The
Chemical Age

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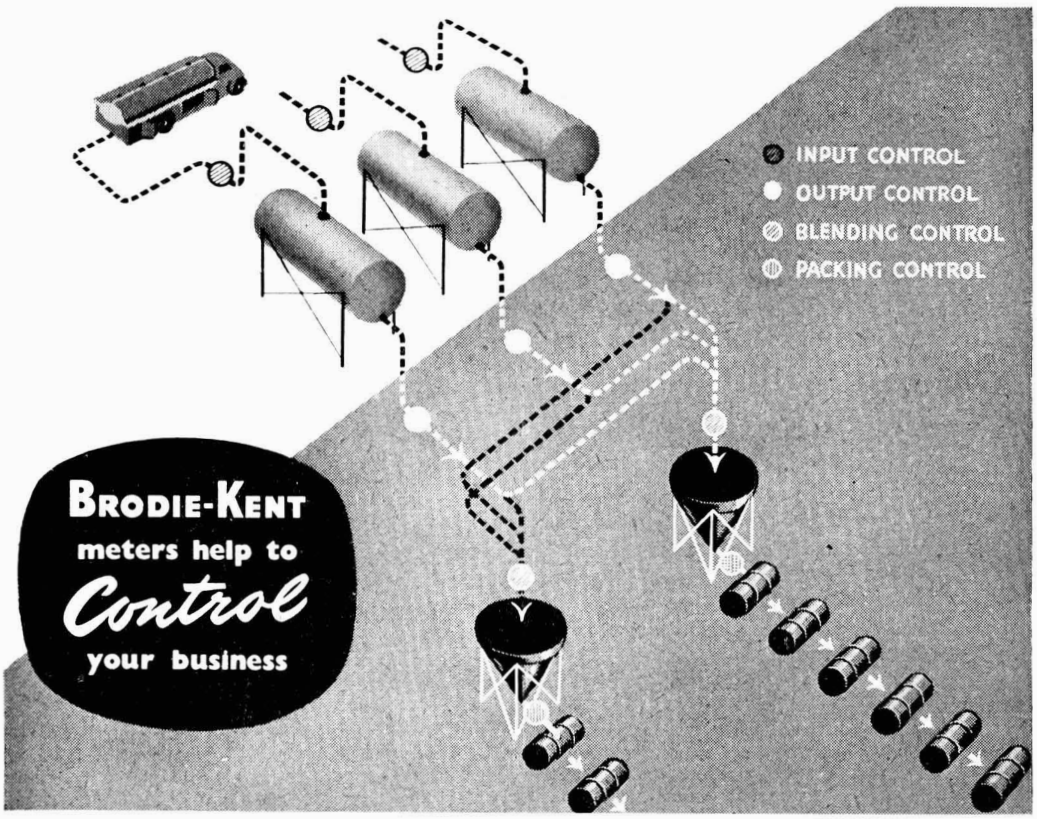

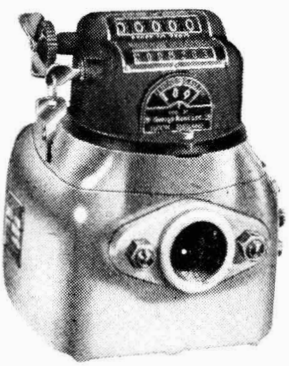

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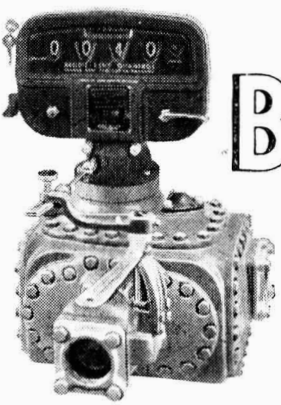

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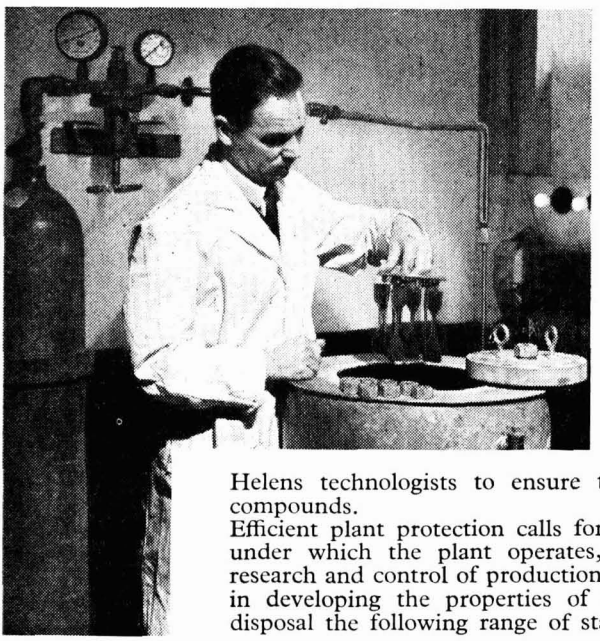

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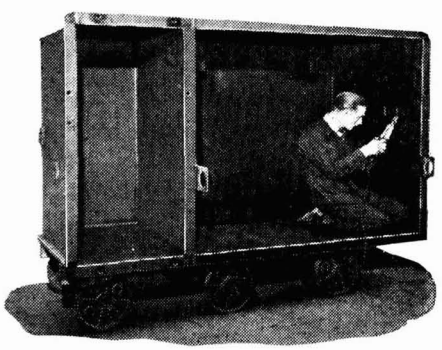

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The Chemical Age

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CONTENTS · 17 OCTOBER 1953

Beilby Memorial Awards	**794**
The Late George E. Davis	**795**
Productivity Drive	**798**
Applications of the Dithiocarbamates	**799**
Pinic Acid Diesters	**801**
Recovery of Selenium	**804**
Metal Melting Under Vacuum	**805**
New Laboratories for Murex	**807**
Solar Energy	**810**
The Chemist's Bookshelf	**811**
Home News Items	**813**
Overseas News Items	**814**
Personal	**815**
Publications & Announcements	**817**
Law & Company News	**819**
Next Week's Events	**822**
The Copper Sulphate Outlook	**824**
Market Reports	**825**

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Chemistry & Man

THE title of a new book sponsored by the Chemical Council is 'Chemistry and Man'.* It is a small book of some 90 pages and it is inexpensive. The text is based upon four lectures which were given under the Council's auspices at the time of the Festival of Britain; and even if the transition from speech to printed page seems to have been somewhat tardy, the fact that the material concerned has been saved from impermanence is certainly important. There have been far too few good and comprehensive efforts to explain the purpose and achievements of chemistry to that real but ill-defined person, the man in the street. The Royal Institute of Chemistry's ambitious effort of 1918, 'What Industry Owes to Chemical Science', was perhaps more specifically aimed at the man in the boardroom or the youth with chemical ambitions; its emphasis, at any rate, was mainly placed upon technology and the applications of chemical knowledge.

From time to time in this century there have been commendable efforts by individuals, notably perhaps the American book on plastics and polymers by Williams Haynes, 'This Chemical Age'. But despite the rapid enlargement and ever-intensifying complexity of the subject which we still somewhat bravely define with the one word 'chemistry', these spasmodic efforts have not been nearly enough. The very growth of chemistry has pushed the man in the street farther away in understanding; yet in his everyday life and use of things he has become far more dependent upon chemists and their work. Two generations ago the thoughtful middle-aged man who had been taught some chemistry at school, even allowing for no little rusting of his memory, could still hope to understand what chemists were up to. The gap is so much bigger now, and bridges are all the more valuable. Modern science must not be allowed to become a new mysticism: therein lurk as many dangers for scientists as for mankind in general.

This new book covers a remarkable amount of varied territory in its compact 26,000 to 27,000 words. Professor Sir Cyril Hinshelwood, Professor Linstead, the late Sir Jack Drummond, and Professor Cook each make superb contributions. If it is generally felt that specialists are not always the best people to come to grips with the public, here certainly are four exceptions to that assumption. At any rate, for a layman readership of the level of, say, *The Listener* or the less sensational daily papers, reception will not be interrupted by frequent technical hitches.

Nor is the persuasive influence wholly materialistic. It is, after all, a little too easy to popularise chemistry by extolling its gifts, to glamourise the chemist because he has made nylon stockings possible, or to tempt youthful ambitions along the chemical path because modern chemistry is so obviously 'big business'. Professor Hinshelwood, though starting the book by defining chemistry as the subject of things and of the fundamental way things are built up, shows that these are not all that chemists transform and

* CHEMISTRY AND MAN. By Hinshelwood, Linstead, Drummond and Cook. E. & F. N. Spon Ltd. & The Chemical Council. London. 1953. Pp. 88 + viii. 7s. 6d.

think about. Hinshelwood's survey of the impact of chemistry upon modern thought and philosophy is a perfectly placed prelude to Professor Linstead's account of 'Chemistry and the Amenities of Life'. And even Linstead delays his survey of chemistry's gifts to better living in order to discuss the moral aspects of applying science; 'It has sometimes been said that science is neither good nor bad; it is neutral. This I conceive to be a distortion. The search for truth, even if only for one sort of truth, must be good in itself. It would be fairer to say that technology is neutral, in that scientific knowledge can be applied with equal force to beneficial and to harmful ends.'

As for the materialistic gifts of chemistry, novelty today can perhaps be unduly stressed. The limelight is shone upon new fibres and new mouldable substances, but Linstead reminds us that, although little praised for it, chemical progress during the past 90 years has given us, for instance, purer water, softer and free from disease organisms.

The breadth of Drummond's survey of the chemical front in agriculture and food handling is astonishing—fertilisers, their effects on crop yields and flavours, meat quality, antibiotics as feeding supplements, pesticides, vitamins and their synthesis, artificial fats, the possibility of photosynthesis without plants, Agene, sugar substitutes, colour and taste, and preservation processes—all these subjects are briefly but clearly outlined in a total of about 9,000 words. So little space allowable to each of these different subjects—yet Drummond also found room in more than one case to discuss the latest research developments! As a lecture in the Festival summer this brilliant and concentrated cross-section picture of food science must have enthralled the fortunate audience; and they will certainly have shared with chemists that deeper shock which the news of Drummond's and his family's crude murder was so soon to bring.

Lastly, Professor J. W. Cook on chemistry in the conquest of disease. Again the field is so wide that admiration of the writer's economy in dealing with it tends to distract attention from the subject matter itself. That, however, may be mainly a scientific reader's reaction. Modern chemotherapy from Paul Erlich to the Mayo Clinic's discovery of cortisone is surveyed with a sense of continuous historical development, close to our own times though so much of it all is. The first chemotherapeutic dyes with their troublesome disadvantages, the search for similar but colourless synthetic substances which led to the arsenical drugs; the metal-free drugs with their less dangerous toxicities; the anti-malarials, first substitutes for and improvements upon, quinine; the sulpha group, even now less than 25 years old, which destroy the smaller bacterial invaders of the body, best represented perhaps by 'M. & B.' although another and younger member, Sulphetrone, may become even more famous in countries where leprosy is more dreaded than pneumonia; penicillin and the successive antibiotics—the stream of chemotherapeutic progress and variety widens to a river.

Nevertheless, Cook has found space to spare for the public health contributions of modern synthetic insecticides, and to discuss vitamin and hormone fortification in dealing with deficiency diseases. Of health improvement, Cook rightly says, 'I think, though, that the chemist gets much less than his fair share of public recognition of the important part which he has been able to play in these matters. . . .' But, for this, who are more to blame than chemists themselves? All too seldom is the effort made, as it is in this book, to tell the public the story of modern chemistry.

However, the book itself will achieve little unless it is widely read. The four distinguished chemists who have written it have admirably served their subject and their profession, and it surely becomes now the task of other chemists to foster general interest in the result of their labours. When the intelligent layman expresses bewilderment or apprehension about the activities of chemists, here at least is an easy answer that can be given to him—the title of a short and consistently readable book. The Chemical Council is to be congratulated on taking part in its publication and it is to be hoped that other attempts to stimulate public consciousness of chemists and their contributions to mankind will steadily follow.

Notes & Comments

Fertilisers in South America

A RECENT FAO publication ('Fertiliser Production, Distribution and Utilisation in Latin America', 1953, pp. 52, from HMSO, 2s. 6d.) somewhat belatedly gives a clear and full account of a conference held in 1951 at Rio de Janeiro. The amount of food that is produced and considerably exported by these countries, important though it is as a world factor, is obviously limited by soil poverty. Only some 25,000 tons of phosphoric acid as superphosphate (roughly equivalent to 140,000 tons of superphosphate) are manufactured and used each year. It is only necessary to cite Italy's 22,000 tons or Eire's 43,000 tons (both as phosphoric acid) to realise how pitifully small South American usage of fertilisers is. On so vast a food-producing acreage, this total quantity of superphosphate is no more than a sprinkling of salt. There is, of course, additional phosphatic help from the bird guano islands of the western coast, but this indigenous source of plant-food is principally utilised in Peru and Chile. The tonnage involved may make the total annual usage of South America look better on paper, but in fact the average rate of application in the non-western countries is unaffected. Nor, despite the long-known reserves of nitrate minerals in Chile, is the nitrogen story of Latin America much better. Some 71,000 tons of nitrogen (equivalent to 360,000 tons of sulphate of ammonia) are totally used. It is far too little. It is approximately equal to the annual consumption of Belgium and Luxemburg! Poor yields of crops are an inevitable consequence. In Argentina the yield of wheat (as cwts. of grain per acre) dropped steadily from 9.5 to 6.2 in the period 1948-51; this can be compared with yields of about 20 cwts. in Western Europe, about 14 cwts. in France, and 9 to 11 cwts. in North America. The maize yield of Argentina is two-thirds that of the United States. When and where fertilisers are used in proper amount, however, and especially phosphates, crop yields in Latin America rise quite strikingly; increases in productivity per acre from 200 and 300 per cent down to 80 and 50 per cent have been established in Uruguay and Brazil.

Indigenous Sources Imperative

THE unanimous view of delegates to the FAO conference was that Latin American countries must urgently find and develop indigenous sources of phosphatic and potassic fertilisers. Mineral phosphate deposits are already known in Chile and Brazil; in the latter country, one deposit of phosphate rock is estimated to be up to 100,000,000 tons in size. There is little doubt that a superphosphate, nitrophosphate, or thermal phosphate (possibly all three) industry must steadily develop in South America. Developing a greater willingness to use modern fertilisers may at first be a slow process but, as results set examples, the pace of expansion should quicken. Manufacturers of fertiliser plant may find it worth while to make themselves better known in industrial centres of major Latin America countries.

Plastics in India

A VALUABLE survey of the ten-years-old plastics industry in India appeared in the *Journal of Scientific & Industrial Research* (1953, **12**, 8, 361). This industry came into existence during the second world war when so many normally imported materials and articles could not be obtained with regularity. There are now some 80 factories and a number of very small 'cottage-scale' workshops producing moulded plastic goods; all these, however, depend upon imported moulding powders, as much as 8,000 tons being annually used. Production of moulding powders has recently been started; but to date the tonnage made is only about 250 tons per year, mainly of phenolic powders based upon imported phenol and formaldehyde. Polystyrene moulding powders, owing to their cheapness, are rapidly becoming the most popular, and of the 8,000 tons of all moulding powders used, 2,500 tons are now of the polystyrene class.

Great Expansion Possible

THE future of this new industry in India clearly depends upon the growth and widening of her chemical industry. Research, though somewhat limited, has already shown how many of the raw materials needed could be produced from India's own resources, from benzene, coal-tar, alcohol, and cellulose. The first major stride towards self-sufficiency would seem to be along the formaldehyde route. Methyl alcohol will shortly be converted into formaldehyde at the Bhadravati Iron and Steel Works, and 3,500 tons of this same chemical will soon be annually produced by a fertiliser factory at Sindri. The latter development, incidentally, will be associated with a production of 10,000 tons of urea per annum. Two large calcium carbide plants have been proposed by the Government's Panel on Heavy Chemicals and Electrochemicals; these projects, which are tied up with the development of hydroelectricity, would make large quantities of acetylene available as a starting material for plastics. Furfural production from agricultural wastes has already begun in Punjab. The already existent plastics industry of India employs 10,000 workers. Expansion in the next 10 years, especially if stimulated by the home-production of basic chemicals, could be much greater. This might not only affect the present importation of moulding powders; it could also reduce the quantities of oils and resinous substances now exported by India. Uses in plastics goods manufacture have been found for tobacco seed oil, cashew nut shell liquid, and castor oil. In countries where a wide-ranged chemical industry has long existed, the advent of a vigorous plastics industry has led to profound changes in the supply and demand equilibria for many chemicals. In a country where the chemical industry is young and still far from organised, the consequences are less easy to predict.

Beilby Memorial Awards

Applications Invited by Administrators

FROM the interest derived from the invested capital of the Sir George Beilby Memorial Fund, at intervals to be determined by the Administrators representing the Royal Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals, awards are made to British investigators in science to mark appreciation of records of distinguished work. Preference is given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy, and awards are made, not on the result of any competition, but in recognition of continuous work of exceptional merit, bearing evidence of distinct advancement in science and practice.

In general, awards are not applicable to workers of established repute, but are granted as an encouragement to younger men who have done original independent work of exceptional merit over a period of years.

The Administrators are empowered to make more than one award in a given year if work of sufficient merit by several candidates is brought to their notice. For 1952, one award of 150 guineas was made to Mr. T. V. Arden.

Consideration will be given to the making of an award or awards from the Fund early in 1954. Outstanding work of the nature indicated may be brought to the notice of the Administrators, either by persons who desire to recommend the candidate or by the candidate himself, not later than 31 December, 1953, by letter addressed to The Convener of the Administrators, Sir George Beilby Memorial Fund, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

The letter should be accompanied by nine copies of a short statement on the candidate's career (date of birth; education and experience, degrees and other qualifications, special awards, etc., with dates) and of a list of references to papers or other works published by the candidate, independently or jointly.

The Late George E. Davis

Memorial Lecture by Norman Swindin, A.M.I.Mech.E., M.I.Chem.E.

A MEMORIAL lecture on the life of George E. Davis, 'the father of chemical engineering,' was given by Mr. Norman Swindin, of Nordac Ltd., in the Reynolds Hall, College of Technology, Manchester, on 10 October, under the auspices of the North Western Branch, Institution of Chemical Engineers, and the Chemical Engineering Group and the Manchester Section of the Society of Chemical Industry. A memorial dinner followed at the Queen's Hotel, Manchester.

The following is a summary of the memorial lecture:—

George Edward Davis died 47 years ago at the age of 57 and the Institution of Chemical Engineers have decided that some record of his life and work be made to establish his claim to be the real pioneer of the profession of chemical engineering.

George E. Davis lived at the time of the great giants of the chemical industry who forged those fundamental dynasties of chemical processes: the Leblanc Soda process, the ammonia soda process and the host of electrolytic chlorine processes. He saw the final development and death of the Leblanc process, the coming of the more scientific methods of the Deacon-Hurter catalytic chlorine process, the ammonia soda process, the many electrolytic processes and the beginnings of the real study of the treatment and purification of coal gas.

Equal of all Others

He made his contribution, but he would be the last to claim a position equal to that of Mond and Hurter. He was, however, the equal of all others in ability, application, zeal and almost sacrificial devotion in demanding clean management and in the study of trade wastes and pollution; he alone seems to have sensed from his early days the need for a new kind of engineer—one who combined the necessary scientific principles with sound practical engineering. His reputation rests on his work in technical education and in laying the foundations of chemical engineering. The purpose of this lecture is, therefore, to show how Davis conceived and worked out, from an intense and most varied experience, the basic principles and training of our profession.

George E. Davis worked with Hurter, Roscoe, Mond, Deacon, Hargreaves, Weldon, Glover, Chance and others during his professional life (1870-1907), formed societies to discuss chemical works problems and became one of the most successful consultants of his time. He was a pioneer in the recovery of benzol, sulphate of ammonia and cyanogen from coal and coke oven gases—in fact he was the first to regard the gas industry as a real chemical industry and not just one kind of technology. He became an authority on questions of river pollution and disposal of trade wastes of all kinds. He was one of the founders of the Society of Chemical Industry and later established his own journal, the *Chemical Trade Journal*, which became an organ of the trade and a forum for voicing his attacks on fraudulent practices and for presenting the latest information to assist the chemical manufacturer. He was for a period one of HM Inspectors under the Alkali Acts.

Born at Eton

He was born at Eton and learnt his chemistry at the Slough Mechanics Institute and at the Royal School of Mines, London. Before he was 20 he was experimenting at the Windsor and Eton Gas Works in extracting benzol from coal gas. This work ultimately led to his appointment by Newton Chambers, Ltd., Thorncliffe, Sheffield, as gas manager at their Rockingham works. Here he erected one of the first by-product gas plants for the extraction of hydrocarbons and sulphate of ammonia.

In 1870, at the age of 20, he obtained a post as works chemist at Bealey's Bleach Works, Radcliffe, near Manchester. For the next ten years he gained experience in the works of J. C. Gamble & Son, St. Helens, and the Runcorn Soap & Alkali Company, and was for a time manager of Cannock Chase Chemical Works. In 1880, at the age of 30, Davis began private practice and opened an office in the Barton Arcade, Manchester. Soon he was appointed by Dr. Angus Smith one of HM Alkali Inspectors. On the death of Dr. Angus Smith in 1883 he resigned and returned to private practice in Manchester.

Davis was a founder member of the Society of Chemical Industry, its first honorary general secretary and a member of the first publication committee. Most of his chemical activities are described in the many papers which he read before this society.

By-Products from Coal Gas

Davis knew the gas industry in his day inside out and was one of the pioneers in the recovery of by-products from coal gas. In 1883 he read a long paper before the Midland Section of the Society on the distillation of coal which contained a fairly complete history of the gas industry and led to a full account of the plant and process for the extraction of benzol and sulphate of ammonia erected at Rockingham for Newton Chambers & Company, Ltd.

The process was the outcome of research begun when he was only 18 years of age. Coal was carbonised in retorts similar to those used in gas works and the gas was scrubbed by being passed through oils cooled to 40° C. by refrigeration with a No. IV Linde ice machine. He obtained very pure benzol, carbolic acid and sulphate of ammonia. The plant was not superseded till after his death in 1907. In his last years he worked out a successful process for the extraction of sodium ferrocyanide from coal gas. Davis adapted the original Coffey still for the recovery of ammonia.

Davis was one of the HM Alkali Inspectors from 1880 till 1884. Looking carefully through his reports, one is impressed with his energy, fairness, sense of justice and thoroughness, combined with intense irritation at the disgusting methods of management he often found. The experience coloured much of his later practice and influenced his efforts to prevent the pollution of the atmosphere and the rivers, and no doubt began his quest for the chemical engineer.

In 1887 Davis founded his *Chemical Trade Journal*. It was the forum for his ideas and criticism, and it published technical and business information for the manufacturer. In these same years he delivered a course of lectures on chemical engineering at the old Manchester Technical School. These lectures were reported in the *Chemical Trade Journal* and some years afterwards they were issued as the first edition of 'The Handbook of Chemical Engineering.' Later a second and revised edition appeared. This handbook is the first work ever written on the subject of chemical engineering.

Davis possessed a profound knowledge of the Leblanc soda process and sought always to avoid waste and the accompanying nuisance and pollution. His first process was the conversion of aluminium phosphate, sand and slack into tribasic phosphate of soda and alkali. The sulphur was recovered and there was no noxious waste product. He improved Weldon's manganese recovery process and later reduced Hargreave's saltcake with water gas to form sodium sulphate, which he converted to carbonate by carbon dioxide from the water gas. The process is interesting in that the solids have not to be moved, the original heat of formation is conserved and there are no waste products. Davis claimed no novelty, but that he had only tidied up existing processes by better chemical engineering.

Davis studied the old reaction to form chlorine by the oxidation of hydrochloric acid, which seems to have fascinated many inventors. In a paper read before the Society of Chemical Industry, he said he had reviewed 166 patents taken out between 1778 and 1876 for the production of chlorine. Davis himself took out four patents in 1890, and on these he based his process for the production of chlorine. The Davis Chlorine Process Company was formed to exploit it and works were erected at Lostock Gralam. The project did not succeed. It came too late because the Leblanc process was slowly dying, and few saw at that time the effect of Castner's mercury electrolytic cell in which brine was converted directly into caustic soda and chlorine.

Essentially an Educationist

Davis was essentially an educationist. He was constantly lecturing and reading papers before all sorts of amateur societies and contributing articles to journals, such as *The English Mechanic*. He was interested in the microscope and established a journal—*The Northern Microscopist*—for publishing papers read at many microscopical societies in the North of England and general business information. Davis himself contributed many papers to his journal. In addition he held at one time a microscopical society in his own house.

Although, along with most chemical manufacturers, he, at first, opposed Roscoe's

Technical Education Bill as being 'all claptrap,' he later recanted. In 1889 he said: 'That State aid should be invoked for the endowment of special chairs of applied science in all our universities and principal colleges . . . . and that in order to aid the deserving but poor student in acquiring the highest attainable knowledge in applied science, a system of State Colleges or universities in which there is State chair of applied science should be established.'

Davis spoke without a trace of accent and with very clear enunciation. He was an excellent lecturer with unusual powers of exposition. Even his early papers are models of their kind and he could explain abstruse subjects in simple language to unlettered audiences. He fought a continual battle for the prevention of all kinds of industrial waste and pollution of rivers. With his brother, Alfred, he published a study of the river Irwell—the Irwell and its tributaries —in the preface to which the following characteristic statement appears:—

'The filthy state of the Irwell watershed is in great measure due to the general apathy to move in the matter. Mr. Brown will do nothing because Mr. Jones is a worse pollutor than himself and Mr. Robinson is always waiting to see what Mr. Brown and Mr. Jones are going to do. But perhaps the worst procrastinator is the proverbial Mr. Smith, who is always supposed to be on the look-out for the best process. Chemistry is well known and we have plenty of experience.'

Founded the Profession

Although the need of an engineer with sufficient knowledge of chemistry and especially physics to design and erect chemical plant was felt long before Davis's time, it was Davis who really founded the profession of chemical engineering. Gossage missed success in many inventions because there was no engineer to carry out his ideas. Gossage complained that 'the chemist led him astray when working on his sulphur recovery process.' A. M. Chance 50 years later handsomely acknowledged his debt to Gossage: 'If Gossage had had the modern machinery at his disposal, he and not we would have hit on the process I am about to describe—the Chance Sulphur Recovery Process.' Davis, reviewing the work on the recovery of sulphur from vat waste, said 'To look over the patents granted during the past 50 years shows how near some of the older experimenters were to the goal.'

Davis's account of how he came to realise the need of the chemical engineer is given in the introduction to his 'Handbook of Chemical Engineering.' He mentions that an attempt to found a society of chemical engineers was made in London in 1880, but the membership was too limited and the idea was abandoned. The definition of a chemical engineer at that time was 'that of a person possessing a knowledge of chemistry, physics and mechanics and who employed the knowledge for the utilisation of chemical reactions on the large scale.'

Three Studies Distinct

According to Davis, chemical engineering differs from general engineering chiefly on account of the destructive character of the materials operated upon and the very nature of the processes themselves require adequate knowledge of theoretical and applied chemistry. He is careful to distinguish chemical technology and applied chemistry from chemical engineering as the three studies are distinct. Chemical engineering runs through all the range of manufacturing chemistry, while applied chemistry simply touches the fringe of it and does not in the least degree deal with the engineering difficulties, while chemical technology is concerned with the problems of one particular industry.

Chemical engineering avoids useless and often costly research because problems solved in one industry can be applied to another and quite different industry for the chemical engineer is concerned with the design, erection and maintenance of plant for carrying out chemical reactions without in any way specifying the industry in which the plant is in use.

The origin of this first treatise of chemical engineering was a series of lectures delivered by Davis in 1887 at the old Manchester Technical School. Many of the lectures were published in his *Chemical Trade Journal*, but owing to pressure of ordinary business engagements, the publication was interrupted. In 1893 he tried 'to take up the lost threads, but in the end little progress was made.' Not till 1901 was there an opportunity 'to collate the accumulated matter of the various chapters that form the present work' (the first edition). In 1904 the second edition was issued, to which I made a modest contribution and which was handsomely

rewarded by 'the author's best thanks' in the preface to it.

The work is now out of print and is not easily accessible to the present day student, who is mainly taught from American textbooks. It is an intensely practical commonsense book and contains much information of the working and design of the various forms of the Leblanc process. To those few of us privileged to see the work grow, it contains much of a personal and historical interest. To the present student it will appear elementary for it contains little mathematical analysis of any process and design is based on experience and is always empirical but usually sound; problems of fluid flow and heat transmission are, of course, not discussed as they are today for the work of Osborne Reynolds had not been made public.

George Davis's son, George Neville, was at this time a student at Owens College under Reynolds, and it is through him I made my first acquaintance with Reynolds and occasionally heard the old professor discuss problems at the Engineering Students' Society. Much is made today of the study of the subject by using processes, but I have never found the idea very fruitful in overcoming special difficulties. I think that the idea arose from the convenience of study when chemical engineering began to be taught as a separate and special subject and is probably based on the chapters into which George Davis divided his book.

Davis was very methodical. On his shelves near at hand were a number of cardboard box files corresponding to a chapter in his book. In these were filed every bit of information that came to him.

Productivity Drive

ABCM Conference on 'Work Study'

A TWO-DAY conference on 'Work Study in the Chemical Industry' was held under the auspices of the Association of British Chemical Manufacturers at Buxton last week-end. Imperial Chemical Industries, Ltd., willingly complied with the invitation of the organisers to provide from their experience of work study techniques the basic material for a conference at which representatives from all branches of the industry as a whole would be given the opportunity of discussing how these techniques could play their part in ensuring higher productivity.

More than 500 senior executives attended the conference and took part, with the result that at the end of the proceedings they appeared to have been convinced of the worthwhileness of work study. Many of the companies represented will, it is hoped, now employ work study engineers. To assist them in this connection the ABCM is to establish in London a work study advisory committee. Representatives of firms already using work study techniques will serve on this committee, which will act as an advice bureau and distribute the latest information and periodicals.

Resulted from Productivity Report

The conference came about as a direct result of the report of the productivity team which toured Great Britain and America on behalf of the heavy chemical industry in 1952. In many American factories, stated the report, the productivity per employee was at least three times that of the British. One way in which British industry could help close this gap, the report claimed, was by a comprehensive use of work study, the scientific study of men and their jobs, with the object of making better use of manpower, plant and raw materials.

Among the speakers, Sir Thomas Hutton, director of the British Productivity Council, said the conference had a unique quality in that one firm, the largest in a very competitive industry, was putting its experience at the disposal of the entire industry.

Sir Ewart Smith, technical director of I.C.I., said I.C.I. was convinced that work study was a major aid to competitive efficiency and no manufacturer could afford to do without it. A careful investigation in I.C.I. over a full year's working showed that there was a net saving due to work measurement and incentives equal to about four times the additional total administrative cost, half of which cost represented staff salaries. There were, too, major savings due to the extended use of work study.

Several speakers at the conference dinner emphasised the importance of work study to the industry. These included Sir Harry Pilkington, president of the Federation of British Industries, and Mr. E. Higgins, national officer of the Transport & General Workers' Union.

Applications of the Dithiocarbamates

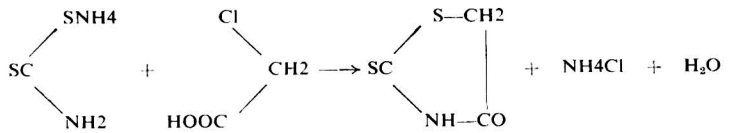
by E. G. CURPHEY

THE dithiocarbamates feature as fast accelerators in the rubber industry. In the compounding of synthetic elastomers their zinc alkyl salts are used in heat ageing mixtures comprising butadiene acrylonitrile copolymers. In conjunction with tetra methyl thiuram disulphide their tellurium and selenium salts have found use as fast accelerators in butyl rubber compositions. Nitrile rubber recipes requiring low hysteresis figures are often compounded from mixtures of accelerators comprising tetramethyl thiuram disulphide, benzthiazyl disulphide and dinitrophenyldithiocarbamate respectively. In vinyl polymerisation techniques, the dithiocarbamates are employed as short-stoppers, like quinone and *m*-dinitrobenzene, whereby the maximum desired characteristics of appropriate copolymers may be obtained. Their possible conversion to the disulphide, and consequent oxidation to the corresponding sulphones, invites their possible application as anti-oxidants.

In agriculture these compounds have found important uses as fungicides and such derivatives as N,N-dimethyl-S-*tert*.butyl-thiosulphenyl dithiocarbamate and appropriate homologues have been claimed as specific fungicides being even effective in dilute solutions (USP. 2,598,989). The efficacy of the dithiocarbamates as fungicides may be correlated with their possible decomposition to CS_2 *in vivo*, the latter compound being an active cytoplasmis poison.

In conjunction with such plant hormones as the naphthoxy acetic acids, the zinc and ferric dithiocarbamates have been employed as precautionary measures against Fruit Rot, *Botrytic cinerea*, a fungus attacking parthenocarpic fruits such as glass-house tomato plants. Here where the compatibility of the fungicide with the hormone is imperative in order to obviate damage to trusses, the dithiocarbamates have proved of use. The prescribed early treatment with some hormone-fungicide sprays serves to attack the focal points of early infection, e.g. the withered corollas, and so prevents the later epiphytotic developments leading to Fruit Rot (Newhook and Davison, *Nature*, **172**, 351 [1953]). Many useful compounds are prepared from the dithiocarbamates, such as the thiuram disulphides. These compounds may be prepared by the electrolytic oxidation of the appropriate alkali dialkyl dithiocarbamates, the oxygen being liberated as a result of the combination of the OH anions at the anode, or by the action of sulphur on the zinc salts.

Other derivatives having fungicidal properties equal to those of the dithiocarbamates are their cyclic derivatives, the rhodanines (J. G. ten Houten, *Nature*, **171**, 1102 [1953]) the substance of most importance being the N-phenyl-rhodanines, where the *p*-position in the benzene nucleus is preferably substituted with a further rhodanine fragment as in the case of the *p*-phenylene *bis* rhodanines. Rhodanine is prepared by the action of ammonium dithiocarbamate on sodium chloracetate, cyclisation being effected by acetic acid, as follows:—

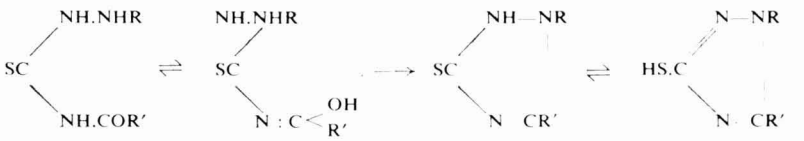


Appropriate 1:2:3:4-tetrazoles have been prepared by the action of sodium azides on dithiocarbamates of the structure R.NH.CS.SR′ where R and R′ are substituted or unsubstituted hydrocarbons (BP. 567,353). Acidification of the alkali salts affords the corresponding tetrazole. The reaction is probably based on the known reactivity of hydrazoic acid with carbonyl centres, as noted for example in the action of hydrazoic acid on unsymmetrical ketones (Schmidt's Reaction). Mercaptans are eliminated during the cyclisation of the tetrazole.

Theoretically, the course of this reaction involving sodium hydrazoate suggests that the salt exists in the cyclic form (I) and not the conventional linear form of a resonance hybrid, the sodium atom possibly contributing to the cyclic form, where such a cyclic

structure would tend to equate bond strains. The possible difference in energy values between the 3s and 2p orbitals, tending to give a decreased overlapping, would diminish the resonance energy of the ring and tend to establish ionic forms. Reaction at the thiocarbonyl centre would give a substituted sodiothio-methylthioaminomethyl hydrazoate, this intermediate undergoing an intramolecular change to the 1:4-dihydro-5-*gem*sodiothio-methylthio-1:2:3:4-tetrazole derivative, elimination of mercaptan giving the 5-mercapto compound.

This intramolecular change is possibly based on an overlapping of the tertiary N p-orbitals adjacent to the carbon with that of an sp orbital of the NH, whereby hydrogen is transferred to the tertiary N, with the consequent formation of the dihydrotetrazole derivative, the reaction being finalised by the elimination of mercaptan.

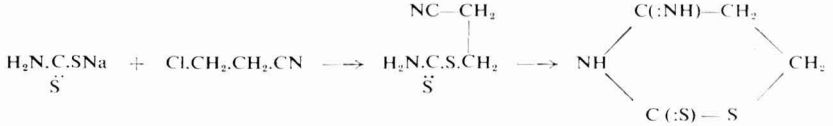


Alkyl dithiocarbamates react with lead nitrate to give the alkyl isothiocyantes as noted in the following equation:—

$$R.NH.CS.S.NH_4 \xrightarrow[PbNO_3]{H_2S} R.N:C:S + NH_3$$

Through the intermediacy of the alkyl isothiocyanates may be prepared the corresponding thiosemicarbazides, such a synthesis being based on the known reactions of the isothiocyanates with given amines:— $R.N:C:S + NH_2.R' \rightarrow R.NH.CS.NHR'$ where R′ is alkyl or NH_2. The therapeutical significance of the thio-semicarbazides lies in the preparation of certain thiosemicarbazones and of which those of the aromatic and heterocyclic aldehydes have been shown to be of importance in the treatment of human tuberculosis.

The addition of alcohols to the isothiocyanate molecule affords the corresponding urethane derivative:—$R.N:C:S + R'OH \rightarrow R.NH.CS.OR'$. These latter compounds have found uses as foaming agents and as inhibitors in pickling baths (BP. 353,337). Through the isothiocyanate link by the action of the appropriate substituted amine (*v. supra*) the 4-alkyl thiosemicarbazides may be synthesised, the latter by acetylation being converted to the 1:3:4-triazoles. This reaction is performed by the use of fatty acid chlorides in pyridine sol tion (BP. 573,105). The reaction probably proceeds through the intermediate enol form of the 1-acyl-4-thiosemicarbazide, ring closure in the presence of alkali yielding 1,2-dialkyl-5-mercapto-1,3,4-triazole. The 4-alkyl thiosemicarbazides are best prepared from ice-cold ethanolic solutions:—



Other interesting applications of the dithiocarbamates involve the synthesis of the triakylthioureas (BP. 314,542). Arsenical derivatives of the dithiocarbamates have recently been used also. The use of dithiocarbamates in the synthesis of possible sulphur derivatives, particularly heterocylic compounds, does not appear to have been fully exploited, although the late Professor Smiles may have included them within the ambit of his theories and researches.

The addition reactions of the nitriles with amino groups, as in the preparation of biguanide from dicyanamide, suggests the possible analogous reaction of 2-chloroethylcyanide on an appropriate dithiocarbamate to give the 4-imino-1-thia-5-aza-*cyclo*hex-6-thione:—

The reactivity of the S-Na group in the thiocarbamate molecule suggests that a useful bifunctional character may be imposed on the molecule using suitable ω substituted halogen alkan-1-ols or acids, the resulting

continued on page 820

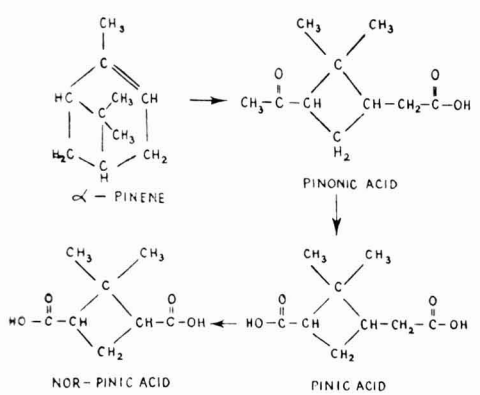
Pinic Acid Diesters

Preparation & Properties of a New Class

A REPORT on the preparation and properties of a new class of diesters prepared from pinic acid and normal alcohols containing from 4 to 10 carbon atoms has been released by the Naval Research Laboratory, Washington, D.C.*

Aliphatic diesters are in increasing demand for the extreme low temperature lubrication of turbo-jet engines, instruments, machine guns, and for aviation and ordnance greases. Some of these diesters are also useful as low-temperature plasticisers. A variety of end products are derived from the dibasic acids, the branched-chain alcohols, and even the diesters themselves. Since 1942, the growing demand for diesters has made it desirable to increase the US domestic supply of cheap dibasic acids suitable for the preparation of lubricants and low-temperature plasticisers. Products obtainable from indigenous raw materials were regarded as especially desirable.

Attention was directed to the possibilities of using certain dibasic acids derivable from α-pinene, a major constituent of turpentine. The principal acids formed in the stepwise oxidation of α-pinene are as follows:



Although the earlier oxidation product, pinonic acid, appeared to be cheaper to produce than pinic acid, it was not expected to be sufficiently oxidation stable for the intended uses. However, it was agreed that esters of this acid should be prepared and studied. A plan was evolved for co-operative research, in which the Southern Regional Research Laboratory (SRRL) of the Department of Agriculture was to make the 2-ethylhexyl ester of pinonic acid and the corresponding diester of pinic acid for a preliminary study by the Naval Research Laboratory.

Pinate Diester the More Stable

Early experiments showed that both compounds had pour points below −50° and viscosity indices of 60 and 86 respectively. Accelerated thermal oxidation tests using air at 125° and 150° revealed not only that the pinate diester was the more stable, but also that it was more effectively stabilised by a good antioxidant like phenothiazine. Since the lesser resistance to oxidation manifested by the pinonates was caused by the keto group, it was concluded that the pinates were the more promising materials from which to develop stable lubricants. This did not exclude the possibility that the pinonates might be very useful for plasticisers or other applications.

Diesters containing cyclic groups have not found extensive use in low temperature lubricant applications because of their large temperature coefficients of viscosity or because of their high freezing points or pour points. Experience with such esters is based largely upon the phthalate esters and others prepared from alcohols containing phenyl or cyclohexyl groups. Since the cyclobutyl ring is much smaller than a 6-membered ring, its presence in the oil molecule should not cause such adverse effects on the combination of properties required of a low temperature oil. The investigators were confident that the dimethyl substituents on the cyclobutyl ring, which increase the asymmetry of the molecule, would act to prevent the close alignment of neighbouring molecules and so produce very low freezing points. The presence in such compounds of four geometrical and optical isomers should cause an additional lowering of the freezing points.

* 'Pinic Acid Diesters: Their Preparation, Properties and Lubricant Applications', by C. M. Murphy, J. G. O'Rear and W. A. Zisman, Lubrication Branch, Chemistry Division, Naval Research Laboratory.

It was demonstrated that branching near the centre of the molecule was more effective in lowering the freezing point and had a less adverse effect upon the viscosity index than branching near the end of the molecule. Diesters of pinic acid made with normal alcohols—especially the C_4-C_{10} alcohols—would have this type of configuration and would, therefore, be expected to have high viscosity indices, low freezing points, and lower viscosities at $-40°$ than the phthalates. Because of the similarity of these dialkyl pinates to other aliphatic dibasic acid esters used as low-temperature plasticisers, it was conjectured that such pinates should have interesting possibilities for the proposed application.

Diesters of Exceptional Purity

In the next phase of the programme the SRRL was asked to prepare small quantities of the *n*-amyl, *n*-hexyl, *n*-octyl, and 2-butoxyethyl diesters of pinic acid for further study by the Naval Research Laboratory. One ester, dihexyl pinate, was to be prepared in larger volume for lubricant studies. Soon afterwards, these and other pinate diesters of exceptional purity were prepared by the Naval Research Laboratory in order to obtain more data on the relation of structure to properties and for comparison with materials prepared in pilot-plant quantities. Later the SRRL undertook the development of oxidation methods suitable for the low-cost commercial production of pinic acid.

Since $-55°$ is the lowest temperature required in current military specifications for lubricants, every pinate not having a freezing or a melting point was subjected to storage tests of 72 hours' duration at 2.5° intervals down to $-60°$. Only the *bis*-(2-butoxyethyl) and didecyl pinates could be made to crystallise. As was expected, the dimethyl substituted cyclobutane ring in the pinic acid molecule hinders the close alignment of neighbouring molecules, and thus liquids were obtained with freezing points or pour points sufficiently low to cater for the current requirements of low-temperature lubricants.

There is a progressive increase in the viscosity of the normal pinate diesters with increasing chain length, rising from 7.1 cs. at 37.5° for the butyl to 29.9 cs. for the decyl diester. The cyclobutane group adds to the overall length of the pinate molecule in its normal or 'stretched out' configuration approximately the equivalent of two aliphatic carbon atoms. These pinate diesters are in the same chain length and viscosity range as the aliphatic diesters made from sebacic, azelaic and adipic acids, all of which are now in wide use in lubricant applications.

The temperature coefficient of viscosity decreases with increasing chain length if the molecular chain is flexible. Thus the Dean and Davis viscosity index increases from 97 for the dibutyl ester to 158 for the didecyl ester and the ASTM viscosity-temperature slope decreases from 0.77 to 0.67. As the molecular cross section remains constant while the length increases on going to the higher homologues, the viscosity index should increase, since the ratio of breadth to length decreases.

In many applications the relubrication intervals are governed by the volatility of the lubricant, and hence the oil used should be as low in volatility as possible consistent with the other characteristics required. The diamyl and dibutyl pinates had weight losses of 1.8 per cent and 4.5 per cent respectively, while all the other pinates examined had values of less than 1 per cent.

The dialkyl pinates have larger rates of evaporation than similar viscosity diesters of aliphatic dibasic acids, but, as expected, the evaporation rates and boiling points of comparable molecular weight diesters are nearly the same. The freezing or pour points of the dialkyl pinates prepared from normal alcohols containing less than 10 carbon atoms are below $-60°$. In this respect the pinates are equal or superior to the 2-ethylhexyl esters of aliphatic dibasic acids.

Accelerated Oxidation Tests

Nearly all lubricants must have good resistance to atmospheric oxidation at temperatures of at least 100° to 125°. Since few organic liquids are sufficiently stable at higher temperatures, it is necessary to require that they exhibit good response to antioxidant additives. Accelerated dynamic oxidation tests in glass systems containing copper, aluminium and steel catalysts were made on the pinates, both with and without the addition of an antioxidant. The extent of oil deterioration and the formation of harmful products was followed by measurements of viscosity and neutralisation number, and by observing the deposits and the corroded condition of the metals present.

As was to be expected, the uninhibited liquids oxidised in 24 hours at 125°. Only

the esters of butyl alcohol and of 2-butoxymethanol-1 yielded highly corrosive products. It was concluded that in resistance to thermal oxidation at these temperatures, the pure diesters of pinic acid were comparable with the pure aliphatic diesters of adipic, azelaic and sebacic acids.

To obtain information as to whether the pinate diesters were responsive to the same types of antioxidants as the aliphatic dibasic acid esters, the effect of several different antioxidants was investigated in dihexyl pinate. These were: dilauryl selenide, 4-*tert*-butyl-2-phenylphenol, phenothiazine, and a combination of the last two compounds. The induction period was taken as the time at which the rate of increase per hour of the neutralisation number for the volatile acids becomes 0.05. All three antioxidants stabilised dihexyl pinate at 125° for more than 500 hours, according to this criterion. The phenolic inhibitor, however, did not prevent the formation of corrosive materials, as evidenced by the etching of a copper specimen and by the green colour of the oil. Both dilauryl selenide and phenothiazine were very much more effective antioxidants at 163°, the latter being the better. Though some insoluble deposits were formed during a test of over 500 hours, there was no evidence of corrosive products, such as were observed with the dilauryl selenide.

Phenothiazine Selected

When a combination of phenothiazine and 4-*tert*-butyl-2-phenylphenol was used as an antioxidant, the induction period was only 48 hours and the copper specimen was badly etched after 168 hours. This indicates that the addition of the latter reduces the effectiveness of phenothiazine as an antioxidant. Consequently, phenothiazine was selected as the antioxidant for use in the comparative studies of the different pinate diesters.

Lubricant compositions often contain rust-inhibiting agents to prevent the rusting of ferrous metal parts during storage and operation. It has been shown that the effectiveness of a given molal concentration of a polar-type rust inhibitor in any oil will decrease as its oil solubility increases. Some commonly used rust inhibitors were studied in the pinate diesters using the static-water-drop test at 60°. Sorbitan mono-oleate, glycerol mono-oleate, high molecular weight zinc naphthenate, barium naphthenate, barium petroleum sulphonate, and barium dinonylnaphthalene sulphonate effectively prevent the rusting of the steel specimen for a week under the test conditions.

Measurements of the friction-reducing properties of the pinates were made with a modified Bowden 'stick-slip' machine. The static coefficient of friction of steel on steel lubricated with dihexyl pinate was 0.20 at 20°. When the temperatures were increased up to 150°, no significant changes in the static or kinetic coefficients of friction were found. These values are essentially the same as those previously reported for the aliphatic diesters. Like mineral oils and the other diesters, the pinates can be fortified with commonly used wear preventives.

Mineral Oil, Synthetics & Additives

Many types of equipment used in the Arctic need to be lubricated with low pour point, high viscosity index oils. A synthetic oil made up at the Naval Research Laboratory largely of *bis*(2-ethylhexyl) adipate was used with unqualified success at Point Barrow, Alaska, as an automotive crankcase oil during the two Arctic winters of 1947 and 1948. A blend of mineral oil with synthetics and additives is now in use for such applications. Suitable lubricants of this type may be prepared from diesters of polyethers. The low viscosities of the oils at sub-zero temperatures permit engine starting without the use of external aids. The behaviour of dihexyl pinate containing 0.35 per cent phenothiazine as a crankcase oil was observed in a small scale, one-cylinder 2.5 h.p. air-cooled petrol engine fitted with aluminium pistons. From the results it was concluded that the dialkyl pinates were promising lubricants for use in whole or in part in formulating petrol engine lubricant oils.

Stable lubricating greases suitable for use over a wide range of temperatures have been made from the dialkyl pinates. The dihexyl pinate greases were found to be comparable in oxidation stability with those made from *bis*(2-ethylhexyl) sebacate. It was concluded that dihexyl, diheptyl and dioctyl pinates are as satisfactory for the production of lubricating greases as those made from open-chain dicarboxylic acids. It is obvious that lithium soaps of other acids can be used as galling agents instead of stearic acid simply by altering the concentration needed to obtain the desired grease consistency. Since

the sodium, calcium and barium soaps of the fatty acids have been used successfully to make useful lubricating greases from aliphatic diesters such as adipates, azelates and sebacates, they may also be used for that purpose in gelling the dialkyl pinates.

Apart from pinic acid, several cyclobutane dibutane dicarboxylic acids may be of future interest in the preparation of diesters for lubricant applications. Related acids derived from natural products include such compounds as *nor*pinic acid, homopinic acid, *nor*caryophyllenic acid, caryophyllenic acid, and homocaryophyllenic acid. In addition to these materials, 1,2-cyclobutane dicarboxylic acids, with or without alkyl substituents in the 3 and 4 positions, may be synthesised by a simple method. Because of the simple relations between molecular structure, viscometric properties and freezing point of aliphatic esters and others, it is obvious that each mole of pinic acid could be reacted with two moles of an aliphatic glycolether to make high viscosity index liquid lubricants. Also, each acid group of the pinic acid could be reacted with a glycol and the resulting product esterified by reacting the terminal hydroxyl group with an aliphatic (or other) monocarboxylic acid. In short, a variety of ways are evident for making high viscosity index 'oils' from pinic acid limited only by the economics of supply and the demand for synthetic liquids of such viscosities.

Wide Variety of Applications

It is concluded that this new class of diesters compares favourably with the diesters of aliphatic dibasic acids and 2-ethylhexanol as regards viscosity index, pour point (or freezing point), volatility and lubricating properties. The pinates were readily inhibited against oxidation and corrosion by typical oil additives. Lubricating oil compositions were developed which establish the suitability of the dialkyl pinates for a wide variety of applications. Excellent pinate-base greases were also prepared with soap and other gelling agents. Since the dialkyl pinates and certain analogous types of compounds have been established as valuable lubricants, any one or any mixture can be used as the base liquid for the manufacture of improved lubricating oils, hydraulic fluids or greases. These compounds can also be mixed with other types of esters, with polyethers, with compatible silicones, or with mineral oils, to formulate improved lubricants.

The commercial development of pinic acid at low unit cost from pinene is regarded as eminently desirable, since this chemical is potentially available in large supply from turpentine. In addition to its use in synthetic lubricants, this dibasic acid has excellent possibilities for the synthesis of low-temperature plasticisers, polymers, resins and fibres.

The report of this investigation has been made available to the Technical Information and Documents Unit of the DSIR.

Recovery of Selenium

Investigation of New Possible Source

IN the course of an article entitled 'Selenium: Its Uses & Recovery,' published in THE CHEMICAL AGE on 10 October (pp. 755-758), it was pointed out that for several years consumption of selenium has outstripped production and no alleviation of the existing shortage is in sight.

We now learn from the Department of Scientific & Industrial Research that a possible source of selenium in this country is the subject of an investigation being carried out at the Chemical Research Laboratory, DSIR. The investigation is the result of a survey of the selenium problem made by the Intelligence Division of the Department. Flash roasting of pyrites, one of the processes used to escape the necessity of using sulphur as a raw material, is fairly new and is expanding here now and it may, like copper refining, produce quantities of selenium worth recovering. The selenium is concentrated in wastes, dusts and muds, etc., which are left in certain parts of the flash roasting plant. Little is known yet about the economics of obtaining it. Samples of these wastes have been examined at the CRL and the proportion of selenium varies enormously.

The wastes from three plants have been tested so far. One at least appears to be hopeful of containing enough selenium to make recovering it worth while. As is the case with copper refining, the problem is to develop a method which will not interfere with the primary object of the process.

As far as can be seen at the moment, the potential yield of selenium from this source will run into tons.

Metal Melting Under Vacuum

Some Mechanical Problems of the Process

THE melting of metals under high vacuum is a process of comparatively recent development, but during and since the last war it has progressed from the initial stages of laboratory experiments with small and makeshift equipment until at the present time a standardised range of sizes is available having crucible capacities from 20 to 240 lb., with accompanying high-vacuum pumping equipment suitable for vacua in the order of 10^{-5} mm. Hg, and there is today a plant installed in a Swiss works with a crucible capacity of 450 lb. steel.

It will be appreciated that the design and construction of the outer vacuum vessel or container which surrounds the furnace proper presents a number of problems, especially in view of the fact that in a well-designed plant the melting should be carried out as far as possible under the same conditions as any other installation working at atmospheric pressure. In the case of the plant illustrated in Fig. 1, which is a 60 lb. standard installation, made by the Swiss firm G.A.B., of Balzars, Liechtenstein, the container is made of stainless steel, double-cased, with a large hinged cover, both body and cover being intensively water-cooled.

In general, the time required for the production of a vacuum in such a vessel depends not only upon the internal capacity of the container, but also upon the dimensions, composition, and quality of the internal surfaces, which should have smooth and flowing lines and be capable of being readily cleaned. Some of the problems which have to be solved in the design of such a container are (1) the provision of means for charging the various constituents of an alloy in the proper order and at the appropriate stages in the process; (2) observation and measurement of the temperature of the melt; and (3) means for pouring the charge.

In the design of the Swiss furnace illustrated, the problem of obtaining access to the crucible for the addition of various constituents during the progress of the melt is overcome by the provision in the main cover of the container of a supplementary 6-chamber rotation hopper. This hopper is situated directly above the crucible, and can be turned by means of an external handle so that each of the compartments can be brought successively over a charging hole, through which the contents of the compartment are dropped on to a hinged shovel immediately beneath, while the actuation of another external lever allows the shovel to be tipped and to slide the charge into the crucible.

Observation of the progress of a melt is a difficult matter in a vacuum plant because owing to the heavy vaporisation of the charge a normal inspection window would

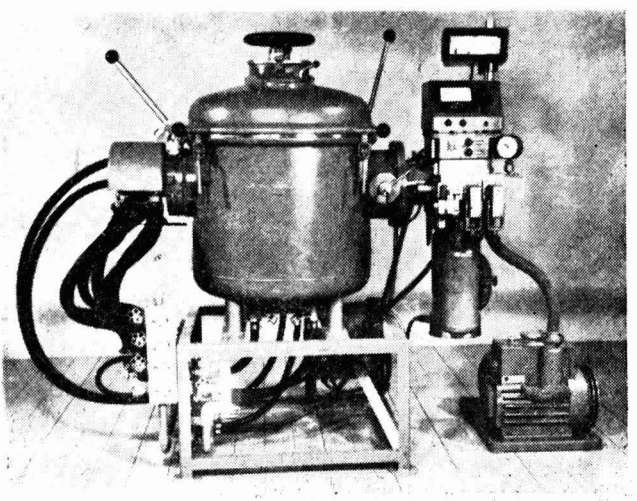


Fig. 1. A general view of the apparatus, showing the water-cooled casing, the vacuum system, and the external levers for actuating controls

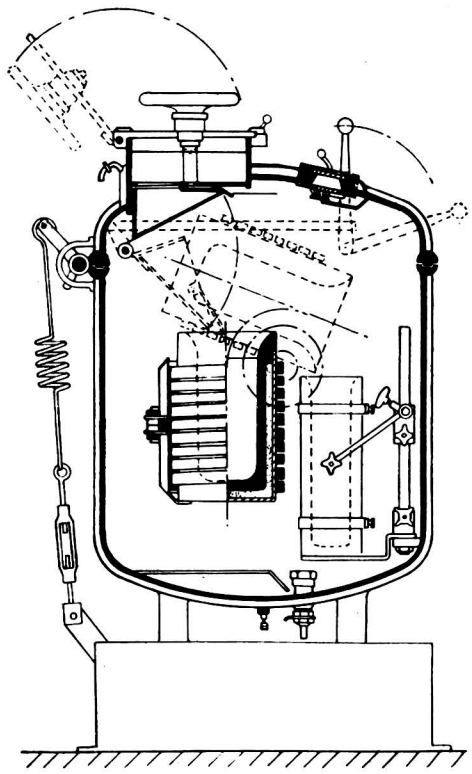


Fig. 2. Sectional diagram, showing tilting mechanisms

be quickly obscured by a metallic deposit. In the plant described, there is an inspection window of quartz glass in the hinged cover, which is reinforced internally by a second window in Pyrex, the latter being protected to a considerable extent against the deposit of metallic vapour when not in use by a movable guard, while it can be cleaned of any such deposit by a wire wiping brush operated by an external lever.

However, advantageous as visual observation is, the method is naturally no substitute for accurate pyrometric measurement, and although the use of an optical pyrometer is not possible, an ingenious method has been devised for readings to be taken by a thermocouple. By means of a spring mounting arrangement, this couple (in a quartz protecting tube) is normally maintained alongside the crucible where it is not liable to either mechanical or thermal damage, and in this position it does not interfere either with the charging or tilting of the crucible. It is inserted into the crucible by the simple movement of an external hand lever.

Various possibilities have been tried for pouring a molten charge of metal inside a vacuum container. In some methods, tilting of the entire container is necessary, which involves the movement of considerable masses. In others, the metal is run off through the bottom of the crucible by the withdrawal of a taper plug, but this system can only be adopted in cases where it is possible to use a graphite crucible. The method adopted in the plant shown in Fig. 1 can be seen from the sectional view Fig. 2, in which it will be noticed that in this case it is only the crucible which tilts.

Induction heating is employed in this case, the method permitting of the crucible being moulded and fired *in situ*, and this latter is of the lip-tilting type so that the molten

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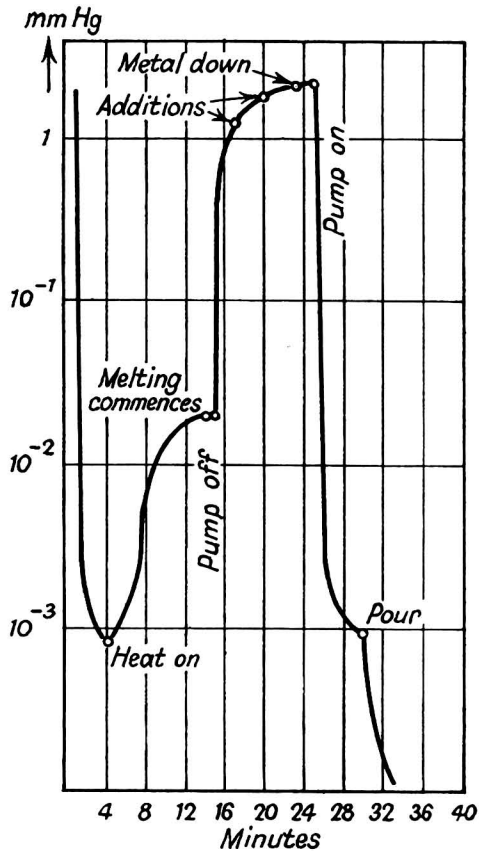


Fig. 3. Melting curves of a typical charge of tool steel

New Laboratories for Murex Limited

Many Facilities for Many Problems

IT is possible that the operations carried on by Murex Ltd., ranging as they do from the production of ferro-alloys by the ton to the manufacture of accurately-sized, pressed and sintered metal powder parts weighing only a few grams each, cover a wider field than that of any other individual metallurgical plant in the world.

Certainly, it cannot have been a simple task to design laboratories suitable in every respect for the investigation of the numerous problems likely to arise in a works in which such a variety of processes is carried on. However, in the latest issue of the *Murex Review* a description by Dr. G. L. Miller, the research manager, of the new research laboratories at Rainham, Essex, shows that the problem has been successfully solved.

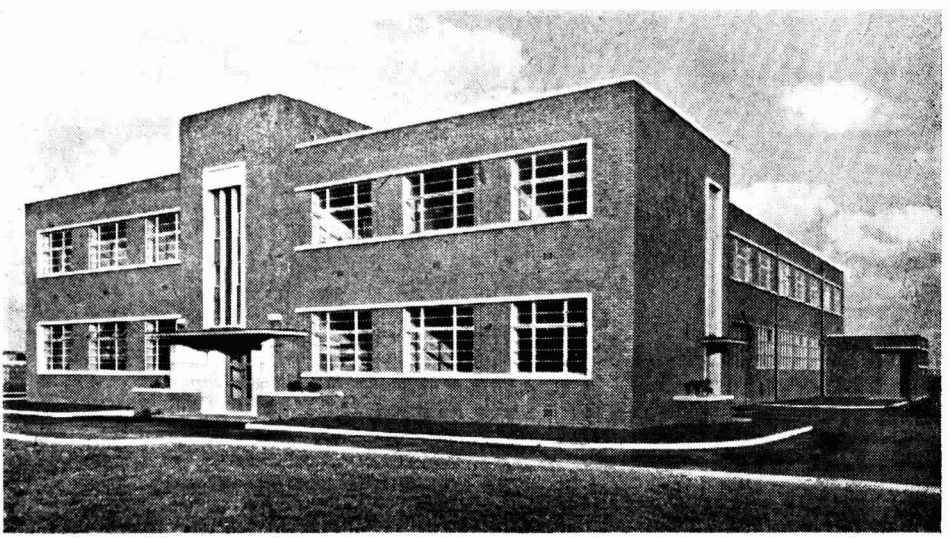
The building is situated within the boundary of the main works, on a fenced-off site with an area of 1¼ acres. The ground floor of the front section is taken up by offices and the library, and over these are the X-ray and metallographic departments. The major part of the rear section is occupied by the main chemical laboratory which covers the whole of the ground floor, with the central nave extending to the roof. Above the side aisles are a number of special laboratories and a store. Access to these is by a gallery which overlooks the main laboratory on three sides of the building.

The main chemical laboratory is 76 ft. by 84 ft., with a central nave 29 ft. high, and with aisles 12 ft. high extending 20 ft. at both sides of the nave. Most of the permanent equipment is housed in these aisles; on one side are a workshop, various types of electric furnace, a small rolling-mill and a large vacuum pump; and on the other a 20 kVA high-frequency furnace, electrolytic plant, and an arc furnace.

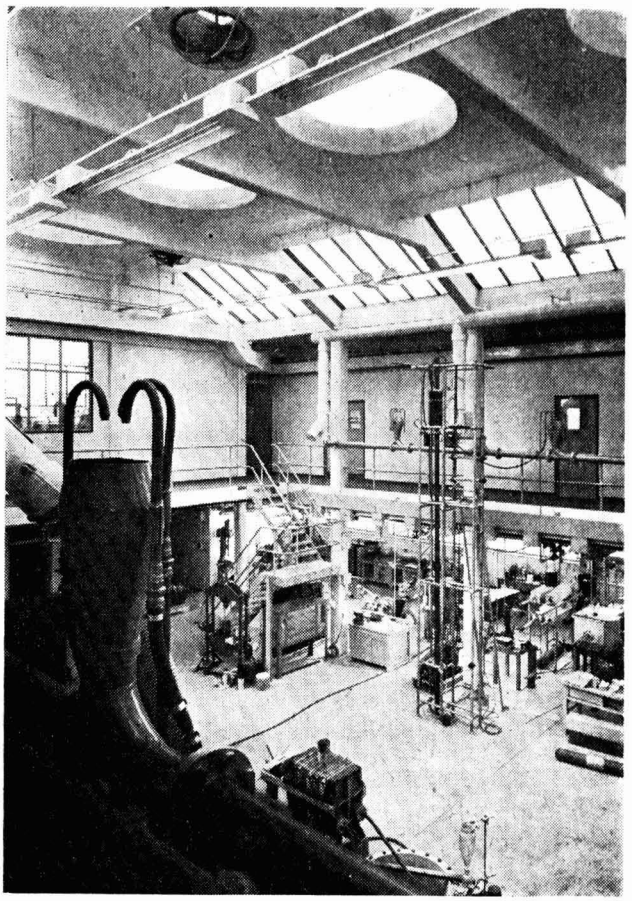
At one end is a door large enough to permit a lorry to enter; a hoist is provided, and an elevator to raise goods to the main store.

The nave is intended for the erection of large pilot plant, which is generally built up on tubular scaffolding. A travelling crane was considered unnecessary, since lifting can be obtained by using the main roof beams, each of which has three prepared points capable of supporting a load of 1 ton. At the end of the nave is a section devoted to gas and oil fired furnaces.

It was found necessary to install a cooling water system, since supplies are restricted on the site. A cooling tower with ample capa-



Front elevation of the new research block



A view of the main chemical laboratory, with pilot plant erected. In the foreground can be seen part of the cooling water return main

city is installed at the rear of the building and cooled water is pumped round a service main.

A steel stairway rises from the floor of the main laboratory to the gallery, accessible from which are the small-scale chemical laboratory, the special preparation room, and the special furnace room, as well as the corridors leading to the front of the building.

At one end of the nave of the main laboratory, and overlooking it through a large window, is the analytical laboratory. Along one wall of this room are three specially designed double fume cupboards. Teak and glass are kept to a minimum in their construction, glazed brick being used wherever possible. Hotplates are fitted flush with the floor of the cupboards.

All the exhausts in the room are connected to a fan which draws air at the rate of 11 changes per hour. This means an air flow of nearly 100 ft. per second through the fume cupboards, which accordingly seldom need to have their sliding doors closed. Adjoining the laboratory are balance and gas analysis rooms.

On the first floor in the front of the building are facilities for the preparation and examination of metallurgical specimens, together with crystallographic X-ray equipment. Dark rooms are provided for each purpose.

Particular care has been taken to ensure that adequate service facilities were available throughout the building. The piped services supply producer gas, compressed air, steam, cooling water and hydrogen, as well as mains, well and demineralised water. Calor gas is laid on as a service in the smaller laboratories, and a low-vacuum supply is also available.

The analytical laboratory, special preparations room, darkrooms, balance rooms, etc., are ventilated with air cleaned by passage

through an electrostatic precipitator. In cold weather the air can be heated to 65° F. An excess of intake air is maintained to ensure slight pressure within the rooms, so as to prevent any air entering from the main building.

Careful consideration was given to the colour schemes for the offices and laboratories in an endeavour to avoid the conventional, and in almost every instance the rooms have been treated individually. In most of them a further attempt to differentiate has been made by painting the window wall in the same colour as the ceiling.

The whole building is pleasingly finished, and should prove a stimulating environment in which to work.

Looking into the analytical laboratory from the gallery of the main laboratory

Metal Melting Under Vacuum

continued from page 806

charge is poured direct into the mould during the progress of the pour.

The ingot mould also presents certain difficulties in vacuum melting. In this process, it is naturally not feasible to employ sand moulds unless it is possible for these first to be heated under vacuum and completely de-gassed, otherwise the gases disengaged in contact with the metal would be liable to result in a porous casting. In the plant illustrated, the moulds usually employed are of cast-iron or steel having perfectly smooth surfaces, and pre-heated to some 300°. The ingot mould is attached to a vertical stand having adjustable arms so that the stand will serve for a variety of moulds of different sizes. Provision is made for these to be water-cooled if necessary.

The diagram Fig. 3 will enable the progress of a typical melt to be followed, this particular instance being the melt of 11 lb. tool steel (0.45 per cent C, 1.2 per cent Cr, and 0.15 per cent V) previously melted under atmospheric pressure. The crucible employed was of magnesium oxide. Four minutes after closing the container a pressure of 8×10^{-4} mm. Hg was reached and heating of the charge commenced. It rose sharply from this point, partly due to gases given off by the crucible and partly from the charge, the pump being switched off immediately after the commencement of the melt as the reaction between the oxygen and carbon in the melt was so strong that the metal was thrown out of the crucible.

Additions to the charge were made at the points indicated, and when all the material was brought down and the melt quiet, pumping was resumed. Energy consumption for melting under a high vacuum is for all practical purposes the same as for an equivalent charge melted in the same type of furnace under atmospheric pressure, and it will be seen from the diagram that the production of the preliminary vacuum has very little effect upon the time factor, the main difference in the time taken being dependent upon the extent to which it is desired to push the de-gassing of the charge.

Solar Energy

No New Era of Utilisation Yet in Sight

A SYMPOSIUM on the utilisation of solar energy was held at the University of Wisconsin on 12, 13 and 14 September. It was sponsored jointly by the National Science Foundation and the University of Wisconsin with Professor Farrington Daniels acting as Chairman of the Committee. Attendance at the conference was limited to an invited list of 40 people in order that the discussions and exchange of information could be as free as possible and no finished, formal papers were presented.

The general purpose of the symposium was to assess the present knowledge and ability to use solar energy and to take a look into the future. In so doing it was hoped that the areas of unknown information could be pointed out and thus arouse the attention of those who might be interested in conducting research.

Long-range Inadequacy

At the opening of the conference the scene was set by Mr. Palmer Putnam, who pointed out the long-range inadequacy of the world's resources of coal, gas and oil and of uranium. At the present rate of use of fuels and with the projected increase over the near future, it was estimated that the supply of easily obtainable coal, oil and gas (by 'easily obtainable' is meant that the price of the fuel should not be more than twice the present price) would be exhausted in less than 100 years. The nuclear fuels would last only another 150-200 years. Therefore, it was felt that this generation would be negligent in its duty to posterity if research in the utilisation of solar energy were not accelerated.

Allied to the power problem was the question of solar evaporation of sea water. Some progress had been made by putting dyes in the water in order to improve the absorption of energy. One part per million of dye might increase the absorption by as much as 30 per cent in the evaporation of water to give salt.

The question of the production of conventional fuels from agricultural and algal sources was considered briefly. The general conclusion was that this was a rather inefficient use of these materials and that energy should be produced by more direct methods.

Chemists should be urged to hunt for a suitable solar compound which would absorb sunlight through photochemical reactions, store the energy, and release it at will in ways which are suitable for practical use. It was a difficult challenge to find such a chemical compound, but basic research should be encouraged in this field. When we knew more about the fundamental principles, we had a better chance of finding such a compound. The use of sunlight in photochemical reactions offered theoretical advantages over its use as heat in engines. One of the difficulties lay in the fact that the products of these photochemical reactions were likely to react immediately and reverse the reaction.

An example of a possible photochemical reaction was the production of hydrogen and oxygen from water using cerium salts as the absorber to transfer the energy to make the water dissociate into the hydrogen and oxygen. The hydrogen and oxygen would be stored and recombined later to give back the stored energy. Another possibility was the absorption of energy by one side of a photovollaic cell or an electrical battery with the second side of the cell kept in darkness. The side which was absorbing the energy from the sun would transmit that energy through an electric circuit to the side which was kept in darkness.

No New Era Yet In Sight

No great achievements of practical value were reported in attacking the problem of the utilisation of solar energy and it was generally agreed that there is no new era of direct utilisation of solar energy yet in sight. However, many of the participants of the conference, including architects, engineers, chemists and meteorologists, were pleased to find that such substantial progress is being made in the preliminary development of solar house-heating, solar power production, evaporation of sea water, and in the applications of meteorology. They were interested also to find that there are many areas of physical chemistry, physics and engineering where fundamental research may well lead to significant advances.

The Chemist's Bookshelf

PETROLEUM AND PERFORMANCE. By E. M. Goodger. Butterworths Scientific Publications, London. 1953. Pp. 295. 32s. 6d.

It may be stated at the outset that, although this book is well written, well illustrated and contains much useful information on fuels and their performance in engines, a better title might have been 'Fuels, Their Origin, Production, and Performance in Internal Combustion Engines'.

The first part, consisting of four chapters, deals with the following: the origin, occurrence and production of crude petroleum; hydrocarbon chemistry as applied to fuels; a brief outline of their manufacture, methods of transportation and distribution; properties and testing of fuels. These sections are followed by a relevant bibliography.

Thermodynamics and engine theory are covered in Chapter V illustrating theoretical aspects of the reciprocating type of engine, and the continuous cycle types as used in gas turbines, ram jets and rockets. Chapter VI deals with the principles of combustion, followed in Chapter VII by the applications of combustion to the spark ignition engine, diesel engine, gas turbine, ram jets, and rockets. All relevant factors are discussed, as for example those influencing the tendency of an engine to knock, from the point of view of both engine design and fuel properties.

Chapter VIII is devoted to fuel rating, covering anti-knock agents and method of testing relative to both spark ignition and compression ignition engine fuels. The remaining three chapters are allotted to mixture behaviour in the manifold, fuel spray atomisation, and applications and specifications of fuels for the different types of engine.

Chapters V to XI inclusive have their own appended list of references, and four appendices appear at the end of the book covering the valency of carbon, determination of carbon to hydrogen ratio, an example exhaust gas analysis, and fuel spray evaporation respectively.

The author has wisely omitted the treatment of fuel systems and engine details except where the inclusion of such details has been necessary to illustrate the point in question. The book will be of great use to both the petroleum and automobile engineer, as well as forming an admirable introduction to those engaged in fuel research.—E.J.C.

GENERAL CHEMISTRY. By W. F. Luder, A. A. Vernon and S. Zuffanti. W. B. Saunders Company, Philadelphia and London. 1953. Pp. 595 + xiii. 30s.

This book, written by three of the teaching staff of an American university, would seem to be designed for use by freshman classes and aimed at the presentation of a general survey of inorganic, organic and physical chemistry. The authors have tried to include recent developments and sufficient historical background to give some understanding of scientific methods. In some cases they claim to anticipate current trends in the teaching of general chemistry.

An introductory chapter outlines the scientific method, includes definitions of chemistry and its branches, matter and energy, and gives a brief outline of the history of chemistry. Succeeding chapters deal with the three states of matter, atoms and molecules, hydrogen, oxygen and water, solutions, the classification of the elements, atomic structure, nuclear chemistry, the electronic theory of valency, chemical equilibrium, and kinetics, acids and bases, oxidation and reduction. The alkali and alkaline earth metals, the boron, carbon, nitrogen, oxygen and halogen groups are then dealt with in turn. Following the chapter on the carbon group are two on open chain and closed chain organic compounds respectively. Chapters on solutions of electrolytes, electrochemistry, colloids, analytical chemistry, the properties of related metals and metallurgy precede outlines of the chemistry of transitional elements. The book concludes with brief accounts of carbohydrates, fats and proteins, and of polymer-

isation, the latter including an outline of rubbers and plastics.

In a book of this type emphasis should be placed on the more fundamental aspects and these should not suffer at the expense of others perhaps better dealt with in a more advanced book. In view of the large amount of material to be included treatment should be concise and non-essentials, as far as possible, excluded. These requirements are not always met. Some of the more fundamental physico-chemical aspects are very briefly treated. Thus the methods of determining molecular weights in solution occupy only four pages with no account of experimental methods. Less than a page is devoted to osmotic pressure and its use in molecular weight determination is not mentioned. The solubility of solids in liquids occupies little more than a page. The chemistry of certain of the elements is sketchy. Thus the compounds of chromium occupy only a page, chrome alum and the complex forming properties of chromium not being mentioned.

The authors say that the book contains more than the average amount of organic chemistry. While more complex compounds are included than is usual in a book of this type, the treatment is very brief and in some cases little more than a list of compounds and formulae. Details of the more theoretical aspects of elementary organic chemistry, rather than the physiological effects of substances of mainly medical interest, would probably lead to a better understanding of this branch of chemistry.

On the other hand, certain topics, such as atomic structure, atomic energy, the electronic theory of valency and electrochemistry, are fairly fully dealt with and in some cases material is included which often finds a place in more advanced books. Thus the chapter on electrolytic solutions includes an elementary account of the Debye-Huckel theory and its later development, although the reader may form the impression that activity is something applied only to electrolytes. The account of acids and bases includes the proton and Lewis theories. The early use of activation energy in the treatment of kinetics and catalysis is a feature though perhaps activation energy might be more precisely defined, rate equations mentioned and chemical equilibrium treated more fully. While the inclusion of more advanced topics may anticipate current American teaching trends and in some respects be desirable, it seems undesirable that they should occupy more space than other and perhaps more fundamental aspects.

There is a good account of systematic properties of related and similar metals. The introductory account of the scientific method is to be commended, as is the introduction of brief historical details at appropriate points in the text. Industrial applications are emphasised in many cases. Another feature is the list of supplementary reading at the end of each chapter, although the sources may not be always readily available to British students. Such reading, together with lectures expanding certain aspects, may compensate for the perhaps rather uneven treatment and enable the reader to obtain an adequate introduction to inorganic and physical chemistry. In the opinion of the reviewer, however, the more elementary topics of organic chemistry should be expanded with the possible elimination of the more complex compounds. The book is well printed and bound and there are many clear diagrams and a good index. The price is not excessive.—W.R.M.

INTRODUCTION TO VISCOSIMETRY AND RHEOMETRY. By Dr. Ing. Hans Umstätter and Dipl.-Ing. R. Schwaben. Springer-Verlag, Berlin. 1953. DM. 5.80. (In German).

Rheology is the teaching based on measurements of systems of laws governing flow. Although the word was first coined by E. C. Bingham in 1931, it has only recently come into use and much doubt and misunderstanding is still prevalent on the subject. The first task the authors have therefore tackled is to remove such misunderstanding and to give a clear and precise outline of the subject. Thus almost three pages are devoted to 'Terms and Units Employed' and there is an excellent list of foreign words, complete with explanations. In this manner the book becomes intelligible not only to the theorist but also to the practical scientist.

There are three main chapters:

(1) Viscosity as a constant of material
(2) Mathematical basis of viscosimetry
(3) The absolute viscosimeter

this last one being particularly extensive and complete.

An interesting and comprehensive bibliography and a good index are included.—FELIX SINGER.

HOME

To Investigate Pollution

Lancashire and Western Sea Fisheries Committee and the Lancashire River Board have engaged Dr. J. E. Forrest, a biologist of London University, and Dr. T. H. Hammence, an agricultural chemist, to investigate the pollution of the Wyre and Lune estuaries and of the Walney Channel.

Export Sales Conference

A three-day Export Sales Conference is to be held by the Federation of British Industries at Buxton, from 30 October-1 November. Practical measures to increase exports will be discussed. Opening speeches will be given by Sir Harry Pilkington, president of FBI, and Sir William Rootes, chairman of the Dollar Exports Council.

Kent's 'Cat-cracker'

The catalytic cracking plant at the Kent oil refinery of the Anglo-Iranian Oil Company, Ltd., on the Isle of Grain, has been completed and is stated to be due to be commissioned shortly. It will then join other 'cat-crackers' at Llandarcy and Grangemouth (the company's two other major refiners in the UK) as a producer of high-grade motor spirit.

Atomic Energy Lectures

Atomic energy experimental lectures are to be given at London University (University College, Physics Theatre, Gower Street), on Tuesdays, 10 November and 8 December, at 6 p.m., by Professor Fredk. Soddy, co-discoverer with Rutherford of natural transmutation of radioactive elements and who gave 'isotopes' their name. Seats are free, but must be reserved by telephoning Museum 7505.

Iron & Steel Foundries Regulations

Regulations for the protection of foundry workers, containing requirements as to gangways, suppression of dust and fumes, protective equipment, bathing facilities, clothing accommodation and storage of tools, come into force on 1 January. These regulations (SI. 1953, No. 1464) are the outcome of a private member's Bill, which was given a second reading in the House of Commons on 12 December, 1952, but was subsequently withdrawn.

Supply of Uranium

According to Australian Press reports, Britain and Australia have failed to agree on satisfactory terms for the supply of uranium by Australia to this country. It is stated that the British terms imposed too many conditions for Australia to accept.

Sugar Factory Begins Work

The processing of sugar at the British Sugar Corporation's factory at Bardney began last week, the slicing of beet having begun on 28 September. Considerable variation in the sugar content of the beet was noticed.

Hydrocarbon Oils Duty

A Treasury Order increasing from 9d. to 1s. 3d. a gallon the amount by which the Excise duty on hydrocarbon oils is less than the corresponding Customs duty came into operation on Wednesday. The effect is to reduce by 6d. a gallon the Excise duty on such oils. The Order also has the effect of reducing by the same amount the Excise duty on petrol substitutes which is at the same rate as that on hydrocarbon oils.

Smoke Abatement

The *British Medical Journal* in its current issue advocates legislation to permit local authorities to propose smokeless zones, and so avoid the heavy expense of promoting Private Bills. The results of smokeless zones in Coventry and Manchester had been most satisfactory, it is stated. In a discussion on smoke abatement, *The Lancet* also attacks the 'Dirty cities which would have shocked our forebears as much as their drains shock us.'

British-made Zirconium

With reference to the Note & Comment 'Zirconium & Corrosion' which appeared on page 697 of our issue of 3 October, we have been reminded that commercial zirconium is available in Great Britain in several forms. Murex Limited have been supplying this material in England for the last 18 months and are able to offer zirconium to the chemical industry in the form of sheet, rod, wire and drawn tubing. We are sorry if our note gave the impression that this metal was available only in the United States.

• OVERSEAS •

Ochres in Pakistan

During the first six months of this year Pakistan produced 186 tons of ochres. Mining of this mineral is as yet in the initial stages in that country.

Brazilian Fertiliser Factory

A factory for nitrogenous fertilisers is to be built near Cubatao Oil Refinery, Brazil. Most of the installation, purchased in Germany, is expected to arrive in Santos before the end of the year. Studies are under way for recuperating the residual gases of the refinery with a view to obtaining 15-25 tons of sulphur a day.

Trade Fair for Iraq

It has been proposed that the Federation of British Industries should organise a British Trade Fair in Baghdad in the autumn of 1954, at a time of year 'when it can definitely be said that it will not rain.' The Fair will have many unique characteristics: it will be in the open air; it will be open in the evening, when the heat of the day is over; and there will be many ingenious lighting effects and other special attractions.

New Canadian Company

Dow Corning Corporation has announced the formaton of a Canadian subsidiary, Dow Corning Silicones, Ltd. Dow Corning's Canadian patents on the uses and compositions of organosilicon compounds are being assigned to the new company, which will have headquarters in Toronto. The compounds have a wide range of industrial applications for polishes, oils, greases, varnishes and plastics.

Sulphur Outlook Not Promising

The New Zealand Department of Agriculture expects that that country's allocation of sulphur this year will be a little over 100,000 tons, which should meet current needs and provide stock for the new superphosphate works being built at Napier. The Department warns, however, that the outlook for future supplies of sulphur is not promising. The French Government has invited other countries to discuss the matter at a conference in Paris this month, at which New Zealand will be represented by the Trade Commissioner in London.

Sugar Research

It was announced at Kingston, Jamaica, last week, that the Sugar Research Foundation of America has allocated $15,000 to the Caribbean sugar research scheme.

Potash in Israel

After a break of five years, the production of potash started again in earnest at Sdom a short time ago, when the big rotary kiln there began operating once more. The present output is 60 tons a day, or about a third of the daily target for the end of the first year of operations. The works should reach an output of 200 tons daily by the end of 1953.

Nickel Control Ended

Control over the sale of primary nickel in Canada, in operation for two years, was ended by the Government last week. The Defence Production Department stated that revocation was made possible by the termination of International Materials Conference allocations at the end of the third quarter and by the fact that demands both for defence and commercial purposes could now be met.

Atomic Energy in Canada

Dr. C. J. Mackenzie, retiring president of the Crown incorporated Atomic Energy of Canada, Limited, said there was no doubt that atomic energy plants would be operating on a commercial scale in Canada within the next five years. Industrial research had been moving forward rapidly at the atomic energy plant at Chalk River, Ont., with Atomic Energy of Canada, Ltd., concentrating on building pilot power plants to produce atomic energy.

Israel's 'Treasure-House'

Plans designed to exploit the mineral resources of the Negev are awaiting endorsement of the Government of Israel after examination by two foreign experts. It is planned to produce 600,000 tons of calcinated phosphate rock annually, 160,000 tons of sulphuric acid, and large quantities of phosphoric acid, soda ash, and triple superphosphate. Manganese deposits thought to total 1,000,000 tons have been found in the southern Negev, and a team of chemists in Haifa is now investigating methods of removing adulterations of the manganese.

· PERSONAL ·

MR. OWEN R. GUARD, a member of the Southern Gas Board (and formerly chairman), has been appointed to the board of Minerals Separation Limited.

DR. J. W. CUTHBERTSON, assistant director of research at the Tin Research Institute, was inducted as president of the Institute of Metal Finishing at the autumn meeting of the Institute which took place in London on Tuesday.

MR. STEPHEN F. BURMAN, who has been appointed to the board of Imperial Chemical Industries, Ltd., will act as a non-executive director. He is managing director of Burman & Sons, production engineers, Birmingham, and a director of Joseph Lucas (Industries), Ltd., W. & T. Avery, Ltd., and other companies.

MR. GORDON SMITH, B.A., has resigned from the secretaryship of the Association of British Pharmaceutical Industry with effect on 1 November, 1953. In accepting Mr. Smith's resignation with great regret, the Council of the Association has placed on record its appreciation of his services to the Association during the past three years. MR. A. DUCKWORTH, B.Com., M.P.S., who joined the Association as assistant secretary in 1947, has been appointed secretary, and MR. J. M. KIRKNESS, B.A., the assistant secretary (Export), has been appointed deputy secretary, both appointments to take effect on 1 November, 1953.

A nuclear scientist, DR. J. S. ANDERSON, will take up his new post as Professor of Chemistry at Melbourne University as soon as he can complete his work as Deputy Chief Scientific Officer at AERE, Harwell. This will probably be late this year or early in 1954. Dr. Anderson, who will replace PROFESSOR E. J. HARTUNG, is a graduate of the University of London. After several years of research at the Imperial College of Science and Technology, he became senior lecturer in chemistry at Melbourne University in 1938. He resigned to go to Harwell in 1947.

MR. H. T. THOMAS, a member of the executive of the Scottish Department of the Pharmaceutical Society of Great Britain, has been co-opted as a member of the Council of the Society in succession to MR. ADAM MELDRUM, of Aberdeen, who has resigned. Mr. Thomas is immediate past chairman of the Scottish executive.

MR. S. J. (SAM) PERRY, southern manager of Dunlop's Dunlopillo division, has been appointed sales manager of Dunlop Special Products' plastics division. Joining Dunlop 23 years ago, Mr. Perry was appointed sales manager of Dunlopillo general upholstery at Walton in 1946 and came to his present position in London a year later.

MR. IAN MCLEOD, who has joined the process engineering division of Sharples Centrifuges Ltd., will be investigating applications for the range of Sharples centrifugal equipment. He was formerly chief engineer to the Premier Mill Corporation, Geneva, New York, USA, producing processing equipment for the chemical and oil industries.

DR. C. J. MACKENZIE, past-president of the Canadian National Research Council, is retiring as president of Atomic Energy of Canada, Limited, on 1 November, when he will become associated with Canadian Chemical & Cellulose Company, Ltd. Mr. M. W. Mackenzie, executive vice-president of the latter company, said the board intends to seek authority to increase the number of its directors. If this is forthcoming, Dr. Mackenzie will join the board. He will be scientific adviser to the company.

DR. JAMES F. EVERSOLE, who has been appointed vice-president in charge of research of Bakelite Company, a division of Union Carbide and Carbon Corporation, joined Union Carbide in the research organisation of Carbide and Carbon Chemicals Company at Niagara Falls as a research chemist in 1929. After working later in the laboratories of Linde Air Products Company (also a division of Union Carbide) he was appointed superintendent of Linde's laboratories at Tonawanda, New York, in 1943. In 1951 he moved to New York to become manager of research administration

of Union Carbide and Carbon Corporation. He was responsible for co-ordination of the research activities of all of the Corporation laboratories where basic research and development work is being done on alloys, chemicals, gases, carbons, and plastics.

MR. CARL R. DOLMETSCH has joined Mathieson Chemical Corporation, Baltimore, in an executive capacity. He was general manager of the Viscose Division of Celanese Corporation of America until this division was merged in 1952 into a newly-created textile division. Since then he has been manager of viscose plant operations in the Celanese foreign service division, with headquarters in New York. After graduating in chemistry from the University of Pennsylvania in 1925, he joined the Tubize Rayon Corporation and was successively assistant to the vice-president in charge of operations, technical assistant to the president, and director of the technical division. When Tubize was merged with Celanese in 1946 he become assistant to the senior vice-president.

Dust & Fume Removal

MANY industries produce large quantities of dust during their manufacturing processes. Sometimes this dust is of no value; more often it is a valuable by-product, the collection of which yields a handsome profit. Frequently material has to be handled in the form of dust at some stage of manufacture, and efficient collection of the product in the form of powder is an important part of the actual manufacturing process.

Uncontrolled dust of any kind is at all times undesirable. Such dust is liable to affect adversely the health of workers, to cause unnecessary wear to machinery, and to become a nuisance to surrounding property; furthermore, in some trades it is a potential cause of explosions or fires. These dangers are fully recognised by the Home Office, and the regulations on the subject have been made much more stringent by the latest Factories Act.

The Visco Engineering Co., Ltd., Stafford Road, Croydon, have just published a new edition of 'Modern Dust Collection,' a manual describing the many installations in which 'Visco' and 'Visco-Beth' dust collectors may be used The many applications of cyclones and of bag filters are fully illustrated, including the collection of coal, cement, lime, soap, milk, sulphur, metallic dust, oxides, silica, asbestos carborundum and chemicals of all kinds.

A further section describes fume removal in metallurgical works and foundries.

Export Licence Changes

CHANGES in licensing control came into force on 14 October. Licences are not now required, except for exports to China, Hong Kong, Macao and Tibet, for ammonium persulphate, dicyandiamide, potassium persulphate, sodium persulphate, titanium hydroxides. An Open General Licence dated 5 October authorises the export to any destination other than China, Hong Kong, Macao or Tibet, of *p*-aminophenol and its salts, *p,p'*-diaminodiphenylmethane, N.N-dimethylaniline, diphenylamine, glycerol, magnesium oxide containing 97 per cent or more by weight of MgO, phenyl-α-naphthylamine, phenyl-β-naphthylamine, *p*-phenylenediamine, *o*-tolyl-β-naphthylamine, zirconium oxide thermally stabilised with lime or magnesia. Export of Goods (Control) (Amendment No. 4) Order, 1953, SI. No. 1487, may be obtained from HMSO, price 3d.

Platinum Metals Exhibition

NO effort has been spared by The Institution of Metallurgists in planning the Platinum Metals Exhibition which is to be held at the Grosvenor House Hotel. Exhibits from distant corners of the world have been gathered and with the full-hearted co-operation of a great number of individuals and several firms the exhibition is bound to be of great interest. As announced previously, H.R.H. The Duke of Edinburgh has graciously consented to open the exhibition on Monday, 19 October. It will be open to the public from Thursday, 22 October to Saturday, 24 October. The exhibition is being held to mark the triple jubilee of the British scientist, William Hyde Wollaston's announcement of his discovery of palladium, and will show the vital part played by the platinum metals in science and industry.

Publications & Announcements

PUBLICATION No. 550 of A. Gallenkamp & Company, Ltd., 17-29 Sun Street, London, E.C.2, 'Particle Size Determination Apparatus,' describes an instrument which has been designed for the determination of particle size within the range of 5-75 microns. If, however, state the makers, the top size is not greater than, say, 20 microns, the lower limit can be extended to about 2 microns, provided the temperature is controlled within fairly narrow limits and agglomeration or flocculation does not take place. The apparatus was devised by Mr. W. Bostock, of Simon-Carves Ltd., and is the subject of British and USA patent applications. Among the applications are alumina, carborundum, china-clay, cement, felspar, pyrites, plastics, etc., as well as dusts collected by electrostatic precipitators and cyclones from boiler, blast furnace and flash roaster plants.

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BESIDES a number of pages devoted to the annual report and accounts for 1952, the latest issue of the *Transactions* of the Institution of Chemical Engineers contains three further papers on 'Liquid-liquid Extraction' by R. Gayler, Dr. H. R. C. Pratt and (in part) N. W. Roberts. Other articles include 'Efficiency of the Kaskade distillation column' by Drs. F. H. Garner and S. R. M. Ellis, and A. J. Hugill; 'The Treatment of Waste Gases in Chemical Industry' by W. A. Damon; 'Heat Transfer from Luminous Gas Flames in Vertical Tubes,' by Drs. S. R. Tailby and M. A. Saleh; and 'The Making of Iron in a Blast Furnace,' by G. D. Elliot.

* * *

IT is nothing new to say that coal tar was the most important factor in the development of organic chemistry, and the latest 'Review of Coal Tar Technology' from the Coal Tar Research Association, Oxford Road, Gomersal, amply demonstrates that the interests of coal tar chemists are nowadays wider than ever. Altogether 545 scientific papers are reviewed, for a period July-December 1952, and cover not only coal tar and its products, and their utilisation, but aspects of general chemistry connected in any way with the work of the coal tar chemist. The price of the volume to non-members of the CTRA is 7s. 6d.

FORMED five years ago, Styrene Co-Polymers Ltd., who were the last to enter the field of surface coating resin technology, now claim to rank among the first three such companies in Great Britain. The company, which in July, 1948, were but an idea of two kindly parents—the Lewis Berger and Petrochemicals organisations—indulge in a little justifiable trumpet-blowing in the September issue of their news sheet, *Scop*, copies of which are obtainable on request to the company at 1 Roebuck Lane, Sale, Manchester. As is rightly pointed out in the article concerned, it is opportune to pause and reflect on the company's activities over the past five years in order to provide the background for further progress.

* * *

HOW a well-known Edinburgh brewery cured its smoke problem and cut its fuel bill by £11,000 a year, is the subject of an interesting article in the autumn issue of *Smokeless Air*, the quarterly publication of the National Smoke Abatement Society, Chandos House, Buckingham Gate, Westminster, S.W.1. The contents also include the following: A Belgian professor's 16-years-old forecast of deaths in the London smoke fog of December last; the story of the smokeless housing estate at Clifton, Nottingham; an article on the burning of low-grade fuel without smoke; and an account of a local authority's attempt to obtain smoke abatement by-laws under the Public Health Act.

* * *

FLUID rubber compositions contain neither water nor volatile solvent; they can be poured and set to form elastic, soft rubber or hard rubber (Ebonite) articles. Information on several new developments in fluid rubber compositions—which use as their starting point a highly broken down rubber known as Rubbone—is given in an article by M. Pike (Rubber Technical Developments, Ltd.) in the autumn issue of *Rubber Developments*, published by the British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3. Other principal articles of note include 'Application of Rubber in Pier and Dockside Fenders,' 'Rubber-tyred Locomotive and Freight Truck' and 'New Developments in Rubber Hydropress Forming.'

UNDER the title 'An Introduction to Amides, Nitriles, Amines, Quaternary Ammonium Salts: Their Manufacture, Properties and Applications,' a brochure has been issued by Guest Industrials Limited, 81 Gracechurch Street, London, E.C.3, which will be read with interest in many quarters. The peculiar characteristics and chemical versatility of fatty amines, nitriles and amines, and their salts, offer to the chemist wide fields for research. Their known uses are manifold and it is claimed that there is a rapidly expanding list of potential applications covering practically every industry. Liljeholmens Stearinfabriks Aktiebolag, of Sweden, who are producing this range of products, were established in 1839 and have been renowned over the passing years for the high quality of their products.

* * *

NEGRETTI & ZAMBRA Ltd. have recently produced a mercury-in-steel air-operated temperature transmitter for the distant indication, recording and control of temperatures up to 650°. The instrument employs the force-balance principle, requiring a compressed air supply of 20 psi. with a consumption of 1/6 cu. ft. per min., and no booster or relay is required on piping runs up to 200 ft. The sensitivity of the balance system is such that for a temperature change of 0.5 per cent of the range, the air leak valve remains wide open or fully closed until balance conditions are obtained, i.e., the correct value is transmitted in minimum time. Leaflet No. T/39, describing the instrument, may be obtained from the manufacturers at 122 Regent Street, W.1.

* * *

A RANGE of self-regulating AC generators is being manufactured by Higgs Motors Ltd., Witton, Birmingham. The advantage of this class of generator over the conventional machine is said to be the elimination of external exciter and the automatic voltage regulator; this, in turn, ensures a low initial cost and a reduced maintenance charge. The machine maintains a level AC voltage at unity power factor; it will run as a series-wound motor off a 24-volt battery with sufficient torque to start an IC engine; and when running as a generator it will give a DC output voltage for re-charging the starting battery. Moreover, the generators are guaranteed for ever.

NEW entries in the BDH catalogue include 2,2'diquinolyl, which gives a purple complex with monovalent copper; phenyl-cyclohexane; thiourea dioxide, a very useful reducing agent; and zinc dibenyl-dithiocarbamate, an alternative for sodium diethyl-dithiocarbamate in the determination of copper, which is stable in strongly acid solution. Two valuable new publications, which may be obtained from the Laboratory Chemicals Group at Poole, are an information sheet on sodium diethyl-dithiocarbamate, giving specification, properties and uses, with a number of references; and 'Ion Exchange Resins,' a second and enlarged edition dealing with the properties and applications of the many resins obtainable from BDH.

* * *

THE announcement, a short while back, by Shell Chemicals Limited of the ready availability of their 'Epikote' resins from a non-dollar source has now been followed by the publication of a new Shell booklet on their properties and applications. 'Epikote Resins for Surface Coatings' is an attractive publication in colour, containing 45 pages of useful information for the paint technologist. A particularly valuable feature is the reference chart of end uses, where suitable type formulations are suggested for a number of applications, including coatings for concrete and chemical plant. This chart is intended as a guide to the type of formulation suitable for these applications, in most cases several alternatives being suggested. A double-page table gives very full information on the solubility characteristics of 'Epikote' resins 1001 and 1007, and is designed to show not only the solubility of these resins in individual solvents, but also the trends. While specific formulations are given in many cases, the booklet is mainly designed to cover general background information on the performance of the different types of coatings which can be made with these resins. For instance, on p. 27 the effect of increasing 'oil length' of the esters on such properties as solubility, hardness, gloss, and drying time, etc., is indicated. The last ten pages of the booklet are devoted to technical data of general value. Full details of the properties of a wide range of solvents, latent solvents, and diluents are also given. Copies of the booklet are available on application to Shell Chemicals Limited, 105-109 Strand, W.C.2.

Law & Company News

Commercial Intelligence

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

Increases of Capital

The following increases of capital have been announced: CIMEX-FRASER TUSON, LTD., from £22,500 to £32,500; F. THOMPSON & COMPANY, LTD., from £2,000 to £5,000; VACUUM OIL CO., LTD., from £12,500,000 to £14,000,000; CHEESEBOROUGH MANUFACTURING CO., LTD., from £200,000 to £300,000; HARDMAN & HOLDEN, LTD., from £300,000 to £500,000.

New Registrations

Glazebrooks Paints, Ltd.

Private company. (524,080.) Capital £100. Manufacturers of and dealers in enamels, paints, lacquers, products known as Permoglaze, etc. Directors: E. C. Coverdale, P. F. M. Coverdale, E. W. Clarke (all directors of Glazebrooks [Holdings], Ltd.) Reg. office: James Road, Tyseley, Birmingham, 11.

Maskells Fertilisers Ltd.

Private company. (524,275.) Capital £100. Chemists, merchants and manufacturers of and dealers in artificial and natural chemicals and chemical and other manures, fertilisers, etc. Subscribers: H. M. Hacker, G. Smart. First directors are to be appointed by the subscribers. Reg. office: 51 Northways, Swiss Cottage, N.W.3.

H. R. Tulk Ltd.

Private company. (524,337.) Capital £5,000. Consulting, analytical, manufacturing, pharmaceutical and general chemists, etc. Directors: L. B. Littlewood, E. Littlewood. Reg. office: Offices of E. J. George & Partners, 329 High Holborn, London, W.C.1.

T. N. Foster Ltd.

Private company. (524,424.) Capital £1,000. Sellers and distributors of crude oil and petroleum products, chemical fertilisers and weed killers, etc. Directors: T. N. Foster, G. I. Foster and H. R. W. Foster. Secretary: H. R. W. Foster. Solicitors: Gardner Leader & Co., Newbury. Reg. office: 20 Northbrook Street, Newbury, Berks.

Company News

Glaxo Laboratories Ltd.

Glaxo Laboratories, Limited, announce that, subject to completion of audit, group profits for the year ended 30 June last total £1,585,000, as compared with £1,503,000 for the previous year. This is after providing for all charges, including £1,238,000 (£1,775,000) for UK taxation. The proportion of these profits attributable to outside shareholders is £5,000 (£900). The accounts of the four subsidiary companies operating in South America have not been included in the group accounts, the directors being of the opinion that in the absence of an effective rate of exchange consolidation would be misleading. A final ordinary dividend of 12½ per cent is recommended, making 17½ per cent for the year, as against 10 per cent, making 15 per cent, last year.

Canadian Chemical & Cellulose Co. Ltd.

Net profit of $267,784 in the six months ended 30 June has been reported by Canadian Chemical & Cellulose Company, Ltd. This compares with a net loss of $1,047,543 in the same period of last year. The loss in the last half of 1952 was $1,087,146 and for the whole year, $2,134,689, after provision for depreciation and bond interest in financing the then developing projects of the company. Mr. Harold Blancke, president, notes that the present report does not cover operations at the Edmonton plant of the subsidiary Canadian Chemical Company, Ltd., where production of yarn and pentaerythritol did not begin until July and August last. The present profit statement is therefore 'not indicative of the probable consolidated net result of operations for the full year of 1953' for all the parent company's operations.

Cheshire United Salt Co. Ltd.

Net profit of £32,039, as against £26,650 for the previous year, is announced by the directors of the Cheshire United Salt Company, Ltd., for the year ended 30 June last. A final dividend of 6 per cent on the ordinary shares, making a total of 10 per cent for the year, is to be recommended.

James Woolley Sons & Co.

This firm of manufacturing chemists show net profit of £15,319 for the year ended 31

March last. This compares with £4,920 for the previous year. Dividend of 5 per cent compares with 10 per cent for the previous period. Group current assets are £631,040 (£626,438), including stocks (less reserve, £5,000) £287,206 (£307,753), sundry debtors £341,233 (£315,818), and cash £413 (£475). Current liabilities and provisions, £156,695 (£174,323), including National Provincial Bank £33,133 (£4,346). Revenue reserves and surplus £182,151 (£170,772), capital reserves £19,895 (£19,699).

Reichhold Chemicals Inc.

An interim ordinary dividend of 3 per cent, less tax, in respect of the year to 31 December next, has been declared by the directors of Reichhold Chemicals Inc. Combined net profits of the operating companies, less expenses of the holding company, for the six months to 30 June last, amounted to £104,729 before tax. Deducting provisions for EPL £11,500, income tax and profits tax £49,746, there remains £43,483. No dividend was paid for the previous period ended 31 December, 1952.

United Indigo & Chemical Co. Ltd.

Group trading profit of The United Indigo & Chemical Company, Ltd., for the year to 30 June, 1953, is £22,870, as compared with £25,523 for the previous year. Net profit, after tax, depreciation, etc., is £4,646 (£3,408), plus unrequired provision £3,474 (£1,778). A dividend of 10 per cent has been declared on preference and ordinary shares, as compared with 7½ per cent.

Canadian Chemical & Cellulose Corporation

Net profit of $267,784 for the six months ended 30 June last is shown by the Canadian Chemical & Cellulose Corporation, which is controlled by the Celanese Corporation of America. This compares with a net loss of $1,047,543 for the first six months of 1952.

Greeff Chemicals Holdings

The directors of Greeff-Chemicals Holdings, Limited, have declared an interim dividend of 3¾ per cent actual, less tax, on account of the year ending 31 December next. This is at the same rate as last year.

I. G. Farben

The West German liquidation committee of the former I. G. Farben chemical combine has invited all shareholders of Old Reichsmark I. G. Farben shares to submit their shares before 31 March next for conversion into new D-mark shares issued by the four main successor companies of I. G. Farben. The conversion regulations provide that an owner of 1,000 Reichsmarks' worth of old I. G. Farben shares will receive 770 D-marks' worth of new shares issued by the successor companies.

Cellactite & British Uralite Ltd.

Mr. George V. Parker presided at the annual meeting last week of Cellactite & British Uralite Limited. In a circulated statement, he said: 'The accounts disclose a trading loss of £37,062. At the beginning of last year we were fully justified in maintaining the progressive programme based upon our increasing trade of the last few years, but the lower turnover, due to the decline in the demand for our products and lower selling prices to meet intensified competition, entirely upset our profit ratio.' After commenting on the difficulties of obtaining raw materials (from overseas), Mr. Parker added: 'I cannot attempt to forecast the future as up-to-date deliveries are still disappointing. All I can say is that every effort is being made to bring about a more satisfactory state of affairs. In this I feel we shall succeed.'

Application of Dithiocarbamates

continued from page 800

bifunctional S-ω hydroxyalkyldithiourethane then being able to react with given polyalkylene di-isocyanates to produce long chained head-tail intermolecular polymers. The use of acids in such systems would of course be restricted to those of low ionisation constants, mineral acids decomposing the lower homologues to CS_2. Dithiocarbamates are prepared by the action of amines on alkaline CS_2 solutions, the process appearing facile and economical.

$NH_2.CS.SNa + Cl[CH_2]n.OH \longrightarrow NH_2.CS.S.[CH_2]n.OH$

$NH_2.CS.S[CH_2]nOH + OCN.[CH_2]m.NCO \longrightarrow [NH.CS.S.(CH_2)n.OOC.NH(CH_2)m.NH.CO.$

Next Week's Events

MONDAY 19 OCTOBER

Institution of Chemical Engineers

London: Burlington House, 6.30 p.m. Corrosion Group meeting with Institute of Metal Finishing. H. A. Holden; 'Phosphating of Steel Prior to Painting'; J. F. Andrew, S. G. Clarke, E. E. Longhurst: 'Protective Qualities of Various Phosphate Coatings on Steel.'

Leeds: Chemical Lecture Theatre, The University, 7 p.m. W. Mitchell: 'The Isolation of Fine Chemicals from Natural Sources.'

Institute of Metals

Glasgow: Anniesland. Visit to Barr & Stroud, Ltd.

Incorporated Plant Engineers

Liverpool: Radiant House, Bold Street, 7.15 p.m. N. Woodhead: 'Design of a Central Heating System.'

Purchasing Officers' Association

Croydon: Greyhound Hotel, High Street, 7.30 p.m. Joint discussion with Sales Managers' Association.

TUESDAY 20 OCTOBER

Royal Institute of Chemistry

Hatfield: Technical College, 8 p.m. K. G. A. Pankhurst: 'The Physics & Chemistry of Detergent Solutions.'

Gravesend: Technical College, Mayfield Hall Annexe, Pelham Road, 8 p.m. F. B. Meech: 'Chemical Problems in Printing.'

Institute of Industrial Technicians

Manchester: Engineers' Club, Albert Square, 7.15 p.m. Miss M. A. Havelock: 'Personnel Management in Relation to Time & Motion Study.'

Incorporated Plant Engineers

Swansea: Mackworth Hotel, 7.30 p.m. Talk and films: 'Lubrication.'

Purchasing Officers' Association

Wealdstone: Railway Hotel, 7.15 p.m. Film: 'The Stanlow Story.'

WEDNESDAY 21 OCTOBER

Royal Institute of Chemistry

Isleworth: Grammar School, Ridgeway Road, 7 p.m. K. G. A. Pankhurst: 'The Physics & Chemistry of Detergents.'

Northwich: I.C.I., Ltd., Alkali Division, Winnington, 8 p.m. Dr. D. W. Hill: 'Oxidation of Cellulose & Some Industrial Applications.'

Institution of Chemical Engineers

Falkirk: Lea Park Rooms, 7.30 p.m. B. Raistrick: 'Phosphorus & Phosphates in Industry & Agriculture.'

Institute of Metals

Wembley: Visit to Osram Lamp Works of G.E.C.

Incorporated Plant Engineers

Glasgow: Scottish Building Centre, Sauchiehall Street, 7 p.m. M. Chadwick: 'Fire Prevention; Fire Fighting in Industrial Premises.'

Rochester: Bull Hotel, 7 p.m. N. Halliwell: 'Heat Recovery from Oil Engines.'

Institution of Works Managers

Stockton-on-Tees: Vane Arms Hotel, 7.30 p.m. H. Bauer: 'Engineering Problems in Switzerland.'

THURSDAY 22 OCTOBER

The Chemical Society

Liverpool: Chemical Lecture Theatre, The University, 5 p.m. Joint meeting with RIC, SCI, British Association of Chemists and the University Chemical Society. Professor C. W. Shoppee: 'Reaction Mechanism & Molecular Geometry.'

Manchester: Room E 17, College of Technology, 6.30 p.m. Original papers.

FRIDAY 23 OCTOBER

The Chemical Society

Birmingham: Chemistry Department, The University, 4.30 p.m. Joint meeting with University Chemical Society. Dr. T. B. Smith: 'Analytical Errors: Heinous & Otherwise.'

Glasgow: Royal Technical College, 3.30 p.m. Joint meeting with Andersonian Chemical Society and Alchemists' Club. Dr. E. J. Bowen: 'Fluorescence of Solutions.'

Newcastle-on-Tyne: Chemistry Building, King's College, 4 p.m. Original papers.

Society of Chemical Industry

Aberdeen: Robert Gordon Technical College, 7.30 p.m. Joint meeting with RIC and Chemical Society. W. Baker: 'The Structure, Stereochemistry & Inclusion Compounds of Some Phenolic Derivatives.'

Institution of Chemical Engineers

Newcastle-on-Tyne: Chemical Engineering Department, Stephenson Building, Claremount Road, 6.15 p.m. J. Wood: 'Heat Exchangers.'

[continued on page 824

Next Week's Events

continued from page 822

Society of Public Analysts & Other Analytical Chemists

Southampton: The University, 5 p.m. 'Paper Electrophoresis.'

Afternoon visit to Esso Refinery, Fawley.

Plastics Institute

Manchester: Engineers' Club, Albert Square, 6.45 p.m. Chairman's address: 'Courtship & Marriage of Plastics & Textiles.'

Incorporated Plant Engineers

Gillingham (Kent): Central Hotel, Watling Street. Annual dinner and dance.

Copper Sulphate Outlook

Association Holds 29th Annual Meeting

THE 29th annual general meeting of the British Sulphate of Copper Association Limited was held at the Association's Offices at No. 1, Great Cumberland Place, London, W.1, on 14 October.

The chairman, Mr. J. D. McKechnie, said: 'In my statement at the last annual general meeting I mentioned that, although supplies of raw materials were expected to be easier, competition in sulphate of copper was likely to increase. Total production actually showed a slight increase over the previous year, and exports were about 4,000 tons higher, even though competition was keener. This increase was due mainly to additional dollar sales, which accounted for 33 per cent of our total exports, showing a considerable improvement over the 1951/52 figures. Our total exports might have been higher had it not been for a shortage of sterling in one market in particular, where it is hoped the position will have improved by the time supplies are required for the present season.

'The importance of our export trade is shown in our figures, for the value of our exports amounted to about £4,500,000, of which £1,500,000 was for dollar markets. The Government continually stresses the importance to the country of exports, especially to the dollar area, and the Association can rightly claim to be doing its share.

'There was a decrease in home deliveries of over 2,000 tons, the demand falling for both agricultural and industrial uses, partly due to a carry-over of stocks and partly, it is thought, to the effect of the high price of sulphate of copper. It is believed that lower prices would have a stimulating effect on consumption.

'The price of copper fell during the year and by the end of the season that of sulphate of copper had been considerably reduced. It is hoped that this fall in the price of sulphate of copper will encourage its increased use.

'Generally, the season's deliveries can be regarded as satisfactory in view of the various difficulties encountered.

'The present season has opened rather badly, for there is a shortage of raw material, partly occasioned by decreased trade in the metal industry as a whole and partly by the fact that secondary material is being run down in this country and then exported. Such material is surely better kept in this country for use in the manufacture of products for export giving the highest possible return. There have also been disquieting reports that the export of non-ferrous scrap and residues might be allowed.

Would Mean Great Loss

'It is vitally important that this should not be permitted, for the sulphate of copper makers require these low grade raw materials to enable them to compete with Continental manufacturers; and it should not be forgotten that, when this happened before the war, scrap had to be imported in order to keep some of the sulphate of copper plants supplied. Sulphate of copper has long been considered an essential export, even during the war, and if its raw materials became unobtainable it would mean a great loss to the country's trade; and it might also lead to the closing down of valuable plants and consequent unemployment.

'The Association has already made substantial dollar sales this season and every effort will be made to increase these; but this will only be possible if supplies of suitable raw materials are forthcoming.'

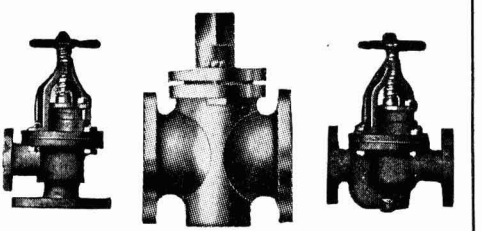
Mr. McKechnie concluded by thanking members of the Management Committee for the co-operation and expressed great appreciation to the general manager and his staff for their able work and loyal service.

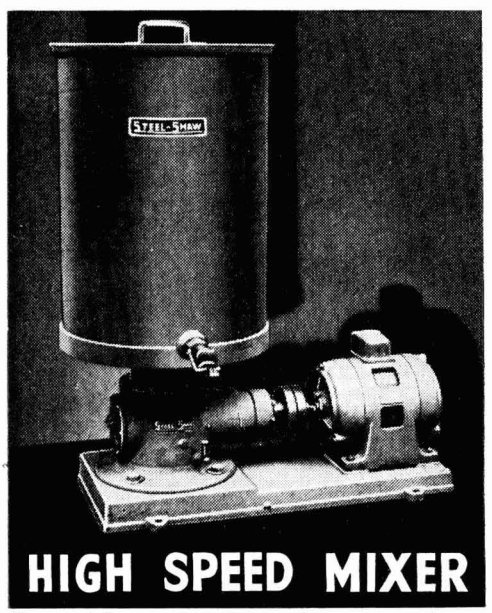
Market Reports

LONDON.—There has been no change either in conditions or prices on the industrial chemicals market during the past week. The movement on home account continues steady with a fair weight of new business for spot or nearby delivery. Inquiry for shipment although moderate in volume is perhaps a little better than of late. The potash chemicals and the leading soda compounds are in good call and other items for which a good demand is reported include acetone, formaldehyde and hydrogen peroxide. The improvement in the coal tar products market has been maintained with creosote oil and cresylic acid moving well. With effect from 12 October, the basis price of dry red lead and litharge has been reduced to £120 15s. per ton and that of dry white lead reduced to £138 15s.

MANCHESTER.—Steady to firm price conditions have been experienced on the Manchester chemical market during the past week and there has been little sign of easiness in any sections of the trade. The alkalies and other leading heavies are meeting with a reasonably good demand from the textile and allied trades and other consumers, while a fair movement of supplies on export account has been maintained. Except in one or two directions the fertiliser trade has been only moderately active. Rather variable conditions have been experienced in the market for the tar products, though most lines, especially among the light materials, are being taken up in reasonably good quantities.

GLASGOW.—As compared with the past week, trade has picked up considerably and the demand from the textile, paint, plastic and allied trades has been extremely good. Prices have remained firm and generally speaking the outlook appears favourable.





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.

CHEMIST required for shift work (42-hour week) on experimental unit in Research Department of **LAPORTE CHEMICALS, LIMITED,** Luton. The work is in an interesting new field with an assured future. Applicants should preferably be of inter. B.Sc. standard with some industrial experience. A good salary is offered with pension rights. Apply to the **RESEARCH CONTROLLER, LAPORTE CHEMICALS, LIMITED, LUTON, BEDS.**

LARGE CHEMICAL WORKS in Home Counties require young, active men, who have completed their National Service commitments, to train for **SHIFT SUPERVISOR** work in the factory. Minimum standard required is General Certificate or equivalent in Chemistry, Mathematics and English. Salary according to age, qualifications and experience. Canteen facilities. Pension scheme. **APPLY BOX No. C.A. 3271, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

LONDON MERCHANTS seek highly qualified Chemical and Pharmaceutical Departmental Manager conversant with international trading conditions, Eastern and barter business. Good profit participation, permanent position. Apply **SECRETARY, J. C. GILBERT, LTD., COLUMBIA HOUSE, ALDWYCH, W.C.2.**

SALES DIRECTOR required by Midland Chemical Manufacturers and Distributors. Qualifications: Age, 30-40; active sales experience to enable him to build from existing conditions. Successful applicant will be required to take up shares in the Company to value of £3,000 to £4,000. Reference. **BOX No. C.A. 3272, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

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.
TWO Whessoe Open Top Riveted Steel **MIXING TANKS,** 13 ft. 9 in. diam., 15 ft. deep, 9/16 in. plate.
NEW GALVANISED PIPING. Immediate delivery. Johnson Filter **PRESSES,** 25 in., 18 Frame, practically new.
TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS.**
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.
SIX **O.T. TANKS,** 7 ft. diam., 14 ft. deep, rubber and brick lined.
Six Aluminium **CONDENSERS,** 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ⅞ in. o.d.
FORTY Riveted **RECEIVERS,** 8 ft. 6 in. long, 5 ft. 9 in. diam., 76 lb. 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, (BOILERS) LTD.,
COLEFORD, GLOS.

FOR SALE

TWO M.S. HIGH PRESSURE AUTOCLAVES 4 ft. I.D by 18 ft. 6 in. long over domed ends. Riveted construction, fabricated from 1⅛ in. thick plate, 625 lb. per sq. in. working pressure.
M.S. HORIZONTAL "U" TROUGH MIXER 3 ft. by 1 ft. 9 in. at top by 2 ft. deep at centre. Fin type agitating gear belt driven through helical gearing from f. and l. pulleys. Arranged for hand tilting.
WERNER TYPE MIXER having G.M. trough 13 in. by 12 in. by 12 in. and double "Z" G.M. agitators belt driven through spur gearing from f. and l. pulleys. Hand tilting.
GARDNER M.S. POWDER MIXERS, sizes D. and E. Belt driven.
STEAM JACKETED COPPER BOILING PANS, 30 galls. capacity. Arranged for hand tilting. Jacket working pressure 40 lb. p.s.i.
STEAM JACKETED COPPER BOILING and **EVAPORATING PANS,** 50 and 100 galls. capacity. Open top. Jacket working pressure 40 lb. per sq. in.
KESTNER HORIZONTAL TUBULAR EVAPORATOR, having six turns 1½ in. bore copper tube, complete with copper reception pot.
TWIN PORCELAIN PEBBLE MILL, 12 in. by 12 in. Belt driven.
Belt driven **DISINTEGRATORS** by **HARRISON CARTER.** Size 00 and 2½.
STEAM JACKETED M.S. VACUUM DRYING OVEN, 3 ft. I.D. by 7 ft. long internally fitted 5-bank steam heating coil supporting 15 aluminium trays in five tiers of three. Rear end dished; domed door secured by eight swivel clamps. Jacket and coil working pressure 20 lb. per sq. in.
DITTO 3 ft. I.D. by 5 ft. long internally having 10 **STAINLESS STEEL** trays in five tiers of two. Quick release C.I. door with handwheel operated spider locking device. Jacket and coil working pressure 20 lb. per sq. in.

PROCESS & CHEMICAL ENGINEERING CO., LTD.
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TOTTENHAM,
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WANTED

SERVICING

PATENTS & TRADE MARKS

WORKING NOTICES

SALE BY AUCTION

INDEX TO ADVERTISERS IN THIS ISSUE

	Page
Alumina Co., Ltd. (The)	829
Blundell & Crompton, Ltd.	Cover Three
Boulton, William, Ltd.	829
British Carbo-Norit Union, Ltd.	830
British Drug Houses, Ltd. (The)	823
British Industries Fair	786
British Oxygen Co., Ltd. (The)	784
Civitas Trading Corporation, Ltd.	787
Classified Advertisements	826, 827, 828
Evans Adlard & Co., Ltd.	784
Foxboro-Yoxall, Ltd.	Front Cover
General Chemical & Pharmaceutical Co. Ltd. (The)	829
Glebe Mines, Ltd.	790
Guest Industrials, Ltd.	829
Harris (Lostock Gralam), Ltd.	Cover Three
Haughton's Metallic Co., Ltd.	825
Holmes, W. C., & Co., Ltd.	Cover Two
Kestner Evap. & Engineering Co., Ltd.	830
Kilner, John, & Sons (1927), Ltd.	825
Laporte Chemicals, Ltd.	Back Cover
Leigh & Sons Metal Works, Ltd.	830
Pascall Engineering Co., Ltd. (The)	Back Cover
Penrhyn Quarries, Ltd.	830
Petrochemicals, Ltd.	821
Pye, W. G., & Co., Ltd.	Cover Two
St. Helens Cable & Rubber Co., Ltd.	785
Stemco, Ltd.	783
Sutcliffe Speakman & Co., Ltd.	788
Steele & Cowlishaw, Ltd.	825
Unifloc, Ltd.	790
Wilkinson, James, & Son, Ltd.	Cover Three
Wood, Harold, & Sons, Ltd.	825

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