chemical Co., Ltd., Montreal, showed an increase in the year ended 31 December, 1952, it is shown in the annual report. Largely due to a sharply increased provision for depreciation, however, the net profit showed a decrease. This is shown at $1,605,318 against $2,525,018.

During 1952 the company spent $11,777,621 on an expansion programme, and issued $10,000,000 of 15-year debentures. Arthur H. Martin, president, announces in the report that the 'company has under study many new projects in its special fields,' and 'in order that it may be placed in a position to take advantage of further opportunities for profitable development,' further public financing in the near future, details of which will be announced in due course.

In addition to working capital of $10,673,398 at the end of 1952, an amount of $2,000,000 has been set aside to complete construction in progress. At the end of 1951 working capital had amounted to $10,845,661. There was a total reduction of $300,000 of first mortgage bonds in 1952 and a principal amount of $50,000 of Series 'B' bonds was bought in anticipation of sinking fund instalment due on 1 August, 1953.

Market Reports

LONDON.—There has been no material change in the movement of industrial chemicals during the past week and delivery specifications have covered good quantities with a fair sprinkling of new business. Export trade is reasonably good, but competition is becoming very active. Quotations on the home market have continued steady, although one or two changes in prices have been reported. As from 2 March, quotations for acetic acid, pure and technical, have been reduced; the 80 per cent pure being £94 per ton and the 80 per cent technical £88 per ton in each case for 10 ton lots. Barium chloride and percarbonate are quoted at lower rates while sodium sulphide is slightly dearer. Business in the coal tar products market remains steady with pitch and creosote continuing active. There have also been reductions in the price of dry white lead to £138 per ton and dry red lead and litharge to £122 per ton.

MANCHESTER.—The recent moderate improvement in the demand for heavy chemicals on the Manchester market seems to have been maintained, though a good many buyers are content to limit transactions to prompt or near delivery positions. The call for the soda and potash compounds on home-trade account has been reasonably active, and a fairly steady inquiry for the magnesia and ammonia products has been reported during the past few days. Few important price changes have to be recorded. Most of the fertiliser materials are now moving steadily and a ready demand for creosote oil, benzol and some of the other tar products continues.

Phthalate Prices Reduced

Reductions of 2d. and 1d. per lb. respectivtly in the prices of di-butyl phthalate and di-iso-butyl phthalate have been announced by A. Boake, Roberts & Co., Ltd., and British Industrial Solvents, Ltd. The new prices per lb., with effect from 2 March, are:

	Di-butyl Phthalate	Di-iso-butyl Phthalate
10 tons, spot or contract ..	2s. 1d.	1s. 10½d.
5 tons, spot or contract ..	2s. 1¼d.	1s. 10¾d.
1 ton, spot or contract ..	2s. 1¾d.	1s. 11¼d.
40/50 gallon drum	2s. 2½d.	2s. 0d.
10 gallons	2s. 5d.	2s. 2½d.
5 gallons	2s. 6d.	2s. 3½d.

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive, or a woman aged 18-59 inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order, 1952.

LAPORTE CHEMICALS LIMITED have a vacancy for a **PLANT MANAGER,** of British nationality, for a small Production Unit at their Luton Works. Qualifications required: Chemical Engineering Graduate, 25-28 years of age. Successful candidate will be given initial training of several months. Good prospects of advancement to position on larger project. Superannuation Scheme in operation. Apply to the **GROUP ENGINEER, LAPORTE CHEMICALS LIMITED, HANOVER HOUSE, 14, HANOVER SQUARE, LONDON, W.1.**

LAPORTE CHEMICALS LIMITED have vacancies for three **SHIFT CHEMISTS,** of British nationality, for a small Production Unit at their Luton Works. Qualifications required: Inter B.Sc. Standard with several years' plant experience, 22-25 years of age. Successful candidates will be given initial training of several months. Good prospects of advancement to positions on larger project. Superannuation Scheme in operation. Apply to the **GROUP ENGINEER, LAPORTE CHEMICALS LIMITED, HANOVER HOUSE, 14, HANOVER SQUARE, LONDON, W.1.**

SYNTHETIC CHEMICALS LTD., KNOTTINGLEY, YORKS, will shortly require **PLANT CHEMIST** who will later be in charge of the Phenol unit of their Synthetic Phenol Plant, now under construction. Particulars of age, qualifications, experience and salary required to the Secretary.

THE CLARENCE BY-PRODUCT AND DISTILLATION PLANT OF DORMAN LONG & CO., LTD., require for impending large-scale developments the following Drawing Office personnel:—

1—**LEADING DRAUGHTSMAN,** fully experienced in the design and layout of coal products distillation plants and their equipment, and capable of taking charge of a small Drawing Office in the absence of the Chief Draughtsman.

1—**EXPERIENCE DRAUGHTSMAN** used to piping details and layouts.

Permanent employment, with good prospects to men with skill and initiative. Pension Scheme in operation. Apply, stating age, experience, wage required and when at liberty, to **DORMAN LONG & CO., LTD., G.P.O. BOX 11, ROYAL EXCHANGE, MIDDLESBROUGH, YORKSHIRE,** marking the top left-hand corner "By-Products."

FOR SALE

CHARCOAL, ANIMAL AND VEGETABLE, horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—THOS. HILL-JONES LTD., "INVICTA" MILLS, BOW COMMON LANE, LONDON, E. TELEGRAMS: "HILL. JONES, BOCHURCH LONDON," TELEPHONE 3285 EAST.

FORGED STEEL PRESSURE VESSEL, 44 ft. long by 4 ft. 3 in. i.d. by 4 in. thick. **WORKING PRESSURE,** 2,000 lb. p.s.i. **C. W. HOGG, 42, BUSHEY WOOD ROAD, SHEFFIELD.** Telephone: 72777.

FOR SALE

ECONOMIC BOILERS—9 ft. diam. by 12 ft. 6 in. Foster Yates, 200 lb. w.p.; 8 ft. diam. by 14 ft. Paxman, 180 lb. w.p. Twenty others, all sizes.
NEW GALVANISED PIPING. Immediate delivery. Johnson Filter **PRESSES,** 25 in., 18 Frame, practically new.
FIVE new **FURNACE RETORTS,** 8 ft. diam., 6 ft. 8 in. deep, approx 8 tons each. Welded Steel.
FIVE Dish-ended **NAPHTHA TANKS,** 18 ft. 6 in. long by 4 ft. 4 in. diam., two having agitators.
TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS.** Stainless Steel **FILTER TANK,** 3 ft. 6 in. diam.
ONE Stainless **CONICAL HOPPER,** 7 ft. 3 in. diam., overall depth, 7 ft. 6 in.
TWO Broadbent **WATER-DRIVEN CENTRIFUGES,** 30 in. diam., 12 in. deep, 1,150 r.p.m., 150 lb. pressure.
FOUR Papier-mache O.T. **TANKS,** 8 ft. 3 in. diam., 9 ft. deep. (Unused.)
SIX O.T. **TANKS,** 7 ft. diam. 14ft. deep, lined inside with acid-resisting bricks.
SIX Aluminium **CONDENSERS,** 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ⅞ in. o.d.
ONE Rectangular Lead-lined **TANK,** 8 ft. by 4 ft. 6 in. by 2 ft. 6 in.
FORTY Riveted **RECEIVERS,** 8 ft. 6 in. long, 5 ft. 6 in. diam., 75 lbs. w.p.
CAST-IRON PIPES, 5000 ft. Each 6 in. and 8 in. **NEW VALVES** in Stainless, Gunmetal, Enamel Lined.
Free Catalogue, "Watkins Machinery Record," available

FRED WATKINS, COLEFORD, GLOS.

GRAVITY Roller Conveyor several lengths, Rolls. 2¼ in. diam. by 16 in. 3 in. centres. Good condition. **THOMPSON & SON (MILLWALL), LIMITED, CUBA STREET MILLWALL E.14.** (Tel.. East 1844.)

LIMITED number of new '**STIRRER GATE**' agitators fitted with vertical moss 5 h.p., 1,000 to 20, worm reduction gears, 3½ in. diam., stainless steel drive shafts with S.S. paddle gates attached; also several new 10 h.p. Wallwork reduction gears, 9 in. centres ratio 210 by 18, vertical output shaft, can be supplied mounted on 6 ft. 6 in. by 1 ft. 10 in. C.I. bed plate if required.

WOODFIELD & TURNER,
BURNLEY. Tel. 3065.

SCREENLESS PULVERIZERS for fine grinding of Chemicals. Also CYCLONES, ROTARY VALVE FEEDERS. Callow (Engrs.) Ltd. Kirkby Trading Est.. Liverpool.

PHONE 98 STAINES

TWO Stainless Steel 50-gal. **PANS,** 2 ft. 2 in. by 2 ft. 6 in. deep.
Ditto, 100-gal., 2 ft. 6 in. by 3 ft. deep, with electric agitator.
Stainless Steel Jacketed Gas-heated Cylindrical **MIXER.** 22 in. by 36 in. deep (approx. 40 gal.), 400/3/50.
STAINLESS STEEL GARDNER MIXER, 5 ft. by 19 in. by 20 in. deep; totally enclosed; electrically driven; 400/3/50.
Two Small Electric **HYDROS** (stainless type baskets). 11 in. by 12 in. deep; 200/1/50.
5,000, 1,200, 1,000-gal. Welded Underground Cylindrical **STORAGE TANKS.**
Ditto; riveted, up to 12,000 gals.; 30 ft. by 9 ft. diam.
EXTRUDERS, with 5 in. and 7 in. diam. dies; water cooled.
BOILERS, CONDENSERS, "Z" and Fin Blade **MIXERS. PUMPS, STILLS, HYDROS, CONVEYORS,** etc Lists on request.

HARRY H. GARDAM & CO., LTD.,
STAINES.

FOR SALE

3 JACKETED **INCORPORATORS,** double "Z" arms, double geared, power-driven tipping motion, with counterbalancing weights.

1—Baker Perkins **MIXER** as above, not steam jacketed, single geared, complete with 25 h.p. A.C. motor.

3—Baker Perkins and Werner Jacketed **MIXERS** screw tipping pattern, friction pulley drive, single geared, with double-fin type agitators.

4—Gardner **RAPID SIFTER MIXERS** and **MIXERS** only, various sizes, one with brass fitted interior and glass-lined end plates.

27—Various **POWDER DRESSING** or **SIFTING MACHINES,** totally enclosed with barrels from 80 in. long by 22 in. diam. to 120 in. long by 30 in. diam., belt driven with collecting worm in hopper bottoms.

1—Simon Horizontal Tubular **DRIER,** 12 ft. long, 100 lb. steam pressure, size 3B, requiring 12 b.h.p.

4—Recessed Plate **FILTER PRESSES,** 30 in. square, 70 plates in each, centre fed.

5—Johnson **FILTER PRESSES,** 24 in. square, side feed and enclosed delivery, fitted 29 plates and 30 frames.

1—Johnson **FILTER PRESS,** 36 n. square, plate and frame type, double inlet and enclosed delivery ports.

Johnson Oil **FILTER PRESS,** Premier type plates 2 ft. 8 in. by 2 ft. 8 in., of which there are 45, with angle lever closing gear.

1—Johnson **FILTER PRESS,** 42 C.I. plates, 32 in. square, centre feed.

Steam-heated **FILTER PRESS,** Premier type, 32 in. square, with 30 recessed plates.

Wood **FILTER PRESS,** fitted 69 ribbed plates, 2 ft. 8 in. square, with top centre feed and bottom enclosed delivery channel.

1—24 in. **HYDRO EXTRACTOR,** self balancing, swan-neck type, self emptying bottom.

Heavy Cake **CRUSHING MILL,** 2-pair high, by Nicholson, for cake up to 3 in. thick, rolls 30 in. long, top with coarse teeth 9 in. diam., bottom with finer teeth 12 in. diam

5 Sets A.A. **CRUSHING ROLLS** for linseed, cotton seed, etc., 48 in. long, belt driven, with feed hopper, side frames, baseplate and striking gear.

Bennett Copper-built **EVAPORATOR,** 4 ft. diam. by 4 ft. 6 in. high, steam-jacketed bottom, mounted on legs, with swan-neck vapour pipe and separate vertical belt-driven vacuum pump.

Douglas **ROTARY PUMP** for oil, soap, etc., belt driven.

6 Various Horizontal Duplex **STEAM PUMPS,** Worthington and Tangye pattern, 1 in. to 2½ in. suction and delivery.

"U"-shaped Horizontal **MIXER,** 8 ft. long, 3 ft. wide, 3 ft. 3 in. deep, belt and gear driven, end outlet, square horizontal centre shaft with cast radial type mixing arms, last used for lineoleum paste.

1—"U"-shaped **MIXER,** as above, but 7 ft. long.

4—5-roll **REFINERS,** fitted chilled iron, water-cooled rolls, 40 in. long, 16 in. diam., belt and gear driven, with clutch drive suitable for motor, by Baker Perkins. Ltd.

No. 2HS Hammamac **HAMMER MILL,** No. 1 size, Standard Miracle Mill, No. 2 size Standard Miracle Mill and a No. 3 Super Miracle Mill, with fans, piping and cyclones.

7 ft. Torrance Positive-driven **EDGE RUNNER,** 2 Vertical Paint Pug Mills, 2-bar Disc Paint Grinding Mills, and 2 Horizontal 40-gallon capacity Cox Pug Mills for paint.

1—No. 1A Water-cooled **CIRCULATOR MILL.**

RICHARD SIZER, LTD
ENGINEERS,
HULL.
Telephone 31743

FOR SALE

MORTON, SON AND WARD, LIMITED,
offer
MIXING PLANT

ONE—Stainless Steel Tilting **TROUGH MIXER** by **CHALMERS.** 3 cwt. capacity; motorised. Interlocking lid.

ONE—TROUGH MIXER by **GARDNER.** 3 cwt. capacity; stainless steel lined trough and twin chrome-plated scroll blades mounted on stainless steel shaft; fast and loose pulley drive.

ONE—as above; motorised. Single scroll blade arranged with sifter.

"MORWARD" "U"-SHAPED TROUGH MIXERS, constructed to REQUIREMENTS. Varying sizes up to 3 tons with scroll- or paddle-type mixing gear; jacketed or unjacketed.

JACKETED PANS

100g., 150g. and 200g. new **JACKETED PANS,** all welded, mounted on three legs; with or without mixing gear.

SEVERAL Second-hand **JACKETED PANS** in stock, from 40g. to 200g. capacity.

ONE—Stainless Steel **MOTORISED AGITATOR,** 5 h.p. geared motor, 200 r.p.m. output, three-bladed propeller.

HYDRO EXTRACTORS

A large selection of **HYDRO EXTRACTORS,** 72 in., 60 in., 48 in. and 42 in., by **BROADBENT** and **WATSON LAIDLAW** available.

PUMPS

Various **MONO** and other **PUMPS** in stock, 2 in. to 6 in., new and second-hand, in stainless steel, gunmetal and cast iron.

INQUIRIES INVITED.

MORTON, SON AND WARD, LIMITED,
WALK MILL,
DOBCROSS, NR. OLDHAM,
LANCS.
'Phone: Saddleworth 437.

NEWTON CHAMBERS GLEN FALLS ROTARY SULPHUR BURNER, complete with secondary combustion chamber, feed hopper and steel flue pipes. Capacity, 10 tons of sulphur per day. Purchased new, 1946. The burner was in service for approximately three years. For further particulars, apply **BOX No. C.A. 3204, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

STORAGE TANKS FOR SALE

HORIZONTAL CYLINDRICAL

2,000 gallon
1,250 gallon
1,000 gallon
600 gallon
500 gallon

RECTANGULAR ENCLOSED

3,000 gallon 1,300 gallon 1,000 gallon

OVAL LORRY MOUNTING

3,000 gallon—6-compartment.
900 gallon—with pump and engine.
500 gallon—galvansied.
450 gallon—on pneumatic trailer.
250 gallon—galvanised.

RECTANGULAR OPEN-TOP

1,000 gallon 800 gallon

VERTICAL CYLINDRICAL

400 gallon—galvanised.
250 gallon—**NEW TVO** storage.

Lists with full details, from :—
WILLIAM R. SELWOOD, LIMITED
CHANDLER'S FORD, HANTS.
'PHONE 2275.

FOR SALE

600

PROCESS PLANT

2 **TUBE MILLS,** each 20 ft. by 3 ft. 6 in. diam., mechanical worm feed and enclosed steel discharge box. Pulley drive.

3 Micro twin **REFINING MILLS** by Torrance, rolls 14 in. by 9 in. by 7 in. Drive from f. and l. pulleys.

Horizontal single trough **JACKETED MIXER** by Day. Trough 7 ft. by 38 in. by 42 in. deep. Intermittent spiral Agitators on 3¼ in. diam. glanded shaft. Driven through 'V' ropes and duplex chain by 7½ h.p. Slipring motor 400/3/50.

Horizontal **DOUBLE TROUGH MIXER** with M.S. Welded Trough 40 in. sq. by 36 in. deep. Z-type Agitators, double geared, motorised 400/3/50. Power op. tilting.

ROTARY VACUUM FILTER by Davey Paxman. Drum 33 in. by 36 in. diam., with stepped perfs. f. and l. pulley drive through spur and worm gear.

2 Recessed Plate type **FILTER PRESSES** by Manlove Alliott, with 54 plates 36 in. sq. by 1 in. thick. Hand op. closing gear.

Two 40 galls. **KELLIE** copper S.J. tilting **BOILING PANS,** 30 in. diam. by 26 in. deep. C.I. jacket for pressure 80 lb. sq. in. Hand tilting.

Two 4-cyl. **AMMONIA COMPRESSORS** by L. Sterne. Type 4 W.7. Each designed to develop 41 tons refrigeration at 410 r.p.m. Complete with Condenser Oil Separator, Liquid Receiver and Centrif. Pump. 'V' rope drive.

New ½ h.p. Slow Speed Stirrers 440/3/50, totally enclosed motor, stainless steel shaft with propellers rotating at 420 r.p.m.

GEORGE COHEN SONS & CO. LTD.,
WOOD LANE, LONDON, W.12.
Tel.: Shepherds Bush 2070 and
STANNINGLEY, Nr. LEEDS
Tel.: Pudsey 2241.

5—**CENTRIFUGES.** Water driven. 48 in. by 20 in. Working speed 950 r.p.m. Water pressure 250 p.s.i. Complete with fittings. Unused. Excellent condition. **APPLY BOX No. 3198, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

2—**HOWARD HVL. ROTARY PUMPS.** 10 galls. minute Light Hydrocarbons at 175 p.s.i. Mounted on Bedplates. Main Glands fitted flexibox seals. Without motors.

1—**HOWARD OHL/DE** Double ended Proportiometer **PUMP.** 3 g.p.m. Hot Caustic Soda against 50 ft. Delivery Head ¾ h.p. Brook Flameproof motor. Mounted on Bedplate.

1—**HOWARD OHL/SE** Single ended Proportiometer **PUMP.** Output 40 g.p.h. against 25 ft. head. Body "Ni-Resist." Valves, seats and plungers—Stainless Steel. Complete with ¾ h.p. Brook Flameproof 1,450 r.p.m. motor. Mounted on Baseplate.

1—**HOWARD OHL/SE** as above but output 40 **GPH.** Hydrocarbon Liquids at 100 p.s.i. and without motor. Apply **BOX No. 3199, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

4—**CLYDE** Fuel Positive Rotary Oil Gear **PUMPS.** Driven direct through Flexible Couplings by 1 h.p. Flameproof M.V. motors. 4 **GPM.** against 50 ft. head. Apply **BOX No. 3200, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

1—**MANESTY No. 1A.** Steam heated Automatic **WATER STILL.** Output 4 galls. per hour. Apply **BOX No. 3201, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

FOR SALE

QUANTITY PHOS. ACID, 1,300 spg. in 10-gallon carboys, available for sale: also quantity second-hand 10-gallon carboys. Offers **BOX No. C.A. 3209. THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

FOR Sale, one each 50-gallon barrels 90's **TOLUOLE** and 20 **XYLOLE.** Price £25 the lot, excluding barrels. **BOX NO. C.A. 3210, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

STEAM-HEATED **TABLES,** 72 in. by 30 in. and 58 in. by 26 in.

Aluminium **TRAYS,** 42 in. by 24 in. and 33 in. by 20 in., 3/16 in. thick.

Cast-iron Copper-lined **STEAM PAN,** 25 gal., on three legs.

Vertical Crosstube **STEAM BOILER,** 9 ft. by 4 ft., 80 lb. pressure.

KIMMINS & SONS, LTD.,
LYNDHURST ROAD,
WORTHING

30 **CWT. CHAIN BLOCKS,** 10 ft.-12 ft. lift, ex-Government surplus. £15 per set.

5 **CAST-IRON JACKETED PANS,** 36 in. diam. by 27 in. deep, 1¼ in. bottom outlet. £20 each.

1 **MILD STEEL WELDED OPEN-TOP TANK,** 60 in. by 27 in. by 42 in. by ⅜ in. plate. £25.

THOMPSON & SON (MILLWALL), LTD.,
CUBA STREET, MILLWALL, E 14.
TEL. EAST 1844.

PATENTS & TRADE MARKS

KINGS PATENT AGENCY, LTD. (B. T. King, A.M.I.Mech.E., Patent Agent), 146a, Queen Victoria Street, London, E.C.4. ADVICE Handbook, and Consultation free Phone: City 6161.

SERVICING

CRUSHING, GRINDING, MIXING and DRYING for the trade.

THE CRACK PULVERISING MILLS, LTD.,
Plantation House,
Mincing Lane,
London, E.C.3.

GLASSBLOWING by HALL DRYSDALE & CO., LTD., 58, COMMERCE ROAD, LONDON, N.22. Telephone: BOWes Park 7221.)

GRINDING of every description of chemical and other materials for the trade with improved mills, wharfage and storage facilities. **THOS. HILL-JONES LTD., "INVICTA" MILLS, BOW COMMON LANE, LONDON, E. TELEGRAMS: "HILL-JONES, BOCHURCH, LONDON." TELEPHONE: 3285 EAST.**

WET AND DRY GRINDING Micronising, Grading and Mixing of Minerals and Chemicals for all trades. Also suppliers of ground zircon, sillimanite, fused silica, precision casting materials and a wide range of ground minerals.

W. PODMORE & SONS, LTD.,
SHELTON, STOKE-ON-TRENT
Phones STOKE-ON-TRENT 2814 & 5475

WORKING NOTICE

THE Proprietors of British Patent No. 631260 for **"IMPROVED MANUFACTRUE OF THICK FOILS OF REGENERATED CELLULOSE DERIVATIVES,"** desire to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from **MARKS & CLERK, 57 and 58, LINCOLN'S INN FIELDS, LONDON, W.C.2.**

THE Proprietors of Patent No. 630861, for **"IMPROVEMENTS RELATING TO THE MANUFACTURE OF SUBSTITUTED AMMONIUM THIOCYANATES,"** desire to secure commercial exploitation by licence or otherwise, in the United Kingdom. Replies to **HASELTINE LAKE & CO., 28, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2.**

WANTED

INDUSTRIAL BY-PRODUCTS, LTD., 16, Philpot Lane, London, E.C.3, will be pleased to receive particulars of any by-products, waste materials and residues for disposal.

TWO RUBBER-LINED MIXERS, 5/600 gal. capacity, fitted heavy type rubber-covered stirrer. Vessel to have 4-in. bottom outlet and 2-in. side outlet. Unlined Mixers would be considered.
BOX No. C.A. 3205, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.

TIMBER PLATE and **FRAME FILTER PRESS,** 20 chambers, approximately 2 ft. square plates.
BOX No. C.A. 3206, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.

24/30-in. **HYDRO EXTRACTOR** with vulcanite covered basket and inner casing.
BOX No. C.A. 3207, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.
HARDINGE CONICAL BALL MILL, 5/6 ft. diam.
BOX No. C.A. 3208, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.

URGENTLY wanted—**USED MERCURY (QUICKSILVER)** in any quantity ; containers supplied. Also **MERCURY SCRAP COMPOUNDS, NON-FERROUS AND PRECIOUS METAL SCRAP,** and waste materials containing same. Highest prices paid. **BELGRAVE BUYERS (C.A.) 5, BELGRAVE GARDENS, LONDON, N.W.8. MAI. 7513.**

WE BUY every kind of redundant and **FLOOD DAMAGED STOCK.** Fair price. Immediate clearance and cash. Large parcels only. For satisfactory disposals please contact **POMSON BULK BUYING CO., LTD., WESTMINSTER ICE RINK, MILLBANK, S.W.1 (EUSTON 5657).**

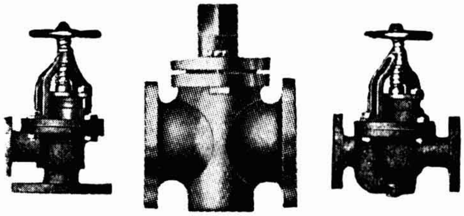
KEEBUSH

Keebush is an acid-resisting constructional material used for the construction of tanks, pumps, pipes, valves, fans, etc. It is completely inert to most commercial acids ; is unaffected by temperatures up to 130°C ; possesses a relatively high mechanical strength, and is unaffected by thermal shock. It is being used in most industries where acids are also being used Write for particulars to—

KESTNER'S

5 Grosvenor Gardens, London, S.W.1

FOR VALVES AND COCKS FOR ACIDS IN IMPROVED DESIGNS



HAUGHTON'S METALLIC CO., LTD.

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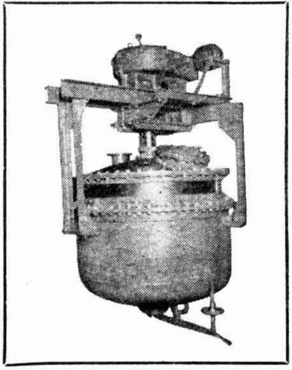

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