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The Alkali Act Report

THE range of the Alkali &c Works Act is today far more '&c' than alkaline so that the subject-matter of the latest and 92nd report is greatly different from that of reports long ago. In addition, the inspectors undertake a diversity of tasks outside their specifically statutory duties in order to assist local authorities with difficult problems of air pollution. As a result of greatly increased public consciousness of air pollution, this trend towards extra-statutory activity is rapidly expanding. Thus, in 1955, the year reported, more than 500 visits were made to non-registrable works in England and Wales and 166 in Scotland. The record of co-operation between industry and the Alkali Act inspectors has long been high; in general, therefore, it is all to the public good and no less to industry that these experienced technical officials should be, so to speak, the spearhead of atmospheric pollution control. Their approach has not been that of enforcement by conviction; far more usually, it has been the approach of investigation and solution. This is well evidenced by the 1955 record of offences against the basic Act. On 21 occasions in England and Wales escapes above the statutory limits were measured and there were also 27 failures to use 'the best practicable means.' That is to say, there were 48 industrial offences. But 'in every case formal notification of an infraction' was followed by 'suitable action . . . so that there has been no occasion to institute proceedings . . .'

It is sometimes believed that the old saltcake process is vanishing. Its registrations under the Act have declined from 45 in 1920 to 31 in 1930 and now to a current 15, of which one is purely technical since the works concerned has not manufactured for some years. But in 1930 the tonnage of salt used was 65,400 tons—in 1955 it was 67,500 and in 1954 68,400. 'There is still,' states the report, 'a large enough demand for saltcake to require the process to be carried on, on something like the present scale, for many years to come, but the number of works operating the process is likely gradually to fall.' The modern story of this ancient process, once the corner-stone of chemical industry, is one of concentration rather than of decline and fall. An interesting comment in the report is that at the time of the passing of the first Alkali Act the total daily loss of hydrochloric acid to the air was estimated to be 150 tons—now, over the past few years, it has been two tons. Control of atmospheric pollution has therefore brought a considerable saving of one of the process's products.

Another registrable sector of the industry—sulphuric acid production—is, of course, in no state of decline, real or supposed. 1955's output exceeded 1954's by 61,000 tons, although 1954's output was formerly the highest recorded total. Despite this expansion, however, output from the chamber and tower processes has declined slightly; and that from the anhydrite process is increasing rapidly. Complaints against this sector of chemical industry have been remarkably few. Thus, 'there has been a number of cases in which the district inspector has felt it necessary to ask for better maintenance of plant, but in no instance was the state

of affairs bad enough for the matter to be regarded as an infraction of the Act.' This statement is admittedly qualified by adding that there was one possible exception to this standard of clean operation, but later it is said that 'the 46 registrations comprise over 70 separate plants, the great majority of which have operated without infraction and without adverse comment.'

The anhydrite process is separately classified. Its expansion is reflected by the figures for anhydrite consumption—1954, 177,000 tons; 1955, 382,000 tons. To the Alkali Act inspectors the most serious problem of the anhydrite process is that of 'mist in the final escapes to air.' Copious, heavy white fumes at one works have given rise to complaints, although the conversion efficiency is high and the acidity of waste gases is reasonable. The cause of this mist formation is not precisely known. One theory is that it is due to a complex of NO_2-SO_2-SO_3. This seems to be a problem still awaiting solution and calling for close co-operation between the inspectors and the manufacturers. However, the overall record of the sulphuric acid manufacturers is good. Despite the large increases in annual production, infractions have fallen from 22 three years ago to a current total of three; and it is admitted that the standards applied are 'perhaps rigid and complex.' For chamber and tower processes, the average (England and Wales) acidity of exit gases was 1.76 grains (SO_3) per cubic foot in 1955 compared with 1.84 in 1954 and 1.90 in 1953. For contact acid plants, the average was 2.13 grains per cubic foot in 1955, compared with 2.65 in 1954 and 2.33 in 1953.

Another problem of mist formation in exit gases, and a relatively new one, is associated with the granulation of compound fertilisers. This is now a registrable process for, in the drying process, the inter-action of free acid with chloride, and possibly also with sulphate, gives rise to some small and incidental production of volatile acids. Nevertheless, the employment of cyclones and scrubbing towers keeps dust and acidity in waste gas emission below illegal figures, and it could be expected that granulation processes at fertiliser works could operate with freedom from local complaints. But this expectation is not fully being realised. Complaints that misty emissions form and fall to ground-levels have been experienced and the number of such complaints has increased in the last year or two. Investigations have found that many are justified. Again the factors giving rise to mist formation are not fully understood, but the inspectors are tightening their requirements. A minimum height of emission of 100 feet is to be asked for in all cases where complaints have arisen and for new granulation plants, or extensions to existent ones, the provision of this minimum height will become a condition of registration. As one cause of mist formation is suspected to be local over-heating in the drying process, better thermal control of the drier is to be asked for.

It is possible that the tendency for complaints to increase is due to the steady increase in plant-food content of granulated compound fertilisers, made possible in recent years by the introduction of triple superphosphate. With less space taken per ton by phosphatic material, more nitrogen—mainly as ammonium sulphate—and more potash as muriate of potash has been included in many formulations. Though this point is not made in the report, the greater throughput of ammonium salts and potash per hour in many of these plants could be associated with greater sublimation of ammonium salts. The separate report for Scotland discusses this matter in great detail, and says that 'in essence, the problem is one of removing extremely small particles of hygroscopic material which promote mist formation.' It is unfortunate that a new and widely used process, virtually one of physical refinement, should be creating new problems of pollution for the fertiliser industry at a time when older problems have been brought under excellent control.

The report as a whole must be regarded as an indirect tribute to the chemical industry. At a time when its activity and also its range of activities have never been greater, the complaints have been singularly few, and almost invariably infringements of the Act have been temporary failings capable of swift correction. This is no petty achievement; on the contrary, it is a notable contribution towards the public cause of cleaner air.

NEWS BRIEFS

Change of Address

The steady expansion of the business of Dallow Lambert & Co. Ltd., Thurmaston, Leicester (industrial dust control equipment) has necessitated a change in its London office facilities. More spacious and more conveniently situated accommodation has now been taken at 6 Stratton Street, W1. The new telephone number is GROsvenor 4766, and telegrams should be addressed to 'Deduster Wesphone' London. The move will enable Mr. A. P. Reeve (office manager) to have a small permanent exhibition of dust control equipment which, it is felt, will be of assistance to visitors and industry.

Italian Fertiliser Exports

Italian exports of chemical fertilisers have continued to increase in recent years as can be seen from the figures given below:—

1 January to 31 May 1954	145,680 tons
1 January to 31 May 1955	190,357 tons
1 January to 31 May 1956	239,756 tons

The figures recorded during the first five months of this year show an increase of nearly 27 per cent over the corresponding figures for 1955.

Fire at Fawley

An outbreak of fire occurred at Fawley oil refinery at Southampton last week. According to an official of the Esso Petroleum Co. the fire was in oil sludge troughs on the marsh perimeter of the refinery between the main plant and Southampton Water. He added that there was no danger to any of the refinery equipment or stores.

ISMA Joint Conference

The Rt. Hon. the Earl of Woolton, C.H., will be the leading speaker at a conference on Britain's marketing problems to be held at the Royal Festival Hall, London, on 9 October. The conference, which will be in session from 10 a.m. to 5 p.m., is organised jointly by the British Institute of Management and the Incorporated Sales Managers' Association and will take as its theme 'The Management Challenge of 1957: Can We Sell Our Way out of Inflation?' In a special statement regarding this theme, Mr. D. R. Griffiths (director and secretary of ISMA) stresses there is evidence that when Britain tries to sell on price the price is too high; when she tries to sell on quality the designs are not good enough; and when she tries to sell on service this country too often breaks its delivery promise. 'Whose fault is this and who can put the situation right?' poses Mr. Griffiths, adding that the conference will do its best to seek the answers.

Institute of Metal Finishing

A joint meeting of interest to many members is being arranged between the north-west branch and the organic finishing group of the Institute of Metal Finishing, to take place on Thursday, 4 October 1956, in the Chester and Manchester area. The meeting will include an afternoon tour of the works of John Summers & Sons Ltd., who are among the biggest producers of zinc-plated steel sheet in this country. At the headquarters of the north-west branch a paper, 'The Evaluation of a Variety of Organic Finishes on Electro-Zinc Coatings,' will be presented by P. Costello and E. Pace. Members wishing to participate in the meeting should apply to the head office of the Institute (32 Great Ormond Street, London WC1) without delay.

Scotland's Industrial Expansion

Important industrial projects in Scotland were disclosed by Lord Polwarth, chairman of the Scottish Council (Development and Industry) in Edinburgh last week. Among the firms involved, he said, was the Glasgow concern of Thermotank which had been helped in setting up a new company. It planned to manufacture tubing etc.

Australia's Atom Project

Mount Isa Mines announced last week that it would send its service manager to Britain and America to investigate the possibility of building Australia's first private enterprise atomic power station at Mount Isa, in North-West Queensland. Mr. Howard Beale, Australia's Minister of Supply, said he had discussed the project with officials of the company and had assured it of full Government technical aid.

Safety Award

Imperial Chemical Industries Ltd., Nobel Division, has been awarded for the first time the company's inter-divisional safety trophy. This is given every six months to the division which shows the biggest percentage improvement during the preceding 12 months over its 'previous best' frequency rate for a year. Nobel's reduction of the accident frequency rate is 39.57 per cent, from 1.170 to 0.707.

Cheaper Plant Protection

West German Farmers Benefit

PRICES of preparations for the protection of plants and prevention of parasites have decreased on average since 1952 by about 10 per cent. Results obtained by rationalising and modernising production have been passed on to agriculture in the form of lower prices, so stated an article in *Chemie Nachrichten* recently. In this way West German agriculture saved more than DM 10 million during 1954-55.

In connection with this result, an investigation was made by the Ifo Institute into the course prices took. The investigation covered 21 of the largest and most important groups of the preparations. It showed that almost three quarters of the West German total sales of preparations for the protection of plants and prevention of parasites went to products, which had become cheaper by about 13 per cent on average since 1952. The price of 16 per cent of all products remained unchanged. Only 11 per cent of the total sales went to these preparations, which have become dearer since 1952 as a consequence of considerable increases in the cost of international raw materials and of an increase of tax (mineral oil tax).

Result of this investigation is confirmed by the fact that production of preparations for the protection of plants and the prevention of parasites had increased quantitatively in 1955, compared with the previous year, by 16 per cent to 66,300 tons, while the value of production only increased by about DM 150 million. During the first quarter of this year quantitative increase of production was 14.5 per cent to almost 22,000 tons, compared with an increase in value of not quite 2.5 per cent to DM 40 million. This means that the trend towards lower prices has continued this year, although increases in production costs have occurred.

Natal Water Laboratory

Following the recent establishment of a water laboratory in South West Africa by the Council for Scientific and Industrial Research, a similar laboratory will be set up in Natal under a grant of £2,500 in the current year by the Natal Provincial Administration. The main problems to be studied are methods of treatment of water supplies, sewage treatment and disposal plants, and the prevention of pollution by industrial wastes.

Restrictive Practices

First Registration Order Made

THE President of the Board of Trade announced in a written reply in Parliament on 2 August that the Board have made the first Order (the Registration of Restrictive Trading Agreements Order 1956) requiring registration of restrictive trading agreements. This Order is made under the Restrictive Trade Practices Act 1956, which received Royal Assent earlier in the day. The Order will be on sale to the public on 10 August.

The President explained that if the Order receives the approval of Parliament it will come into force on 30 November 1956. During the three months following that date, particulars of the classes of agreement specified in the Order must be furnished to the Registrar of Restrictive Trading Agreements.

The specified classes of agreements are, broadly, those which include restrictions as to prices or other terms or conditions or which involve collective discrimination. These are the most important and the most numerous kinds of agreement. They include agreements about common prices and conditions of sale, agreements about level or agreed tendering, agreements under which preferential terms are granted to certain persons or traders and agreements under which supplies of goods are confined to certain persons or traders.

Agreements which contain restrictions affecting exports and which do not affect supply to the home market, do not have to be registered but must, under Section 31 of the Act, be notified to the Board of Trade.

Gamma Ray Source

Completion of a 2,000 curie cesium-137 gamma ray source was recently announced by Arthur F. Rupp, director of the operations division at Oak Ridge National Laboratory. This is the second large cesium-137 gamma ray source to be produced at the laboratory, which is operated by Union Carbide Nuclear Co., a division of Union Carbide and Carbon Corp. for the Atomic Energy Commission. The first source, which contained 1,540 curies of cesium-137, was completed in 1954 and is now in use for medical research at the Oak Ridge Institute of Nuclear Studies. The second source will be used in a fission-product utilisation programme at the University of Michigan.

NOTE & COMMENT

MOST British chemical manufacturers will think twice about participating in the Brussels International Exhibition, to be held from April to October 1958. At a press conference given last week by the Federation of British Industries it was stressed that the exhibition will be a prestige exhibition 'as opposed to a hard selling trade fair.' At £6 10s per sq. ft. gross, which has to include circulating areas and gangways, this prestige is costly. The British site, of about five acres, will consist of two separate parts —a Government pavilion, and an industrial section comprising a pavilion and supporting features. Although coming under the general jurisdiction of Sir John Balfour, as UK Commissioner-General for the Exhibition, the industrial section is the responsibility of the Federation of British Industries, through its subsidiary company, British Overseas Fairs Ltd. The industrial pavilion will provide 100,000 sq. ft. gross of indoor exhibition space. It is understood that the building alone will cost nearly £500,000.

Forgotten Industry

ALL ASPECTS of British industry are to be represented at the exhibition, but on what scale is not known. The Association of British Chemical Manufacturers, however, told THE CHEMICAL AGE last week that it had at first considered organising a composite display but had since decided against it. One of the main reasons for this, it is understood, is the terrific expense involved; for this reason few British chemical manufacturers are expected to exhibit. It is unfortunate that expense precludes the chemical industry's large-scale participation in a major exhibition such as that at Brussels. When the Government stopped the BIF earlier this year, Mr. Peter Thorneycroft, President of the Board of Trade, said it was intended that the money hitherto spent on publicity for the BIF would in future be used by the Board of Trade mainly in connection with overseas fairs and exhibitions at which British goods were shown and the prestige of our products upheld. The Government obviously recognises the importance of the Brussels exhibition and is spending a lot of money on it. Yet it seems unaware of the importance of the chemical industry—Britain's fourth largest exporting industry. Has the time now come when, as we suggested earlier this year, the chemical industry should organise its own trade fair on a scale comparable with most of the important European trade fairs?

Ammoniacal Gas Liquor

'IT IS PROBABLE that the ammoniacal liquor which abounds in gas works . . . will, ere long, be extensively used as a manure.' So said a Mr. Handley in the *Journal* of the English Agricultural Society more than a century ago. This month a paper by H. Tod and K. Simpson (*Journal of the Science of Food & Agriculture*, 1956, **7**, 511) states 'On grassland, raw ammonia liquor from gasworks (0.75 to 2.30 per cent N) may be a useful source of nitrogen.' Thus does the wheel of technology turn full circle! Before the true significance of nitrogen as a plant-food was either proved by experiment or established by empirical fact, farmers had used ammoniacal liquors from the gas industry with some success. Slowly from this stage the use of ammonium salts became more popular, first the chloride, later the sulphate; and all larger gas works converted their ammoniacal liquor wastes into sulphate, which became a valuable by-product. Even today, however, there are a number of small works in England and Scotland where the annual output of ammoniacal liquor is considered too small to justify installing plant to make sulphate of ammonia. Instead, the liquor with its useful nitrogen content is discarded. Almost invariably small gas works such as these are placed in or close to agricultural areas. In Scotland some 50 million gallons are wasted each year, the equivalent of 10,000 tons of sulphate of ammonia; yet at the same time disposal

of the waste liquor causes problems and costs. It is not irrelevant to point out that in the US a steadily rising proportion of the nitrogen used as fertiliser is applied as liquid ammonia, aqueous ammonia, or as mixed solutions of ammonia and ammonium nitrate.

Modern Research

MODERN RESEARCH has shown that the liquor is effective, though, for comparable rates of nitrogen supply per acre, by no means as effective as sulphate of ammonia. It seems to be generally accepted that grassland and not arable crops should be fertilised with this somewhat crude material. Presumably the practical reason for this is that applying a bulky liquid fertiliser is more easily and cheaply done if machinery can be moved over firm ground rather than over ploughed land sown to crops in rows. For in applications of the latter kind injection types of machinery must be used. In the 19th century, crop damage caused by ammoniacal liquors was attributed to the presence of impurities; more emphasis today is placed upon damage by 'scorch', i.e., the normal effects of chemical contact with plant foliage, and it is said that the risk of scorch can be largely overcome by using spaced jets instead of spray nozzles in applications. Only when unusually concentrated liquor is used have there been significant modern observations of damage due to impurities.

The relative effectiveness of this and other standard sources of nitrogen can be judged from a comparative statement of 1955 test results. For 56 lb. of nitrogen per acre applied in different forms to grassland, the extra outputs of crude protein (lb.) were: ammoniacal liquor 68 lb.; sulphate of ammonia 103 lb.; 'Nitro-Chalk' 103 lb. Thus, there is about a 35 per cent loss of nitrogen utilisation efficiency for liquor. Possibly some of the otherwise expectable crop response is lost through scorching, which must operate as a temporary check to growth; but it seems more likely that there is an appreciable loss of nitrogen as ammonia by volatilisation, a form of wastage not associated with the use of solid compounds. Nevertheless, a waste product that is only some 65 per cent efficient is better used than thrown away.

Titanium Pigment Plant

AFRICAN Explosives and Chemical Industries Ltd., and British Titan Products Ltd., have formed a new company to manufacture titanium dioxide at Umbogintwini, Natal. The new plant, which is planned to come into production some time in 1958 with an initial annual capacity of 8,000 tons of pigment, will cost £2,000,000.

Titanium dioxide is progressively displacing the traditional white pigments in the paint, rubber, ceramic, paper and ink industries because of its high refractive index, durability, and non-poisonous properties.

The main raw material used in the production of titanium dioxide is ilmenite. British Titan Products are also developing large deposits in West Africa, and ilmenite-bearing sands of varying qualities are also found on the south coast of Natal.

Butadiene Expansion

A MULTI-MILLION dollar expansion programme has been announced by the Texas-US Chemical Co. to increase output of the butadiene plant (claimed to be the world's largest) at Port Neches, Texas, by over 50 per cent to 300,000 short tons a year.

Work on the expansion has already begun and it is anticipated that some of the increased output will be realised late in 1957. Full production from the new facilities is scheduled for autumn 1958.

The Port Neches butadiene plant was purchased from the US Government by Texas-US Chemical Co. and Goodrich-Gulf Chemicals in May 1955. A portion of the butadiene output will be supplied to adjacent rubber producing plants owned by these companies. Another portion will go to other rubber and chemical producers.

Scottish Tar Distillation Unit

An order for a pipe still tar distillation unit of 250 tons per day capacity has been placed by Scottish Tar Distillers Ltd., of Falkirk, with Chemical Engineering Wiltons Ltd. The unit, which will be sited at Lime Wharf chemical works, Falkirk, is to be in operation by mid-summer 1957.

GEC Rename Laboratories

The General Electric Co. Ltd. has renamed three laboratories at Stanmore, Coventry, and Salisbury, South Australia, under a group title of Applied Electronics.

ACCELERATOR INSTALLED

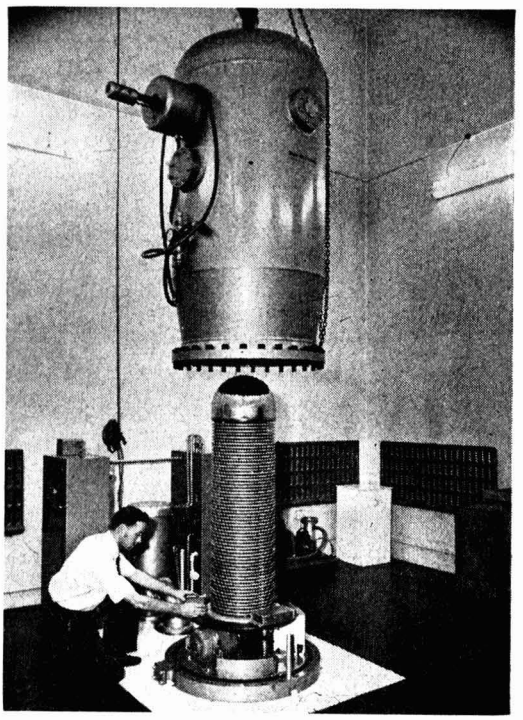
A VAN DE GRAAFF electrostatic particle accelerator has been installed at the Enfield works of Standard Telecommunication Laboratories Ltd. (a wholly owned subsidiary of Standard Telephones & Cables Ltd.). This company is interested in using radiation to produce structural or chemical changes in materials.

The accelerator, which cost about £50,000, was built by the High Voltage Engineering Corp. of America, and is particularly useful in industrial research since it produces radiations which can be readily controlled and accurately measured. It is a safer source than either radioisotopes or reactor sources.

A stabilised potential of two million volts (positive or negative as required) is generated and can be used to produce intense and highly penetrating beams of electrons and other atomic particles. The article to be irradiated is placed on a moving belt which can be passed at controlled speeds through the emitted beam.

The whole equipment is contained in a reinforced concrete building with walls which vary from one foot thick at the top to three feet at the bottom.

Important applications of this accelerator will include the irradiation of plastics materials to produce modifications in the physical and chemical properties. For example, polythene which has been irradiated will stand up to temperatures of 125°C without softening. The crystalline melting points of Alkathene-HD (the new ICI polythene) and Alkathene-2 (ICI's ordinary polythene) are given as 120-124°C and 106-109°C respectively.



Above: The Van de Graaff accelerator with the outer casing removed. The ring construction shown is an anti-sparking device. Below: Sir John Cockcroft performing the official switching-on

Experiments have also been carried out on other materials. Normally, styrene-polyester mixtures will not react unless a catalyst is present. If, however, the mixture is irradiated, polymerisation will proceed readily without the addition of any contaminating chemical.

As briefly reported in last week's issue, the opening ceremony was performed on 1 August by Sir John Cockcroft, director of the Atomic Energy Research Station. Sir John remarked on the great engineering advances shown by the accelerator compared with the ones he had experimented with some 25 years ago. In those days he could never be sure that the machine was going to work when switched on, but now the operation of the machine itself was just routine.

THE 4th INTERNATIONAL POTASH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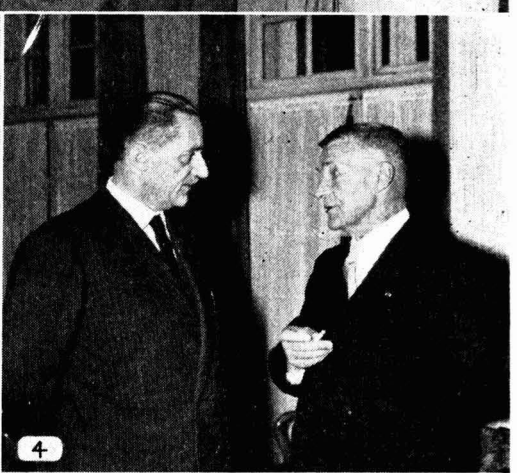
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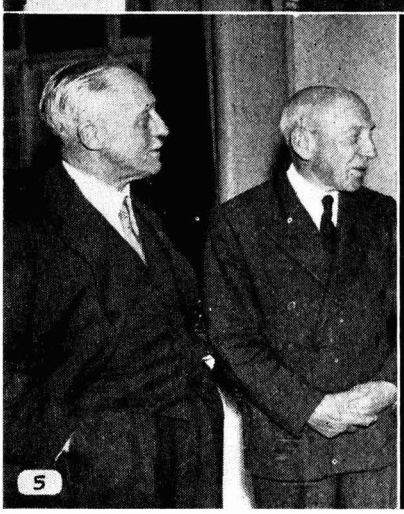
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CONGRESS IS HELD IN LONDON

1, Professor and Madame G. Torstensson (Sweden); 2, left to right, Dr. Gustav Humbert, Prof. Dr. E. van Boguslawski and Frau von Boguslawski, Herr H. E. Boettrich; 3, left to right, Prof. Dr. H. Deuel and Madame Deuel (Switzerland), Mon. R. Gadonneix, French Potash Selling Organisation, and Herr J. Schmelz, West German Potash Selling Organisation; 4, Dr. Borel with Mon. P. Rouquerol (Switzerland), left, a director of the International Potash Institute; 5, left to right, Sir James Scott-Watson, Sir William Ogg, director of Rothamsted Experimental Station; 6, Dr. G. W. Cooke (Rothamsted) (centre) with Dr. O. Kohnke (West Germany) (right), and Mon. L. Audidier (France); 7, left to right, Madame Barbier, Mon. M. Rochaix and Madame Rouquerol (from Switzerland), Prof. G. Barbier (France) and Prof. Dr. F. Alten (West Germany); 8, Prof. F. Tilkin (Belgium) (centre), with Madame Tilkin and Dr. D. A. Boyd (Rothamsted); 9, left to right, Mrs. G. A. Cowie, Lady Ogg, Dr. G. A. Cowie (Potash Ltd.) and Mrs. T. Walsh; 10, left to right, Sir John and Lady Russell, Mr. Morley Davies (National Agricultural Advisory Service) and Dr. T. Walsh (Eire). Sir John was chairman of the Congress; 11, left to right, Mr. C. M. John (India) with Mr. G. A. Stolar (Israel) and Mr. B. Bulsara (India)

FERTILISERS having a high potash content were extolled by the Earl of Radnor, chairman of the Rothamsted Experimental Station governing body, on 2 August. He was speaking at the dinner which marked the end of the two-day congress in London organised by the International Potash Institute of Berne. Lord Radnor ('I am no scientist but I know something of the problems which beset the ordinary farmer') said

International Potash Congress

that on his chalk land at Longford Castle in Wiltshire, potash fertilisers had helped to increase the grain yield.

The dinner, presided over by Sir John Russell, chairman of the congress and a former director of Rothamsted, was attended by nearly 200 delegates and their ladies representing 19 countries of the world. Welcoming them, Sir John said the congress (the fourth) had been most successful. In a humorous reference to automation ('a dreadful word'), he considered the farm of the future. 'Automation will invade the farm which will have an electronic computor receiving reports from automatic instruments placed at various points. There will be automatic photographic arrangements to show what each crop is like. Then, by remote control, the crops will be sprayed and fertilised. The farmer will just sit down and collect the profits,' remarked Sir John amid laughter.

'More K Conscious'

Professor H. G. Sanders, chief scientific adviser, Ministry of Agriculture, said that the United Kingdom was becoming 'more K conscious.' Last year about 275,000 tons of K_2O were used which represented a 10 per cent increase on the previous year. We were using more and more potash and yields could increase still further as we became more conscious of its value.

The final speaker, Dr. A. Borel, president, International Potash Institute, thanked the British organisers, and in particular Dr. G. A. Cowie, for their hospitality. He said British agriculture today was an example of what had been done to increase the productivity of farm land.

Next year's congress will be held in Vienna.

As reported in THE CHEMICAL AGE of 28 July, the Congress was held at University College, London. Papers were presented by Dr. J. F. Sutcliffe (Selective Absorption of Alkali Cations by Storage Tissues and Intact Barley Plants); Dr. R. Heller (Paris) (Le Potassium en Culture des Tissus); Dr. Y. Coic (Versailles) (Le Potassium dans la Cellule); Dr. F. J. Richards (Some Aspects of K Deficiency in Plants); Professor Dr. E. Welte (Berlin) (Uber die Bedeutung des Kaligehaltes in der Pflanze); Dr. D. J. Watson (Physiological Basis of the Effect of K on Crop Yield); Professor T. Wallace (Visual Symptoms of K Deficiencies in Crops and Relation of Potassium to Magnesium in Plant Nutrition); Dr. D. A. Boyd (Effect of Potash on Crop Yield); Professor Dr. W. Schuphan (Der Einfluss des K auf die Qualität der Nahrungspflanzen unter besonderer Berücksichtigung des biologischen Wertes); Dr. F. T. Last (Effect of Potassium on Parasitic Plant Diseases).

Final session was devoted to a review of British farming by Sir James Scott Watson. Then a film 'Modern British Farming' was shown. On Friday 3 August, male delegates visited Rothamsted while their ladies went to Windsor Castle and Hampton Court Palace.

Fermentation Industry

THE more recent history of industrial fermentation processes, including those which have received successful commercial application and others which await this step, was reviewed by Mr. J. J. Hastings, M.B.E., M.Sc., in a paper on 'New Products of the Fermentation Industry' delivered at the recent annual meeting of the Society of Chemical Industry.

A distinction was made between fermentations giving macro-products and those from which only micro-products are recovered. It was pointed out that these two fields can be brought together by examining the complete fermentation harvest. Research on the production of vitamins and antibiotics had had a profound influence on all fermentation techniques, said Mr. Hastings.

The paper made a realistic examination of the standing of fermentation processes in industry. Cost factors were outlined, and competitors in the form of natural resources or synthesis were given careful consideration. Methods of reducing fermentation costs were discussed, including the possibility of continuous processes and automation.

Mr. Hastings concluded his paper by expressing views on the future of the industry over the next 25 years.

Change of Address

Powell Duffryn Ltd. announces that on and after 11 August its registered office and London departments will be located at the new group headquarters at 8 Great Tower Street, London EC3 (Telephone: MANsion House 4555 (20 lines).

Publications & Announcements

TWO publications, *Terylene in Industry* and *Terylene Buyers' Guide, Industrial Version,* have recently been issued by Imperial Chemical Industries Ltd. The first of these reviews briefly the properties of Terylene. Terylene, it is claimed, is an extremely strong fibre which retains its strength completely when wet, and can withstand heavy loads with little extension. Heat, chemical and rot resistance are also claimed to be high. A section of this booklet describes filtration fabrics, felts and industrial clothing made from Terylene. A number of operations hitherto made difficult or very costly by the poor resistance of cotton or wool to hot air or acid conditions are now using Terylene filtration fabrics. The Buyers' Guide lists manufacturers and merchants of industrial fabrics and articles, and a separate edition has been published covering apparel and domestic uses for Terylene.

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HIGH production standards characterise the spring issue of *The Lamp,* published by the Standard Oil Co. of New Jersey, US, distributed in the UK by Esso Petroleum Co. Ltd., London. Two articles deal with gas turbines for road vehicles and their bearing on the design of motor cars of the future. Another well illustrated feature considers, in somewhat sketchy form, the development of powered road vehicles. It is a pity that the authors have culled continental libraries and neglected the successful experiments made by British engineers in the pre-internal combustion engine days.

* * *

IN *The Year's Achievements,* an attractive, illustrated digest of ICI Ltd. annual report for 1955 produced specially for employees of the company, it is stated that for the first time in ICI's history the accident rate for the whole year was less than one lost-time accident per 100,000 man-hours worked. This, states the publication, is a particularly good result for any industry, and particularly for a heavy industry, especially when it is remembered that 100,000 hours is one man's entire working life.

* * *

AN ARTICLE on 'Silicosis and Related Diseases' by Dr. P. F. Holt, is included in the latest issue of *Science Progress,* Vol. xliv, No. 175. After discussing the symptoms of silicosis and referring to experimental work that has been carried out, the author goes on to consider methods for combating pneumoconiosis, of which silicosis is a form. It is only recently that efficient respirators have been available and even now it is found to be impossible to do really prolonged hard work while wearing a respirator. The methods of ventilating factory workshops have undergone radical changes in recent years. An attempt is made to enclose machines which produce dust, and to keep a reduced pressure inside the cover so that air never passes from the machine into the shop. If it is impossible to enclose a machine, a ventilating hood is fixed as near as possible to the dust source. *Science Progress* is published by Edward Arnold Ltd., 41 Maddox Street, London W1, price 12s 6d (by post 12s 10d).

* * *

THE problem of air entrapped in glass reinforced polyester mouldings is discussed in Vol. vi, No. 2 of *Resin Review* published by Rohm & Hass Co., Philadelphia, US. During the development of Paraplex P-444 it was found that it had a greater tendency to form bubbles than standard products under some conditions of curing. Elevated temperatures, it was found, tended to produce bubbles. The possible causes of bubble formation are: (1) Boiling of monomer, (2) boiling of monomer/water azeotrope, (3) water vapour, (4) gas from excessive and rapid catalyst breakdown, (5) difference in rate of wetting and therefore displacement of air from fibres, (6) presence of air. Experimental work showed conclusively that air was the source of the bubbles. Another article in this journal traces the history of the use of ion exchange techniques in atomic energy developments. The first general application of ion exchange techniques in the atomic field is thought to be the work of Spedding and his co-workers at the Ames (Iowa) laboratory of the Atomic Energy Commission used resins to separate and purify rare earth elements. In 1950 the US began to place emphasis on finding uranium ore in continental America. Although many sources were available, the ores were generally of low quality and extraction of the metal was both difficult and expensive by conventional means.

Ultrasonic Gauge

Aids Chemical Industry

MANY chemical processes are, by their very nature, highly corrosive and the maintenance of production plant in a safe and efficient condition is one of the most exacting tasks of the plant engineer. The problem is particularly acute in the shipping industry, since tankers are subject to corrosion not only by crude oil and refined products carried within the tanks, but also by sea water from without.

The chemical and oil industries which, like that of shipping, are both faced with similar problems of thickness measurements on pressure vessels, pipes and other plant, have found ultrasonic gauging a reliable alternative to drilling or dismantling. Recent advances in electronics have made it possible to produce a battery-operated, self-contained and portable gauge which is sufficiently simple and robust for constant use on open sites by ordinary maintenance personnel. The instrument, known as the Type 1101 Ultrasonic Thickness Gauge, is made by Dawe Instruments Ltd., of Uxbridge Road, London W5, and operates on the resonance principle.

An Ultrasonic Signal

A variable oscillator within the instrument generates an ultrasonic signal, which is injected through a crystal probe into the plate whose thickness is to be measured. Just as light is reflected by a mirror, so the signal is reflected by the far, inaccessible side of the plate and is picked up again by the probe. If the outgoing and reflected signals are in phase, they will reinforce each other and resonance occurs. In operation, the probe is applied to the plate and the wavelength is slowly changed by means of the control knob, until resonance is achieved. The thickness of the plate is read off a scale graduated directly in inches, and is found opposite another scale showing the fundamental resonant frequency. The gauge is suitable for thickness measurements from 0.06 in. to 12 in. in steel, and for a similar range in most other metals.

The latest model of this gauge, which is provided with a 50-ft. lead between the instrument and the probe, has been developed especially for the chemical and shipping industries. The long lead enables one operator to apply the probe in high or awkward locations, while another operator, at a central position, takes the readings on the gauge. It is thus often possible to dispense with the need for staging and to use ladders instead, with a consequent saving in time and cost.

As far as the chemical manufacturing industry is concerned, the main advantage of the gauge lies in the fact that corrosion surveys can be carried out without interfering with the manufacturing process. Completely satisfactory readings have been taken on pressure vessels containing hot acid, on Horton spheres and cracking towers. The high cost of shut-downs occasioned by the consequent loss of production has thus been eliminated, and more frequent checks have made a close control over plant conditions possible. Although new applications are being found, ultrasonics have already proved one of the most important aids developed for the chemical industry since the war.

Fuel Efficiency Conference

IMPORTANT statements about the efficient use of fuel in industry will be made at a conference that is to take place in conjunction with the Fuel Efficiency Exhibition at Olympia, London, from 2-10 October. The conference has been organised by a committee under the auspices of the Institute of Fuel and will be opened by Sir Graham Hayman (president of the Federation of British Industries). Consisting of four sessions (each starting at 10.30 a.m.), it will be held in a hall at Olympia adjoining the Exhibition. Open discussions will follow each address. The final session will have as its subject 'The Clean Air Bill and Industry'. Chairman on this occasion will be Sir Hugh Beaver, K.B.E., M.I.C.E., (chairman of the Air Pollution Committee).

Pollution Abstracts

THE FEBRUARY issue of *Water Pollution Abstracts* has now been published by the Department of Scientific & Industrial Research, price 3s 6d from HM Stationery Office. These abstracts are prepared by the water pollution research staff of DSIR and as far as possible the original literature is consulted and a fair summary is given of it. When, however, it has not been possible to consult the original literature the abstract is prepared from a published summary or abstract.

UK Sulphuric Acid Returns

Production & Consumption—1 April-30 June

PRODUCTION of sulphuric acid and oleum from 1 April to 30 June 1956 totalled 562,416 tons of 100 per cent H_2SO_4 (chamber, tower and contact) according to figures issued by the National Sulphuric Acid Association Ltd. UK consumption in that period amounted to 558,931 tons of 100 per cent H_2SO_4.

SULPHURIC ACID & OLEUM
1 April-30 June 1956
(*Tons of* 100% H_2SO_4)

	Chamber & Tower only	Contact only	Chamber Tower & Contact
Stock, 1 April, 1956	24,281	56,481	80,762
Production	144,291	418,125	562,416
Receipts	23,484	38,239	61,723
Oleum feed	—	1,699	1,699
Adjustments	−79	+119	+40
Use	94,725	182,439	277,164
Despatches	71,341	267,261	338,602
Stock, 30 June, 1956	25,911	64,963	90,874
Total capacity represented	197,800	493,230	691,030
Percentage production	72.9%	84.8%	81.4%

UK CONSUMPTION, 1 APRIL-30 JUNE

Trade Uses	Tons 100% H_2SO_4
Accumulators	2,590
Agricultural purposes	732
Bichromate & chromic acid	4,669
Bromine	2,577
Clays (Fuller's earth, etc.)	2,448
Copper pickling	751
Dealers	3,198
Drugs & fine chemicals	4,289
Dyestuffs & intermediates	19,056
Explosives	4,981
Export	1,006
Glue, gelatine & size	119
Hydrochloric acid	15,451
Hydrofluoric acid	2,858
Iron pickling (including tin plate)	29,847
Leather	1,134
Lithopone	4,153
Metal extraction	999
Oil refining & petroleum products	15,704
Oils (vegetable)	2,174
Paper, etc.	1,670
Phosphates (industrial)	145
Plastics, not otherwise classified	10,595
Rayon & transparent paper	64,815
Sewage	2,690
Soap, glycerine & detergents	19,168
Sugar refining	154
Sulphate of ammonia	73,306
Sulphates of copper, nickel, etc.	6,589
Sulphate of magnesium	251
Superphosphates	132,680
Tar & benzole	5,940
Textile uses	4,746
Titanium dioxide	67,995
Unclassified	49,451
Total	558,931

RAW MATERIALS (*Tons*)

	Pyrites	Spent Oxide	Imported Sulphur	Recovered Sulphur H_2S & Filter Cake	Zinc Concentrates	Anhydrite
Stock, 1 April, 1956	195,520	124,122	47,580	10,527	46,744	10,319
Receipts	83,842	69,132	73,782	9,344	45,003	176,107
Adjustments	+4,819	+523	−22	−1	+90	—
Use	107,308	63,426	62,363	9,615	43,563	169,325
Despatches*	1,411	3,731	1,061	2	857	—
Stock, 30 June, 1956	175,462	126,620	57,916	10,253	47,417	17,101

* Including uses for purposes other than sulphuric acid manufacture.

FMC Sponsors Research Project

Mr. Carm A. Ramano, resident manager of Intermountain Chemical Co., a subsidiary of Food Machinery & Chemical Corporation, announced recently that FMC will sponsor a full time research project at Montana State College during the coming school year. Mr. Jerry D. Mason, a candidate for the master's degree in mechanical engineering, will investigate for FMC the processing of trona and soda ash in the mineralogical field. Intermountain Chemical Co., under the management of FMC's Westvaco Chlor-Alkali Division, currently produces a thousand tons a day of high purity soda ash from trona mined near Green River, Wyoming.

New US Chemical Plant

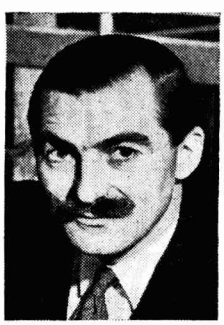
A new high energy chemical fuel for use in missile and aircraft engines will be produced for the US Air Force by Olin Mathieson Chemical Corporation in a $36 million plant to be constructed near Niagara Falls, New York. The Air Force contract calls for construction of the plant at the Lake Ontario ordnance works in Model City, NY, about 14 miles north of Niagara Falls. Olin Mathieson's research department has been carrying on experimental and development work on the new fuel for the Department of Defence since 1952, it is stated. In addition, the corporation is building a smaller plant, also at the ordnance works, to produce the same fuel for the US Navy.

PEOPLE in the NEWS

● MR. D. R. MACKIE, managing director of Monsanto Chemicals Ltd., announces that, to meet the organisational requirements of the company's development programme, the following appointments have been made:— MR. W. M. THOMPSON, director of purchases, to be sales director; MR. J. S. BROUGH, chief engineer, to be general manager of production; MR. J. S. HUNTER, sales controller, to be general manager of development; MR. W. E. HAMER, manager of research department, to be general research manager; MR. J. M. KERSHAW, project manager, to be chief engineer; MR. D. C. M. SALT, sales controller, to be general manager of sales; MR. G. DODD, director and general manager of Monsanto Plastics Ltd., to be controller of purchases, Monsanto Chemicals Ltd. MR. E. L. PIXTON, sales controller of Monsanto Chemicals Ltd. and a director of Monsanto Plastics Ltd., will, until further notice be seconded to devote the whole of his time to promoting the present and future marketing interests of Monsanto Plastics Ltd. The appointment is also announced of MR. O. W. MURRAY, chief construction engineer, to be deputy chief engineer.

● MR. FREDERICK DORRIEN HUCKLESBY has been appointed superintendent of the process development section at British Oxygen's sales technical service department, Cricklewood.

● MR. E. J. WESTNEDGE, who is general sales manager of British Resin Products Ltd., has now been appointed to the board of that company.



Mr. E. J. Westnedge

● MR. E. R. BROWN has been appointed chief planning engineer of Quickfit & Quartz Ltd., the Stone (Staffs,) manufacturers of interchangeable laboratory glassware. He succeeds MR. C. CLISS, Before joining Quickfit & Quartz, Mr. Brown was employed on similar duties in the pottery industry.

● MR. E. T. GILL, B.SC., F.I.M., joined the staff of the development and research department of The Mond Nickel Co. Ltd., on 1 August, as development officer for constructional alloy steels, in succession to MR. L. W. JOHNSON, who was recently appointed assistant manager of the department.

● MR. E. W. WARD, general sales manager, plastics division, Celanese Corp. of America, has announced the appointment of MR CHARLES M. REYNOLDS as sales director for the division's newly-established sheet department. Mr. Reynolds was formerly assistant director of sales for film. MR. CHARLES H. EDGAR, formerly a Celanese plastics sales representative in New England, succeeds Mr. Reynolds as assistant director of sales for film.

● Lederle Laboratories Division, Cyanamid Products Ltd., announces the appointment of MR. ERIC WALTERS as assistant sales manager. This follows the recent appointment of MR. A. M. ROSS as sales manager (THE CHEMICAL AGE, 4 August, p. 208).

● At a recent investiture in Cardiff by HRH the Duke of Gloucester, Grand Prior of the Order of St. John, DR. J. G. M. BREMNER, ICI Dowlais works manager, was one of those who received a Priory vote of thanks for his work for the Dowlais ambulance division of which he is president.

● MR. JAMES F. WIDMAN has been appointed to the board of Union Carbide and Carbon Corp. Mr. Widman has served in the sales research and sales divisions of Union Carbide both in the US and abroad. He joined the Gemec organisation in Britain in 1950. For some time he has been manager of the Gemec Chemicals Co. and Kemet Products Co., both divisions of Union Carbide.

● One of the joint secretaries of Glaxo Laboratories, MR. J. A. NATHAN, has retired and MR. AUSTIN E. BIDE has been appointed secretary of the company jointly with MR. A. T. DAWSON.

Interaction of Cellulose Derivatives with Solvent

by W. R. Moore

In many industrial applications of cellulose derivatives, such as varnishes and other coatings, the derivative is used in solution. The factors which determine whether a cellulose derivative will dissolve in a particular liquid and the principles governing such solution properties as diluent tolerance and viscosity are therefore of considerable importance. Cellulose derivatives are substances of very high molecular weights with very long linear chain-molecules, belonging to the class of substances termed high polymers. The principles governing the interaction of flexible and relatively non-polar polymers with liquids are well known and in recent years theories accounting successfully for such interaction have been developed. Although cellulose derivatives differ from flexible and non-polar polymers in certain important respects, the consideration of such theories is of value as a preliminary to the consideration of cellulose derivative-solvent interaction. This article is based on a lecture given by Dr. Moore, of Bradford Technical College, at the Gordon Research Conference on Organic Coatings, New Hampton, US, in July

SOLUTION will only occur when there is a decrease in the Gibbs free energy of the solute-solvent system as a whole. The change in Gibbs free energy, ΔF, can be expressed in terms of the corresponding heat, ΔH, and entropy, ΔS, changes by:—

$$\Delta F = \Delta H - T\Delta S$$

where T is the absolute temperature. Theoretical calculations of ΔH and ΔS by Huggins (**1**) and Flory (**2**) have led to the use of a free energy parameter, called μ by Huggins and χ by Flory, which characterises a polymer-liquid system. Although semi-empirical in nature, χ represents our best measure of solvent power in a thermodynamic sense.

For systems involving flexible, relatively non-polar, polymers it has values between 0.3 and 0.5. The smaller the value the better the solvent thermodynamically. If χ is greater than approximately 0.5 the polymer will not dissolve in the liquid and will only swell. χ can be written as the sum of heat and entropy contributions by:—

$$\chi = \chi_s + \chi_h$$

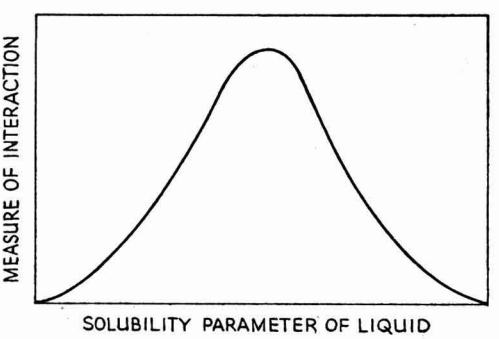
In cases where polymer and solvent mix with the absorption of heat the heat contribution χ_h may be expressed as:—

$$\chi_h = KV_1(\delta_1 - \delta_2)^2/RT$$

where K is a constant, generally assumed to be unity, and δ_1 and δ_2 are the solubility parameters of solvent and polymer. δ is equal to $[(L_e - RT)/V]^{\frac{1}{2}}$ where L_e is the latent heat of vaporisation and V the molar volume, both at the absolute temperature T. If χ_s does not vary much with solvent the difference between δ_1 and δ_2 will largely determine the value of χ, which will be least when δ_1 equals δ_2.

In other words, the best solvent will be that whose solubility parameter is closest to that of the polymer. If δ_1 differs sufficiently from δ_2, χ may be greater than 0.5 and solution will not occur. A given polymer will therefore only dissolve in liquids whose solubility parameters lie within a

Fig. 1



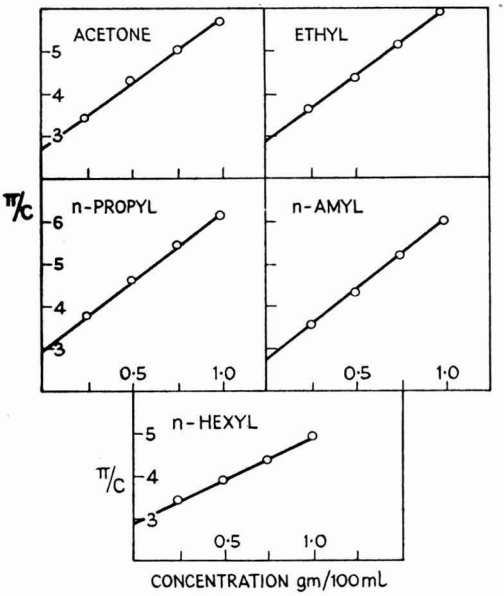


Fig. 2

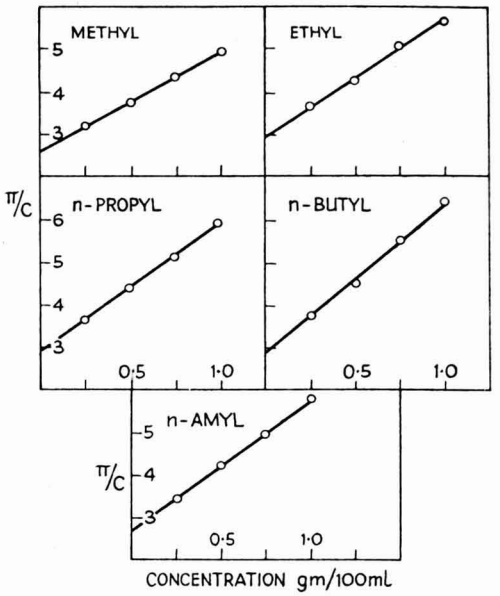
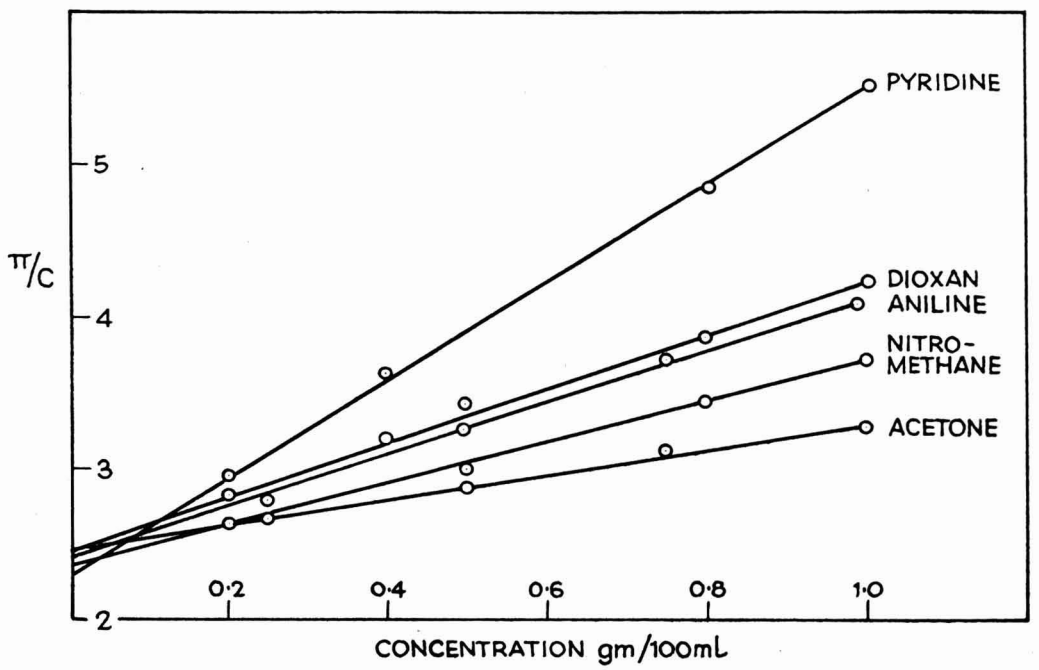


Fig. 3

Fig. 4



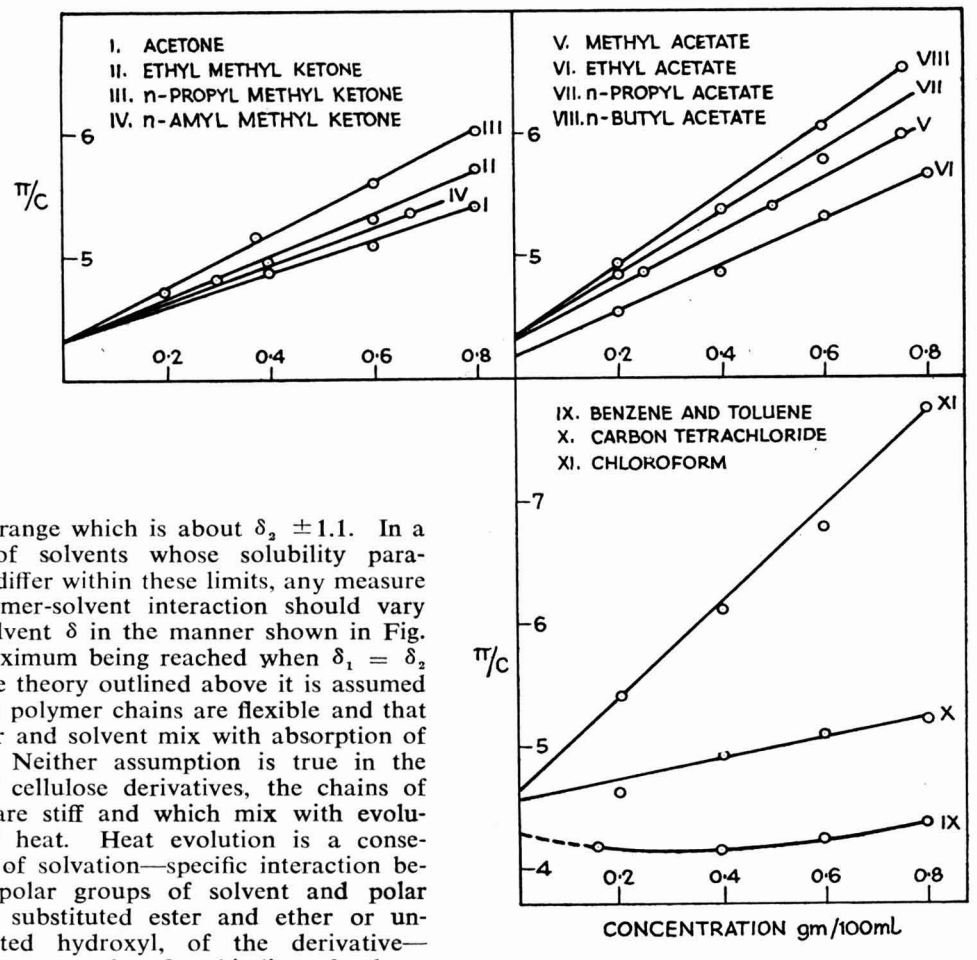


Fig. 5

certain range which is about $\delta_2 \pm 1.1$. In a range of solvents whose solubility parameters differ within these limits, any measure of polymer-solvent interaction should vary with solvent δ in the manner shown in Fig. 1, a maximum being reached when $\delta_1 = \delta_2$

In the theory outlined above it is assumed that the polymer chains are flexible and that polymer and solvent mix with absorption of heat. Neither assumption is true in the case of cellulose derivatives, the chains of which are stiff and which mix with evolution of heat. Heat evolution is a consequence of solvation—specific interaction between polar groups of solvent and polar groups, substituted ester and ether or unsubstituted hydroxyl, of the derivative—causing more or less firm binding of solvent to polymer.

There is ample evidence (**3, 4, 5**) for solvation, which often appears to involve hydrogen bonding, but the number of solvent molecules bound to each glucose residue is often doubtful. Many experimental studies (**6-10**) suggest from 2 to 6 but larger numbers have been suggested (**11**). Firm binding of large numbers seems unlikely but some propagated attraction is possible (**12**).

Solvation, by itself, does not cause solution. A solvent must not only solvate the derivative but also dissolve the solvated polymer. Solvation will render the derivative less polar and although the solvated derivative will vary somewhat with solvent it might be expected that the requirements of solvents for less polar polymers would apply, in some degree, to those for cellulose derivatives.

Spurlin (**13**), regarding solvation as acid-base interaction, says that solvents must be acidic or basic and also possess an appropriate solubility parameter. This seems to be the case with solvents for secondary cellulose acetate which have solubility parameters within the range 9.5 to about 13. Solvents for commercial ethyl cellulose have δ values between about 8.2 and 12. The rather wider range, compared with that for less polar polymers, reflects the influence of varying solubility parameter of solvated polymer.

It is found that certain measures of polymer-solvent interaction, such as the volume of hexane required to cause precipitation from solution (**14**) and swelling in solvent/non-solvent mixtures (**15**) vary, in

the case of cellulose nitrate, with solvent δ in the manner illustrated in Fig. 1.

It might be expected that, if solvation and stiffness of chains are taken into account, it should be possible to interpret solution properties of cellulose derivatives in terms of the theories applying to less polar and more flexible polymers. It is of particular interest to compare the values of suggested measures of solvent power for cellulose derivatives, obtained from precipitation and viscosity measurements, with thermodynamic estimates obtained from values of χ.

With these aims in view, we may consider the results of some experimental studies on dilute solutions of a 12.5 per cent N cellulose nitrate, a secondary cellulose acetate of 54.7 per cent acetic acid yield and an ethyl cellulose of 48.7 per cent ethoxyl content. These three derivatives, all of which are used industrially, are of similar degree of substitution and molecular weight (50,000 to 100,000).

Osmotic Pressure

Osmotic pressure (π) measurements are illustrated in Figs. 2-5 by plots of π/c against concentration (c) for a temperature of 25°C. The variation of π/c with c is given by:—

$$\pi/c = RT/M + RT(\tfrac{1}{2}-\chi)c/V_1d_2^2$$

where M is the molecular weight of the polymer, d_2 its density, and V_1 the molar volume of solvent. Generally, the plots are linear and extrapolate to essentially the same point, for a particular derivative, at zero concentration, implying molecular dispersion of polymer. The curved plots for ethyl cellulose in benzene and toluene, however, suggest association (**16**).

Values of χ can be obtained from the slopes of such plots and are given, for a number of polymer-solvent systems involving the three derivatives, in Table 1. The values of χ are all positive. On ascent of each of the homologous series of solvents for cellulose nitrate and ethyl cellulose the value of χ seems to fall to a minimum and then increase.

Positive values of χ are, at first sight, surprising since cellulose derivatives and solvents mix with evolution of heat. Since $\chi = \chi_s + \chi_h$ and χ_s, because of solvation and stiffness of chains is likely to be small, a negative χ_h would be expected to give low and negative values of χ. Calorimetric studies (**8**), however, show that solution involves at least two processes. Heat evolution in solvation is followed by heat absorption in solution of the solvated derivative. Both processes will contribute to χ_h and the combined effects of the entropy and heat absorbed contributions may give positive values of χ.

TABLE 1

Values of x and δ_1

Solvent	*Cellulose nitrate*	*Cellulose acetate*	*Ethyl cellulose*	δ_1
Acetone ..	0.27	0.45	0.46	9.76
Methyl ethyl ketone ..	0.21		0.42	9.15
Methyl *n*-propyl ketone ..	0.15		0.37	8.84
Methyl *n*-amyl ketone ..	0.02		0.38	8.45
Methyl *n*-hexyl ketone ..	0.16			8.35
Methyl acetate ..	0.30	0.46	0.41	9.55
Ethyl acetate ..	0.22		0.40	9.05
n-propyl acetate	0.13		0.33	8.75
n-butyl acetate ..	0.015		0.24	8.53
n-amyl acetate ..	0.02		0.28	8.45
Chloroform ..			0.34	9.30
Carbon tetrachloride ..			0.46	8.60
Benzene			0.48	9.15
Toluene ..			0.47	8.90
Pyridine		0.28		10.40
α-picoline ..		0.36		9.60
β-picoline ..		0.285		10.00
γ-picoline ..		0.26		10.00
Nitromethane ..		0.44		12.6
Aniline ..		0.38		10.8
Dioxan		0.38		10.0

If χ_s and the contribution due to heat evolution do not vary much within a homologous series of solvents the contribution from heat absorbed will largely govern the variation of χ within the series. This latter contribution would be expected to depend on $(\delta_1-\delta_2)^2$, where δ_2 is the solubility parameter of the solvated polymer. If δ_2 does not vary greatly within the series the interaction will largely depend on the value of δ_1. With cellulose nitrate and ethyl cellulose χ seems to be least, in each series of solvents, when the value of δ_1 is between 8.4 and 8.8.

The volume of non-solvent liquid which is required to cause precipitation from solution is often used as a measure of solvent power. Although this method gives important information regarding the ability of solutions to tolerate additions of diluents, its value as a means of estimating solvent power, in a thermodynamic sense, is often doubtful. Different precipitant liquids may give different orders of solvent power in a range of solvents. In certain cases, addition of diluent may initially cause an increase in solvent power (**13**).

Table 2 gives the volumes of different precipitants which when added to five ml. of solution just cause precipitation of polymer at 25° C. The initial polymer concentrations were such that the same concentrations (0.25 per cent) were obtained at the precipitation point. In the case of cellulose nitrate the variations of the volumes of hexane and toluene in each of the homologous series are similar to those reported by Doolittle (**17**).

With ethyl cellulose the volume of hexane decreases on ascent of each series and the poor non-polar solvents, carbon tetrachloride, benzene and toluene, require only small volumes. With cellulose acetate, the volumes of hexane and toluene place the solvents in the same order, although those of toluene are larger. The order with ethanol is quite different.

Comparison of the volumes of precipitants with the appropriate values of χ shows that hexane places the solvents for cellulose nitrate in approximately the correct order of thermodynamic solvent power but that toluene does not. Both hexane and toluene give approximately the correct order for cellulose acetate but ethanol does not. The volumes of hexane are clearly not a measure of solvent power for ethyl cellulose.

The interpretation of these results is helped by consideration of the values of δ_m, the solubility parameter of the solvent/precipitant mixture at the precipitation point, which may be calculated from:—

$$\delta_m = \delta_p\phi_p + \delta_1\phi_1$$

where p refers to precipitant and ϕ to volume fraction. Values of δ_m are given in Table 3. With hexane as precipitant for cellulose nitrate they decrease on ascent of each homologous series of solvents. Similar behaviour is seen with toluene but values are larger and the decrease smaller. In the case of ethyl cellulose there is a small decrease on ascent of each series and the non-polar solvents give a larger and almost constant δ_m.

Values for cellulose acetate with hexane as precipitants are not very different and, except in the case of nitromethane, do not vary much with solvent. Values with ethanol are larger and more variable.

Precipitation should occur when δ_m differs sufficiently from δ_2 to cause χ just to exceed the critical value of *ca* 0.5. If the entropy contribution to χ is small and does not vary much with solvent, δ_m should depend on δ_2 and for a particular polymer, apart from the effect of molar volume, be largely independent of solvent. Solvation will modify this. Addition of precipitant may cause desolvation (**17**) or solvated polymer may precipitate.

The results of studies of absorption of solvent from solvent-hexane mixtures by cellulose nitrate (**18**) and acetate (**19**) suggest that solvated polymer precipitates. If so, δ_2 will refer to solvated polymer and might be expected to vary with solvent. The decreases in δ_m observed on ascent of the homologous series are consistent with precipitation of solvated polymer. The larger values obtained with toluene as precipitant for cellulose nitrate may be due to precipitation of a differently solvated polymer than that precipitated by hexane.

There is evidence (**20, 21**) that aromatic hydrocarbons can solvate the highly polar nitrate and the toluene may compete with solvent in solvation. The larger, almost

TABLE 2
Volumes of Precipitants

Solvent	*Cellulose nitrate*		*Cellulose acetate*			*Ethyl Cellulose*
	Hexane	*Toluene*	*Hexane*	*Toluene*	*Ethanol*	*Hexane*
Acetone	4.16	37.2	0.49	2.80	4.65	12.25
Methyl ethyl ketone	5.05	32.0				9.4
Methyl *n*-propyl ketone	5.87	30.0				7.3
Methyl *n*-amyl ketone	7.19	24.5				4.45
Methyl *n*-hexyl ketone	7.12	15.6				
Methyl acetate	3.90	15.6	0.30	0.83	4.30	11.55
Ethyl acetate	6.00	18.8				8.8
n-propyl acetate	7.01	18.2				7.8
n-butyl acetate	7.79	16.5				7.3
n-amyl acetate	7.46	14.35				4.75
Chloroform						19.3
Carbon tetrachloride						0.87
Benzene						2.3
Toluene						1.45
Pyridine			2.13	6.80	5.70	
α-picoline			1.15	3.23	3.15	
β-picoline			2.02	6.10	4.5	
γ-picoline			2.16	6.95	4.0	
Nitromethane			—	1.85	7.55	
Aniline			—	4.44	9.35	
Dioxan			0.75	1.60	5.40	

TABLE 3
Values of δm

Solvent	*Cellulose nitrate*		*Cellulose acetate*			*Ethyl Cellulose*
	Hexane	*Toluene*	*Hexane*	*Toluene*	*Ethanol*	*Hexane*
Acetone	8.69	9.01	9.53	9.45	11.38	8.01
Methyl ethyl ketone	8.27	8.94				7.94
Methyl *n*-propyl ketone	8.06	8.89				7.93
Methyl *n*-amyl ketone	7.83	8.82				7.91
Methyl *n*-hexyl ketone	7.79	8.72				
Methyl acetate	8.61	9.06	9.41	9.45	11.19	7.99
Ethyl acetate	8.15	8.95				7.93
n-propyl acetate	7.96	8.87				7.86
n-butyl acetate	7.84	8.81				7.83
n-amyl acetate	7.82	8.79				7.79
Chloroform						7.71
Carbon tetrachloride						8.58
Benzene						8.55
Toluene						8.54
Pyridine			9.41	9.48	11.84	
α-picoline			9.21	9.33	11.98	
β-picoline			9.50	9.57	11.68	
γ-picoline			9.32	9.44	11.51	
Nitromethane			—	11.60	12.42	
Aniline			—	9.93	12.30	
Dioxan			9.43	9.52	11.61	

constant, δ_m obtained with the non-polar solvents for ethyl cellulose probably results from separation of unsolvated polymer since solvation, in these solvents, is improbable.

The similar values obtained with hexane and toluene as precipitants for cellulose acetate may result from precipitation of solvated or desolvated polymer. The former, with hydroxyl groups solvated by basic solvents (**3**), is perhaps more likely. The large values of δ_m observed with ethanol as precipitant are due, in part, to its high solubility parameter (13.1). Addition of ethanol will cause precipitation when δ_m becomes sufficiently greater than δ_2, whereas with hexane and toluene, with low solubility parameters (7.4 and 8.9), precipitation will occur when δ_m is sufficiently less.

It should be noted, however, that the solubility parameter of ethanol will include a large contribution from association forces, since ethanol is associated. To what extent such forces will persist in the mixtures is unknown and for this reason the δ_m values must be regarded as doubtful. The same may apply to the value for the nitromethane-toluene mixture, the components of which may interact inductively.

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(To be continued)

Anglo-Soviet Trading Hopes

RUSSIA is considering placing firm orders with British manufacturers of chemicals, chemical plant and other goods essential to industrial expansion in the USSR. The purchases would be made under Mr. Khrushchev's so-called £200 million 'shopping list'. Sales directors and production experts of several British firms have been invited to fly to Moscow to discuss design, prices and delivery dates of machinery and equipment in which the Russians are interested. During a three weeks' tour of more than 80 factories, a Russian trade delegation (which was divided into five parties) paid close attention to our chemical industry. Mr. Peter Thorneycroft, President of the Board of Trade, was to have final talks with Mr. Malyshew, leader of the delegation, and his colleagues this week.

From all Quarters

Canada's Petroleum Needs

Canada's petroleum needs will be more than 625 million barrels by 1976, or about three times what they were last year, said Mr. Beringer, president of the British American Oil Co. recently.

Israeli Oil Contract

A contract has been concluded for the purchase by the Israel Government of all the crude oil produced by the two companies, Lapidot and Israel Oil Prospectors, which are jointly drilling the Heletz field in Southern Israel.

Indian Refinery Decision Expected

The Indian Government will shortly take a decision on the proposal to set up a State-owned oil refinery, the Indian Minister for Natural Resources and Scientific Research, Mr. K. D. Malaviya, announced in Parliament last week. He added that the Government was considering when and where it would be located and the extent to which private enterprise would be allowed to participate in it.

Australian Petroleum Exports Up

Increased refinery capacity in Australia resulted in the export of petroleum products rising from £A3m. in 1954-55 to £A8m. in the 1955-56 financial year, according to the quarterly *Australian Treasury Bulletin.*

Particle Accelerator Purchased

Compagnie Francaise de Raffinage, the leading French petroleum refining and processing organisation, has announced the purchase of a two million volt Van de Graaff particle accelerator for basic research from High Voltage Engineering Corp., Cambridge, Mass., US. CFR, which maintains research facilities in several French cities, will install this machine in its Paris laboratory. According to CFR officials, the Van de Graaff accelerator will be used in fundamental research studies relating to effect of radiation on the organisation's line of petroleum products.

Depositary Receipts

It is announced that J. P. Morgan & Co. will issue American depositary receipts representing shares of stock in Montecatini Societe Generale Per L'Industria Mineria E Chimico Anonima, the Italian chemical and mining company. American depositary receipts are certificates of ownership issued usually by an American bank against foreign securities which remain physically in a foreign country.

World Petroleum Output

World crude petroleum production in November averaged 15,880,000 barrels daily, according to the Bureau of Mines, US Department of the Interior. The October daily average was 15,613,000 barrels.

Vienna Trade Fair

The forthcoming Vienna Autumn Trade Fair to be held from 9-16 September 1956 will display a variety of goods of some 3,500 exhibitors, among them firms from 20 foreign countries. The chemical section embraces, among other things, dyestuffs and varnishes, plant protection and rodent destruction. Further information can be obtained from the British-Austrian Chamber of Commerce, 29 Dorset Square, London NW1.

Birwelco Orders

Birwelco Limited have recently received an order for the supply of four Petro-Chem Iso-Flow furnaces for use in UOP platforming facilities being engineered by Procon (Great Britain) Ltd. for the Trinidad Oil Co. Ltd., at the Pointe a Pierre refinery in Trinidad, BWI. These heaters are of the radiant integral convection type with throughput varying from 238,200 lb./hr. down to 87,000 lb./hr. Procon (Great Britain) Ltd. have ordered from Brown Fintube (GB) Ltd., a Birwelco associate, a series of heat exchangers on behalf of Lobitos Oilfield Ltd. These are for use on a new gas treating unit at present being contracted by Procon and designed by Universal Oil Products Ltd., Chicago.

Parliamentary Topics

WHEN Mr. Harold Macmillan, Chancellor of the Exchequer, was asked in the Commons last week whether the UK would participate fully in the European Atomic Agency, which the Organisation for European Economic Co-operation decided on 18 July to establish, he replied that as the Agency did not yet exist it was too early to define the extent of the UK participation.

ASKED what arrangements were being made to provide the necessary fresh water for the nuclear power station at Bradwell-on-Sea, Mr. Duncan Sandys, Minister of Housing & Local Government, in a written answer on 2 August, said it was proposed that the Southend Water Company should provide a bulk supply from the Hanningfield reservoir to the Maldon Rural District Council.

CONSIDERATION is being given to the possibility of making arrangements under which members of staff and suitably qualified students from universities or elsewhere might have access to a reactor to be specially provided for research and training purposes, said Mr. H. Brooke, Financial Secretary to the Treasury, in a written answer on 2 August.

Obituary

DR. HERBERT LEVINSTEIN, M.Sc., Ph.D., F.R.I.C., the celebrated dyestuffs chemist, died on Friday of last week (3 August) at his home near Maidenhead, Berks., at the age of 78. A former technical director of the British Dyestuffs Corporation, Dr. Levinstein was president of the British Association of Chemists in 1923 and in 1949-50. In 1953 he received the Association's Hinchley Medal. He was president of the Society of Dyers and Colourists in 1928-29 and in 1929-30 he was president of the Society of Chemical Industry. In 1938 he delivered the Perkin Memorial Lecture before the Chemical Society and the Society of Chemical Industry. Dr. Levinstein was a pupil of Professor W. H. Perkin, son of Sir William Perkin, the discoverer of mauveine.

MARKET REPORTS

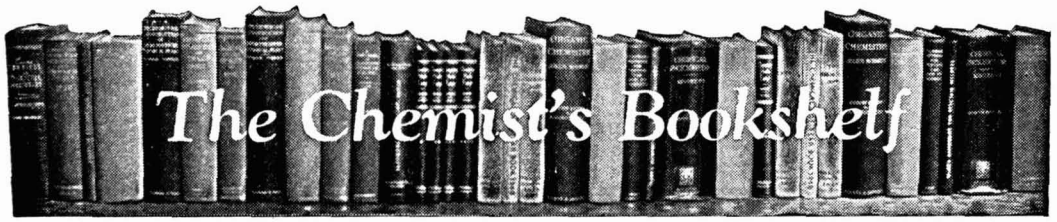
LONDON Trading has been quiet in most sections of the market and conditions are likely to remain uneventful during the holiday season. Nevertheless the movement on home account is satisfactory for the period and the flow of export inquiry continues to be good. With regard to prices, white lead was increased to £149 15s per ton and red lead to £145 per ton as from 4 August. Moderate business has been reported from the coal-tar products market with the position of most items unchanged.

MANCHESTER Prices generally on the Manchester chemical market during the past week have continued on a steady basis, with little change on balance. In spite of the holiday influences, now at their peak, contract deliveries of caustic soda and other leading heavy chemicals have been on a reasonably good scale, with a moderate number of fresh inquiries from home users and shippers circulating. Activity in fertilisers has again been confined to a few sections, including nitro-chalk, basic slag and their compounds. Allowing for the seasonal factor a steady demand is reported for the leading tar products.

GLASGOW Trade on the whole has been rather quiet this week. This, however, is to be expected as owing to the holidays in Scotland several large consuming areas are closed down. The impact of the forthcoming holidays in England has also been felt. There have been a number of price advances, although many of these can be attributed to the usual fluctuating state of the market. A good number of export inquiries have been received and some business has been placed. The demand for agricultural requirements is steady.

Fluor Get Sarnia Contract

The Fluor Corp. of Canada has been awarded the $3 million contract for the petrochemical plant at Canadian Oil's Sarnia refinery. The contract calls for the erection of a Udex plant and a platforming unit with daily capacities of 3,650 and 4,400 barrels respectively. Construction will begin this autumn and completion is scheduled for next summer.



ANNUAL REVIEW OF NUCLEAR SCIENCE, Vol. 5, 1955. Annual Review Inc., Stanford, Cal., US. Pp. 447. $7.50.

With the appearance of the fifth volume in this series, the editors, according to their preface, are taking careful stock of the purpose and scope of the *Reviews*. As for purpose, no great change is apparently contemplated; some articles will be ordinary reviews describing fully the present standing of their subject; others will merely catalogue and classify recent developments.

With regard to scope, the unfortunate term 'nuclear science,' which never at any time delineate a definite field of endeavour, has been threatening, in recent years, to embrace most of physics, chemistry and biology, and the editors are finding it difficult to decide what subjects are admissable. It seems likely that they will eventually have to prune 'nuclear science' down to nuclear physics and some branches of nuclear engineering. They have, indeed, decided that radiation chemistry would be more appropriately treated in *Annual Reviews of Physical Chemistry*, and it is hard to see how they can long maintain a contrary position with regard to radiobiology.

The amount of material directly interesting to chemists in these *Reviews* is bound to diminish as time goes on. The present volume contains only two strictly chemical chapters. 'Radiochemical Separation Techniques', by Finston and Miskel, is actually a survey of developments in methods of separating metals during 1953-55, and treats general analytical chemistry, with emphasis on radiochemical separations.

Information on separations by precipitation, electroplating, volatilisation, solvent extraction, ion exchange and paper chromatography is well tabulated for easy reference. Lainton's excellent critical review on 'Radiation Chemistry in 1954-55' appears at a moment when the pieces of the jigsaw of water radiation chemistry are at last dropping into place. On the borderlines of chemistry are chapters dealing with industrial applications of mass spectrometry, and with the chemical species produced by low energy electrons in the mass spectrometer.

Schubert's chapter on 'Removal of Radioelements from the Mammalian Body' deals with a problem which might some day be of vital concern to society. Its conclusions are not encouraging. The only way of significantly speeding up the elimination of some chronic radioactive poisons from the body is to administer over long periods substances which would themselves be dangerous to health, though the outlook is more promising if the victim is properly treated immediately after ingesting the poison.

Borst's chapter 'Design Comparison of Reactors for Research' is a useful assessment of the facilities offered by different types of nuclear reactors, and of the financial and other commitments involved in building them. It should be particularly helpful to universities contemplating reactor construction. In spite of recent advances, however, the building of reactors by any but the largest institutions still appears to demand expenditures and degrees of responsibility out of all proportion to their probable research value.—H.G.H.

FLUID FLOW IN PRACTICE. Edited by J. R. Caddell. Reinhold Publishing Corporation, New York; Chapman & Hall Ltd., London. Pp. vi+119. 24s.

This book is based on a collection of papers presented at a symposium in May 1955 under the auspices of the American Institute of Chemical Engineers, and the Department of Chemical Engineering, University of Pennsylvania. The material covered is itemised under the headings 'Review of Basic Principles', 'Planning New Piping Systems', 'Which Valve and Why?', 'Which Pump and Why?', 'Which Flow Meter and Why?', 'Operation and Maintenance of Fluid Flow Equipment', and 'Trends in Research'.

It is easy for a reviewer to criticise the

The Chemist's Bookshelf

efforts of others when the work appears in published form. But there appears to be little new in the reading matter which is not available elsewhere. Possibly the major contribution is in the last section which suggests new problems needing satisfactory solution. Even so, there will not be many chemical engineers, instrument engineers, or university students who will feel justified in paying 24s for the book; an appropriate scientific journal would appear to be a more suitable place for the publication of the papers in question. Two minor faults are that there is no index, and the individual sections do not contain references to the scientific literature as a whole, except in the first section. —E.J.C.

ADVANCED ANALYTICAL CHEMISTRY. By W. Wagner, C. J. Hull & G. E. Markel. Rheinhold Publishing Corporation, New York; Chapman and Hall, London. 1956. Pp. v+282. 48s.

This is a useful and reasonably priced textbook at advanced student level, designed to bridge the gap between the classical analysis taught in elementary courses and analytical chemistry as it is practised. It succeeds admirably in its aim, and can be fully recommended for more advanced university and equivalent teaching courses in this country.

The book consists of two parts. The first part treats, chapter by chapter, modern topics such as organic reagents, various selected modern methods of instrumental and physical analysis (among which may be noted with some approval thermogravimetry), and statistics as applied to analytical chemistry. None of these is dealt with in any great detail, but the essential theoretical background is provided for a suitable practical course, in clear and simple fashion.

The second half of the book is an interesting account of the analytical chemistry of the individual elements, an aspect of analysis which nowadays tends to be forgotten in the attempt to modernise courses. The elements are dealt with group by group, following the short form of the periodic classification. A brief account is given of methods for both recognition and determination of the elements, with some indication of the separations that may be achieved by various methods. About 70 elements are dealt with.

An acquaintance with the second section of this book will prevent any student from going into the world with the illusion that analysis is nowadays a matter of pressing buttons and of scorning sound chemistry. Any student with a thorough grasp of this book will at least be able to go into the average general analytical laboratory without making a fool of himself, a state of affairs that is rarely achieved at present.

Useful bibliographies are supplied which will make the book valuable for reference far beyond student days.—CECIL L. WILSON.

INORGANIC QUALITATIVE ANALYSIS: A CONCISE SCHEME USING THE SEMI-MICRO TECHNIQUE. By H. Holness. Sir Isaac Pitman & Sons Ltd., London. 1946. 4s.

This is a folded card (essentially of six-page length—*i.e.* twelve pages—with two of the page sides utilised for front and back of the folder) and is treated to render it resistant to bench hazards. It is simply a set of tables designed to remind the bench worker of the steps to be followed in the conventional qualitative analysis of the more familiar cations and anions.

There are a few novel points. There is no Group I, the cations usually comprising this Group being included in the Group II separation. Lithium hydroxide is used to break down the 'acid sulphides' into two groups. The remainder of the tables for cations follow established procedures. Zirconium oxychloride is used for phosphate separation. The lithium hydroxide separation might, one feels, have been coupled with the inclusion of lithium as one of the cations in Group VI. The detection of anions depends on the results obtained (expressed in tabular form) on applying a series of nine tests. Another table deals with the treatment of insoluble residues.

The card, one feels, will be more than sufficiently sturdy to survive the amount of hard usage that might reasonably be expected in any normal course of semi-micro work, and should therefore prove very acceptable in the teaching laboratory.—CECIL L. WILSON.

Director Retires

MR. T. A. GILBERT has resigned from the board of Klinger Manufacturing and has been appointed in a consultative capacity.

Commercial Intelligence

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

Mortgages & Charges

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

METALLURGICAL REFINERS LTD. Minworth, Nr. Birmingham. 2 July, £20,000 deb., to NFB Holdings Ltd.; charged on specified land at Minworth and plant and machinery, present and future. *Nil. 12 May 1955.

Satisfaction

LAFARGE ALUMINOUS CEMENT CO. LTD. London W.—Satisfactions 4 July, of Trust Deed registered 25 June 1946 to the extent of £5,555 and Trust Deed registered 11 April 1949 to the extent of £2,777.

Change of Name

MASTER PHARMACEUTICALS LTD., 12 East Smithfield, London E1, to Loames Ltd., on 27 June 1956.

New Registrations

A. J. Campbell Ltd.

Private company. (569,517). Registered 27 July. Capital £1,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in chemicals, gases, drugs etc. The directors are: Archibald J. Campbell and Mrs. Maureen G. Campbell, both of "Sesquiacre", Fir Tree Avenue, Stoke Poges, Bucks. Secretary: Maureen G. Campbell. Registered office: 133 Bath Road, Slough, Bucks.

Ingold's Scientific Enterprises Ltd.

Private company. (569,555). Registered 27 July. Capital £500 in £1 shares. Objects: To carry on the business of consulting scientists and chemists etc. The permanent directors are: Christopher K. Ingold, Edith H. Ingold, both of 12 Handel Close, Edgware; and Sylvia R. Ivermee, address not stated.

D. & S. Taylor Ltd.

Private company. (569,773.) Registered 1 August. Capital £200 in £1 shares. Objects: to carry on the business of manufacturers of and dealers in scientific and laboratory glass work etc. Directors: Sydney F. Taylor and Mrs. Daphne E. M. Taylor, both of 14 Charnwood Road, Enfield, Middlesex. Secretary: Daphne E. M. Taylor. Solicitors: H. W. Pegden & Co., 811 Green Lanes, London N21. Registered office: 598 Green Lanes, London N13.

Company News

Shawinigan Water & Power Co.

Net earnings of $2.02 per common share, after deduction of all charges and provision for preferred dividends, were shown in the interim consolidated statement of earnings of The Shawinigan Water & Power Co. and St. Maurice Power Corporation for the six months ending 30 June. This compares with $1.50 per common share for the first half of 1955. Revenue from power sales for the period was $26,574,249, up 15.1 per cent over the corresponding period of 1955. Total revenue increased from $24,501,491 to $27,982,235, a rise of 14.2 per cent.

The Mirrlees Watson Co. Ltd.

Consolidated profit and loss account of The Mirrlees Watson Co. Ltd. for last year shows a decrease in trading profit of £112,261. Net profit available to the company is £125,661, to which is added the unappropriated balance, making £166,719 available to the profit and loss account. This information was given to shareholders at the 48th annual general meeting of the com-

pany in Glasgow on 12 July. Dealing with chemical and distilling plant, the chairman said that demand for vacuum equipment in chemical and oil factories continues, but as much of this plant is constructed in corrosion-resistant materials, the company has difficulties in meeting the deliveries requested owing to the current shortage of these materials. The chairman pointed out that two tannin extract plants are on order for Africa. Legislation on effluent disposal has necessitated the treatment of the spent wash, or potale, from some of the whisky distilleries, and two multiple-effect evaporating plants, with instrumentation for automatic control, have been supplied for this purpose.

Borax (Holdings)

The directors of Borax (Holdings), formerly Borax Consolidated, have declared an interim dividend of six per cent on the £3 million deferred ordinary capital for the year ending 30 September next. Previously there was a five per cent interim followed by a final of 18 per cent.

Ugine

The annual general meeting of Ugine, manufacturers of electro-chemical, electro-metallurgical and electric steel products was held in Paris on 26 June. Net profit for the year was Fr 1,308,239,429, as against Fr 1,232,429,044 in 1954. Turnover in the same period rose by 20 per cent from Fr 31,833 million to Fr 38,266 million. The value of exports was approximately Fr 5,000 million. During 1955 an important agreement was signed with Union Carbide on the use of the company's technique in producing carbon-based ferro-chrome.

Saint-Gobain SA

The report of the board of directors, presented at the annual general meeting of Saint-Gobain SA in Paris on 25 June, states that the company's fibre glass output rose by 20 per cent in the year ended 31 December 1955. The development of the French chemical industry during 1955 was again slightly in advance of that of French industry as a whole, with Saint-Gobain playing a prominent part, continues the report. Total tonnage delivered by the company's plants to industry rose by 6.5 per cent with sales of sulphuric acid increasing by seven per cent. Output of nitric acid rose by 20 per cent, synthetic hydrochloric acid advanced by 11 per cent, and carbide by 15 per cent. The profit and loss account showed a net profit, after the usual appropriations of Fr 1,590,966,728 which, together with the balance of Fr 259,907,260 brought forward from the previous year, produced a grand total of Fr 1,850,873,988.

Lewis Berger & Sons Ltd.

Group trading profit of Lewis Berger & Sons Ltd., paint manufacturers, for the year ended 31 March 1956, was lower at £802,238 compared with £933,067. Gross income from associated companies was £58,760 against £48,972. A final dividend of 11 per cent on the £2 million ordinary is recommended. With the four per cent interim paid last December the total for the year is 15 per cent. A further payment, not subject to tax, of three per cent, is also proposed.

Chas. Pfizer & Co. Inc.

Sales and earnings of Chas. Pfizer & Co. Inc., New York, for the first half of 1956 were the highest for any similar period in the company's history. Net sales, exceeding $87 million, were 10 per cent higher than in the first half of last year. Net earnings after taxation increased by 17 per cent during the same period to more than $9.5 million, and were equivalent after payment of preferred dividends to $1.77 per share of common stock, against $1.58 in 1955.

Gas Purification & Chemical

The Board of Gas Purification & Chemical is recommending a final dividend of 25 per cent on the capital as increased by a 400 per cent scrip issue and issues against acquisitions. Group net profits for the year to 31 March 1956 are announced at £464,270, before taxation of £240,520. Of the profits £49,060 is applicable to pre-acquisition periods. The present issued one-class capital is £512,912—an interim of 75 per cent for 1955-56 has been paid on £94,132. The annual general meeting is to be held at Winchester House, London EC, on 18 September.

Compagnie Française des Petroles

Net profits for 1955 of the Compagnie Française des Petroles was Fr. 6,398,280,380 the chairman stated in the annual report. A gross dividend of Fr. 600 per share of Fr. 5,000 nominal was adopted. This is equivalent to 12 per cent as before.

CLASSIFIED ADVERTISEMENTS

EDUCATIONAL

UNIVERSITY OF MANCHESTER
THE NEXT SESSION COMMENCES ON THURSDAY, OCTOBER 4TH, 1956.

SITUATIONS VACANT

CHEMISTS required by **MINISTRY OF SUPPLY,** Tropical Testing Establishment, Port Harcourt, Nigeria, for work on general problems associated with scientific study of behaviour of a wide variety of materials (plastics, rubber, metals, fibres, etc.) in tropical environments. Candidates should possess a 1st or 2nd Class Honours Degree or equivalent qualifications. For Senior Grade, at least three years' post-graduate research experience required. Appointment as Senior Scientific Officer (min. age 26) or Scientific Officer (min. age 21). Salary within range: S.S.O., £1,135-£1,345; S.O., £605-£1,055. Free accommodation provided and Foreign Service Allowance also payable. Initial tour of eighteen months, but further tours by mutual agreement. Consideration for further employment in UK at end of service in West Africa. Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting F51/6A. Closing date, 1 September, 1956.

ION-EXCHANGE MEMBRANES. A long-term investigation of the industrial applications of these materials is commencing shortly. A team of **ORGANIC CHEMISTS, PHYSICAL CHEMISTS** and **CHEMICAL ENGINEERS** is being formed, but several vacancies for these still exist. Posts are permanent and pensionable. Assistance given in finding local accommodation. Write for application form to Sondes Place Research Institute, Dorking, Surrey.

MECHANICAL ENGINEER
COURTAULDS, LIMITED,
Chemicals Division,
requires a
GRADUATE (or qualified) **MECHANICAL ENGINEER** for its large chemical manufacturing plant near Manchester. In addition to the day-to-day manufacture of heavy chemicals (which offers a great variety of work) there is also scope for investigational and development work on the design of new plant and on the maintenance side of works engineering. In short, the work combines traditional workshop practice with an original approach to new problems and requires an absence of professional prejudice. It also provides opportunities for a man to follow his own work through to the final fruition of commissioning and operation. Previous industrial experience is desirable but a new graduate would be considered if he has had practical vacation experience. The post is pensionable and the occupant will be eligible for the Company's Co-partnership Scheme.
Candidates should write for a detailed form of application to
DIRECTOR OF PERSONNEL,
COURTAULDS, LIMITED,
16, ST. MARTINS-LE-GRAND,
LONDON, E.C.1,
quoting reference number H.13.

WANTED—Young Organic Chemist for technical sales of industrial chemicals made by Rohm & Haas, Philadelphia, and their English subsidiary. Technical sales experience required. Excellent opportunity. Send curriculum vitae to **BOX No. C.A. 3488, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

PROCESS PLANNING ENGINEER
required by
CHEMICAL PLANT MANUFACTURERS
for new factory in Surrey.
Applicants should be fully conversant with all machining operations and fabrication, particularly in stainless steels A knowledge of jig and tool design is desirable Applicants should have served a recognised apprenticeship.
Applications, in writing, giving age and salary expected, to:
MESSRS. SHARPLES CENTRIFUGES, LTD.,
FARNHAM TRADING ESTATE,
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