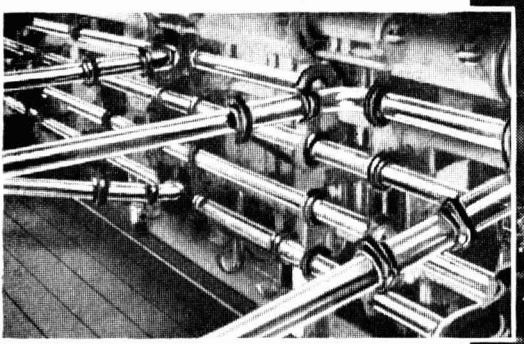
THE Chemical Age

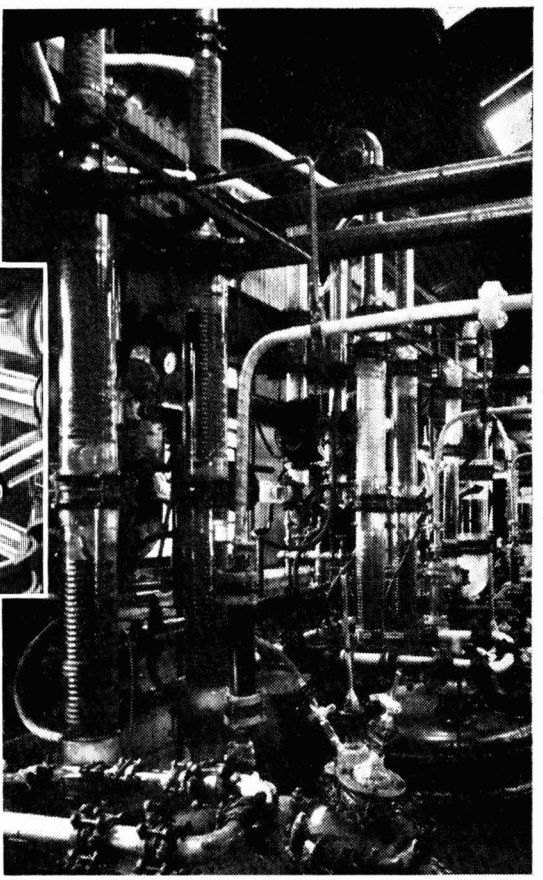
VOL. LXXI 14 AUGUST 1954 No. 1831

QUICKFIT Visible Flow

Glass equipment used in Toxaphene production

Below : Part of an installation in Visible Flow pipeline





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Research Into Practice

THERE is, or should be, no particular difficulty in putting into practice the results of research conducted by individual industrial companies. The research projects have been planned to fit the probable needs of the company concerned and success is almost certain to be followed with speedy application. A company may at times have too many promising research developments competing for the capital and other resources available; or economic conditions may change and restrict a company's readiness to adopt new processes or launch new products. On the whole, however, the application of private industrial research is not seriously faced with obstacles, and the view that better products or lower-cost methods of manufacture are cynically put into cold storage and withheld belongs to the past. Competition is enough to minimise this tendency, and in most branches of industry world competition forces the pace of technological innovation. Research itself has become highly competitive today and secrecy alone is a dubious custodian of results; what one company's research organisation has discovered, say, in London in 1954 is likely to be identically discovered in Amsterdam or Berlin or Chicago in 1955.

But the problem of putting research into practice is much bigger and far wider. Except in the United States, the number of companies large enough to conduct extensive research activities is small. Though such activities are individually impressive, they rarely amount, when added up, to a majority share of a country's total research effort. Year by year the trend for the lion's share of research to be run and financed by the State becomes more obvious. Even the collective research efforts of branches of industry are generally state-aided; research institutes founded long ago by far-sighted men of wealth can no longer meet this century's higher costs on the income from trust funds that once seemed ample, and today government grants often provide 75 per cent or more of the annual revenue. Even the universities are far more independent in spirit than in economic fact. Research can be divided into two classes—independent and state dependent—and in annual volume the latter much dominates the former. It is in the application of this type of research that most of the difficulties and obstacles are encountered. In one sense this seems paradoxical for a research idea whose costs of discovery have been paid for by the state is an obvious bargain for a company that can develop it with hope of economic success. In another sense, however, slowness of application is natural; the research idea does not arrive as part of a company's own technical planning, and its potentiality may not be readily recognisable. A research project in independent industrial research has had considerable examination in theory before much expenditure upon it has been sanctioned and its suitability for large-scale development is known in advance of actual research success. The number of research projects on which an individual company is engaged is limited and the closest assessment of their progress is continuously possible.

The problem is indeed so large and important that it needs its own research. The Manchester survey (see THE CHEMICAL AGE, 1954, **70**, 609) was an example of this, though of a limited nature. Essentially the facts first need to be well set out, and a new book, itself the outcome of the British Common-

wealth Scientific Official Conference of 1946, has done this ('The Application of Results of Research,' edited by V. Connell. Butterworths Publications Ltd. 1954. Pp. 212. 21s.). The text was originally the comprehensive report on this subject presented at the BCSO Conference of 1952 in Australia, but it has since been brought up to date. Nine appendices make up rather more than three-quarters of the book's length, and they deal with the organisation of official research, with the methods used for making research results known in Britain, Canada, Australia, New Zealand, South Africa, India, Ceylon, Southern Rhodesia, and finally with special aspects of these matters in the United States. These appendices have a most useful reference value, though they are naturally factual rather than critical.

The commentary portion of the book is the report itself, and this reaches a number of conclusions. One of these is that great improvement in industrial efficiency is still to be derived from existing knowledge. The restricting influence of economic, political, and taxation factors is admitted, but the positive factor of technological improvement or innovation is assessed as the most important single influence. In short, though this is not so openly said in the report, look after the technological factor and the others will look after themselves. But the principal conclusion is that the conversion of research knowledge into industrial practice is far too slow; and the methods of distributing technical knowledge to the right places for utilisation and the receptiveness of industry both require great improvement. The following passage deserves full quotation:

> 'Information obtained through research represents in the aggregate very large expenditures of money and of the time, energy, and intelligence of all-too-scarce trained men. Failure to make the fullest possible use of this effort is a flagrant waste which no country can afford. The responsibility for minimising this waste must be shared by industry and research organisations. Management and labour must be receptive and those responsible for research organisations must accept, as one of their primary duties, the task of ensuring that there is no waste of information through their default or neglect. This should be a cardinal point of policy. To give effect to it requires conviction of its necessity, continuous and close attention to its operation, imaginative but realistic choice of the methods to be used and persistence in their application.'

Stress is laid upon the importance of publishing research results in forms suitable for various levels of reception, e.g., managing directors, plant engineers, foremen, etc., as well as in the scientific paper form habitually used for reaching other scientists. It is true that in this country the DSIR establishments have lately become more conscious of this but much more movement towards semi-scientific publication is still desirable. The pursuit of this policy is no doubt handicapped by sheer scarcity of people able to do this difficult kind of work well. Many research workers, though certainly not all, are incapable of describing their own results in simple language. Also, the specialised scientific journals have too little room to publish scientific papers without long delays and they cannot be expected to enlarge their functions.

A greater development of liaison staff by research organisations is also recommended. Time and time again in the appendices the fundamental importance of personal contact in 'getting things done' leaps to the fore. Should we really expect it to be otherwise? Is there a company with a good product to sell that has been able to dispense with good outside representation? But official research has not yet realised its obligation 'to sell'—it has too long adopted the attitude that it is available to be consulted if the inquirer finds the right address and knocks on the right departmental door. This outlook may be changing but it needs a revolutionary upheaval. Yet this cannot be easily done. First-class liaison officers will be wanted and once again progress will find itself slowed down by scarcity; liaison officers with only moderate competence and industrial experience will not easily win the confidence of industry.

Notes & Comments

Killing the Goose?

OVER and over again the burden of taxation is presented as the villain of the industrial piece. Reports from industrial organisations which emphasise this point may be regarded by some people as prejudiced, but the same conclusion has been reached by numbers of independent and mixed committees. It is rather too easy to say that the burden cannot be relieved because a certain total sum must in any case be collected to meet the nation's running-costs. A country's industrial prosperity is not annually decided; it is a long-term product. If British industry is penalised more severely than, say, American or German industry, then eventually there will be less trading and less dividend income to tax and the 'welfare' calls upon the national purse may become even more costly or, worse still, insupportable.

Write-Off Changes

THESE general comments are prompted by the news that the US Congress has recently passed new measures to provide quicker 'write-off' relief for industrial plant and special relief for research expenditure. Plant depreciation allowances have previously been given on a 'straight line' system which assumes a useful lifetime of ten years, i.e., with an even 10 per cent depreciation each year. Two new methods have been proposed: a declining balance system permitting a company to write off two-thirds of the initial cost in the first five years, but which never permits a final writing off of the total cost; and a combination of this and the old straight line system, by which a company may write off two-thirds of the cost in the first five years, thereafter depreciating the balance by even (straight-line) amounts which bring total write-off at the end of ten years. There have been small differences between House and Senate in their discussions, but the Bill that the President is expected to sign will probably allow companies to select whichever system of depreciation suits them best.

Increasing Flexibility

THIS is not as invidious as it might sound. A new plant in an industry likely to decline may still be vital for lowering current costs, but faster depreciation in the early years may be essential if capital is to be invested in long-term uncertainty; while a new plant in an expanding industry may be more soundly financed if the straight-line depreciation system is still permissible. Flexibility in place of rigidity will not significantly reduce the state's industrial tax income over a number of years, but it will help companies to spread the annual burden according to their actual circumstances. As for expenditure upon 'research and development,' there will now be much more help for the smaller concerns. All companies will have the option of treating these costs as current expenditure, or of capitalising them and writing them off in periods of five years or more. Hitherto, small companies spending relatively high amounts on research with small annual budgets have often lost relief on the 'current expenditure' system, and this has acted as a disincentive to bold research planning. There can be little doubt that these changes, on which both political parties seem well agreed, will stimulate new plant installation and research in American industry; the chemical industry will particularly benefit. Yet already most American companies scrap old plant and back research far more liberally than companies in any other country.

Going with the Grain

ONE of the few essentially technological changes which has advanced much more in Britain than in the US in the past decade is fertiliser granulation. Today something like 85 per cent of British compound fertiliser production is produced in the free-flowing, drillable granular form, but in the United States manufacturers started in-

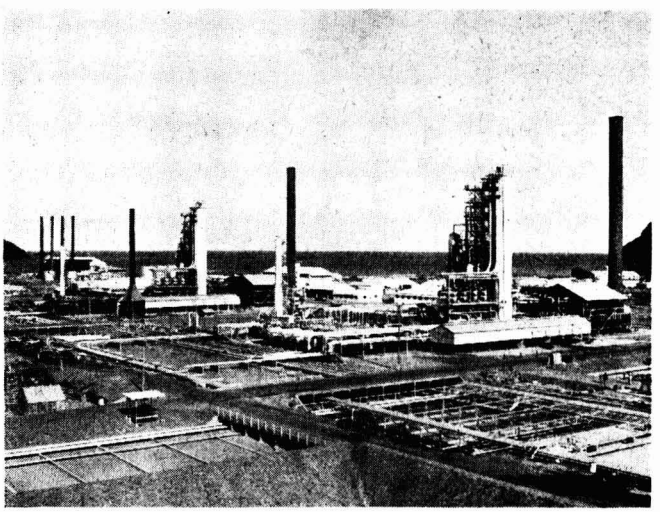
stalling granulating plants only about two or three years ago. At this summer's American National Fertiliser Association conference a symposium meeting on granulation was part of the proceedings and one of the speakers said that the demand for granulated material was such that practically no fertiliser manufacturers 'were not giving some serious thought to this form of product.' Relatively the same comment could have been made of the British industry in 1945-47. The oddity is that British farmers' demand for granular fertilisers was considerably stimulated by wartime experience with fertilisers imported from across the Atlantic. It was Canadian-made triple superphosphate, in excellent granular condition, which impressed upon so many farmers the field-convenience of using this type of fertiliser. Though we may be several years ahead of US in this particular development, we shall certainly be foolish not to keep close watch on their new and vigorous progress. They have started late, but this has given them the benefit of all our own pioneering experience. Their attitude to the various granulating processes can be selective from the beginning; when British manufacturers started granulating in the later years of the war or in the very early post-war period, their main problem was getting *any* plant made and installed, not choosing between several possibilities. Granulation has revolutionised the industry here; it may well do the same in America over the next three or four years, but it will be a revolution with new plant, and able to borrow substantially from the great store of US 'know-how' about similar chemical processes.

Associated Ethyl Company's New Works

For the two new works of the Associated Ethyl Co. Ltd. now being commissioned at Amlwch and Ellesmere Port for the production of tetraethyl lead anti-knock compounds, the General Electric Co. Ltd. was entrusted with the contract for the whole of the 415 volt motor control gear to be installed in switchrooms in non-hazardous areas. Over fifty multi-tier cubicle switchboards, controlling more than a thousand circuits, have been supplied.

Buflovak Equipment for Britain

Blaw-Knox Ltd., 94 Brompton Road, S.W.3, announce that arrangements have been concluded with the Blaw-Knox Co., Buffalo, N.Y., for the manufacture in Britain of 'Buflovak' equipment for evaporating, drying, solvent recovery and other processes. Latest designs are to be incorporated, and plant will be available in Britain or for export against payment in sterling. Mr. G. N. Harcourt will be in charge of this new section of Blaw-Knox Ltd.



The two crude oil distillation units and power house of the Anglo-Iranian Oil Company's new 5,000,000 tons a year Aden refinery which came on stream on 29 July, four months ahead of schedule

New Ideas in Chemistry

Topics at British Association's Oxford Meetings

NEW ideas in chemistry will be discussed by Sir John Lennard-Jones, principal of University College of North Staffordshire, in his presidential address to members of the chemistry section at the 116th annual meeting of the British Association for the Advancement of Science being held at Oxford from 1 to 8 September.

To be addressed altogether by about 300 speakers, each an authority on his own particular subject, the meeting will again provide a platform for reviewing latest developments in a wide range of scientific topics. The speakers, who are expected to talk for a total of 225 hours, include 175 from the universities, 80 from Government establishments and 20 from industry. The programme also contains about 120 excursions and visits to works enabling members of the Association to visit the main places of interest in Oxford and the surrounding country.

Award of Honorary Degrees

First general assembly of members will be held in the Sheldonian Theatre on Wednesday evening, 1 September. The inaugural meeting will be preceded by a Convocation of the University, at which the vice-chancellor, Sir Maurice Bowra, will confer the honorary degree of Doctor of Science on Sir Ben Lockspeiser (secretary, Department of Scientific and Industrial Research), Sir John Lennard-Jones and Sir Harold Spencer Jones (the Astronomer Royal). The vice-chancellor of the university and the Mayor of Oxford, Ald. W. R. Gowers will welcome the Association to the city, and Dr. E. D. Adrian (the Master, Trinity College, Cambridge) will deliver his presidential address on 'Science and Human Nature.'

The sixteen sections of the Association will begin their sessions on Thursday morning, 2 September, and will continue as arranged by the sectional committees. The chemistry section will be accommodated in the Department of Physical Chemistry.

Details of the chemistry section arrangements are as follows:—

Thursday, 2 September: 10 a.m., presidential address by Sir John Lennard-Jones; 11.15 a.m., Prof. C. K. Ingold (Professor of Chemistry, London University), 'The Changed Outlook in Organic Chemistry'; 11.40 a.m., Prof. E. Bright Wilson, Jr. (Professor of Chemistry, Harvard University), 'Advances in Molecular Dynamics and Molecular Structure'; 12.5 p.m. Professor E. G. Cox (Professor of Inorganic and Structural Chemistry, Leeds University), 'The Changed Outlook in Inorganic Stereochemistry.' *Afternoon excursions to* the Central Research Establishment I, National Coal Board, Stoke Orchard; Radio-Chemical Centre, Amersham; Forest Products Laboratory, Princes Risborough and Wolvercote Paper Mills.

Coal & Britain's Future

Friday, 3 September: Coal and Britain's Future, 10 a.m. introduction by chairman, Sir Cyril Hinshelwood (Dr. Lee's Professor of Chemistry, Oxford University); 10.5 a.m., Dr. W. Idris Jones (Director-General of Research, National Coal Board), 'Modern Coal Processing in Relation to Britain's Coal Problem'; 10.40 a.m., Dr. F. J. Dent (Director, Birmingham Research Station, Gas Council), 'The Gasification of Coal'; 11.25 a.m., Dr. R. Holroyd (Research Director, Imperial Chemical Industries Ltd.), 'Coal as Source of Chemical Raw Materials.' Afternoon excursions to the Northern Aluminium Co. Ltd., Banbury; Alpha Cement Ltd., Shipton-on-Cherwell; Oxford City Waterworks, Swinford. At 7 for 7.30 p.m. the Section dinner will be held at the Forum Restaurant, High Street, Oxford.

Saturday, 4 September: 2 p.m., excursion to AERE, Harwell.

Monday, 6 September: Session A, Complex Natural Colouring Matters, 10 a.m., chairman: Prof. Sir Robert Robinson (Waynflete Professor of Chemistry, Oxford University); Prof. A. R. Todd (Professor of Organic Chemistry, Cambridge University) 'The Colouring Matters of Aphids'; 11.5 a.m., Prof. R. P. Linstead (Professor of Organic Chemistry, Imperial College), 'Chlorophyll and Related Hydrides of Macrocyclic Pigments'; 11.45 p.m., Dr. A. Neuberger (Head of the Biochemistry Department, National Institute for Medical Research, Mill Hill), 'The Biogenesis of Porphyrins.' Session B, Metals and Alloys,

10 a.m., Dr. Hume-Rothery (Lecturer in Metallurgical Chemistry, Oxford University), 'Metals and Alloys, Ideal and Real'; 11 a.m., Dr. J. W. Christian (Pressed Steel Co. Research Fellow, Oxford University), 'How Metals Transform'; 11.40 a.m., Dr. H. M. Finniston (Head of Metallurgy Division, AERE), 'Metallurgy and Atomic Energy.' Afternoon excursions to Research Laboratories of Esso Development Co. Ltd., Abingdon; and Works of the Oxford and District Gas Undertaking.

Tuesday, 7 September: Black Diamonds: New by-products from coal and British minerals. 10 a.m., Mr. A. R. Powell (Research and Development Manager, Johnson, and Matthey and Co. Ltd.), 'Extraction of Germanium and Gallium'; 11 a.m., Mr. A. A. Smales (Analytical Chemistry Group, AERE), 'Analytical Problems'; 11.40 a.m., Dr. E. G. James (Scientific Staff, Research Laboratories, General Electric Co. Ltd.), 'Scientific and Industrial Applications and Implications of Germanium.' Afternoon excursions to the Royal Military College of Science, Shrivenham; Oxford City Sewage Disposal Works; and Morris Motors Ltd., Radiators branch.

Steam Generation

At the Engineering Section (Session A), meeting in the Inorganic Chemistry Lecture Theatre on Thursday morning, 2 September, Mr. D. C. Gunn (boiler department, British Coal Utilisation Research Association) will speak on 'Efficient Industrial Steam Generation' during which he will analyse boiler thermal losses and consider their relative importance and more adequate control.

Presidential address at the Mathematics and Physics Section on Thursday morning, 2 September, will be given by Sir John Cockcroft, whose subject will be 'Recent Developments in Nuclear Physics.'

As well as the excursions arranged to works and other places of interest in the area, a number of social events are scheduled. These include a small garden party being arranged for 2 September by the British Council, at which overseas visitors will be able to meet a group of UK scientists. On the same evening from 8 to 11 p.m. there is to be an 'Open Evening' in the University science area when heads of departments have agreed to open the laboratories and arrange special demonstrations. There is to be no formal reception of guests, but members will be free to enter the science area at any point and proceed at will to those departments they most wish to visit. A comprehensive programme giving details of these exhibits in pamphlet form will be available.

Temporary Exhibitions

Apart from the departmental exhibitions which will be on view during the science area 'Open Evening,' special temporary exhibitions will be open throughout the meeting at the Ashmolean Museum, the Bodleian Library, the Radcliffe Science Library, the Museum of the History of Science, the School of Geography and the University Museum. Visits to individual colleges and to the Bodleian Library, the old Ashmolean Building, the University Observatory and the Painted Room will be organised during the week.

A programme of recent films of scientific interest has been arranged by the British Universities Film Council for Wednesday, 8 September, in the Town Hall.

The Association's president and general officers are to meet exhibitioners and other selected students at coffee in the Department of Crystallography on Friday, 3 September, at noon, when the president will present cheques to the winners of *Endeavour* essay prizes, presented by Imperial Chemical Industries Ltd.

Officers of the Chemistry Section are: *President*, Sir John Lennard-Jones; *vice-presidents*, Prof. G. R. Clemo (Professor of Organic Chemistry and Director of the Chemistry Department, King's College, Newcastle-on-Tyne), Professor Sir Cyril Hinshelwood, Sir Rudolph Peters (Professor of Biochemistry, Oxford University), Prof. Sir Robert Robinson; *recorder*, Prof. L. Hunter (University College, Leicester), *secretaries*, Dr. J. Dewar and Dr. D. C. Martin; *local secretary*, Dr. F. M. Brewer.

The British Association's annual meetings are the largest general gatherings of scientists in the country, average attendance in University centres being 3,700. Objects are to let scientists and laymen meet so that they may get to know each other and appreciate each other's problems and viewpoints, to inform the public on the progress of science, and increase public understanding of the objects and methods of science.

Galvanic Corrosion of Titanium

Some American Electrochemical Studies

SOME of the factors important in the galvanic corrosion of titanium have been studied by the US Bureau of Mines as part of a programme initiated to evaluate the corrosion properties of this metal.

Titanium is on the whole chemically inert relative to its position between beryllium and magnesium in the electromotive force series. Recent work indicates that it has noble electrode potentials in low concentrations of hydrochloric acid and sulphuric acid and is resistant to these solutions. It has less noble electrode potentials in hydrofluoric acid solutions and is attacked rapidly, while metal ions increase the corrosion rate. It has recently been reported that the corrosion of titanium in boiling 10 per cent solutions of hydrochloric and sulphuric acids is greatly reduced and that the electrode potentials of the metal are made more noble by the presence of copper or iron in concentrations of 0.005 to 0.03 mole per litre. The corrosion rate of stainless steel in sulphuric acid is affected in a similar manner.

The investigation under review is concerned with the electrode potentials of titanium in some common solutions, the passivating effect of air and certain metal ions on titanium in hydrochloric acid solutions, and the galvanic corrosion properties of titanium in sodium chloride and hydrochloric acid solutions.

Production of Samples

The titanium metal used in this work was produced in the US Bureau of Mines laboratories by a modification of the Kroll process and was consolidated by power-metallurgy techniques. Compacts were reduced to sheet stock on a schedule involving many annealing and rolling operations. A typical specimen of powder contained the following impurities: iron, 0.1; magnesium, 0.35; silicon, 0.01; manganese, 0.02; chlorine, 0.1; and nitrogen, 0.02. A sample of the final metal contained iron, 0.13 per cent; magnesium, 0.064 per cent; and chlorine, 0.093 per cent.

The work was done at room temperature (20-28°). Electrode potentials were measured with a Leeds and Northrup type K-2 potentiometer, a saturated-calomel electrode, and a saturated potassium chloride bridge. The apparatus was arranged to measure the potential for the whole specimen surface rather than for a particular point. The value + 0.246 volt was used for the potential of the saturated calomel cell with reference to the standard hydrogen electrode, no temperature corrections were made, and the electrode potential values were read to the nearest 0.01 volt.

Variations in Electrode Potential

The electrode potentials of titanium were measured in solutions of 1 per cent and 3 per cent sodium chloride, 1 N and 7.5 N hydrochloric acid, 1.1 N and 2.2 N sulphuric acid, and 6 per cent sulphur dioxide contained in open beakers. The electrode potentials changed with time and approached steady-state values which varied with the solution but not with the pre-treatment of the metal surfaces. Similar measurements were made in 1 to 10 N hydrochloric acid solutions contained in sealed bottles and continuously aerated with air or helium. Air caused the electrode potentials of titanium to become much more electropositive (noble) in 1 to 3 N solutions but had less effect in more concentrated acids.

Low concentrations (0.0032 mole per litre) of metal ions added to 1 N hydrochloric acid also made the electrode potential of titanium more noble. Work with lower concentrations of cupric ions and more concentrated acid solutions gave similar results. Weight-loss corrosion tests supported the conclusion that air and cupric ions cause titanium to become passive in hydrochloric acid solutions. Passivity was always accompanied by noble electrode potentials. There was no visible deposit on or change in the appearance of the titanium specimens, except for a slight tarnish under certain borderline conditions. Other corrosion tests indicated that titanium in contact with small volumes of stagnant 10 N hydrochloric acid containing cupric ions loses its passivity after a time. This is attributed to the presence of atomic hydrogen.

There was no chemical or galvanic corrosion of titanium in 3 per cent sodium chloride solution during galvanic couple

tests in open beakers. However, magnesium, zinc, aluminium, iron and copper corroded as a result of being coupled with titanium. Stainless steel did not corrode by galvanic action. Titanium, coupled with copper in various concentrations of hydrochloric acid in sealed bottles with a flow of helium, was generally anodic. Copper became the anodic member of the couple in the presence of air. Cupric ions sometimes changed the polarity of the couple by causing titanium to become more noble.

A report of this work has been published as Bureau of Mines Investigation 4965.

New Oil Sands Tests

THE Alberta (Canada) government has granted an 18 months option on its Bitumont plants to two Calgary companies, Can-America Oil Sands Development and Mill Creek Oil Company. Further tests are planned on the bituminous sands which are at Fort McMurray, 225 miles north-east of Edmonton.

The companies paid $19,952 for the option. If bought, the plants and 47 acres of land on which it stands would cost $180,000. The Department of Mines and Minerals would also approve a lease giving the purchaser the right to 5,874 acres of oil sands.

The Bitumont plant was built by the Alberta government in 1948. Mr. S. M. Paulson, president of both the companies, said that about 40,000 lb. of oil sands from the McMurray area were sent to Poughkeepsie, N.Y., where a factory is completing construction of oil extraction equipment.

Phthalic Anhydride Expansion

CONSTRUCTION of a new Canadian plant for the manufacture of phthalic anhydride will probably begin within the next few months. Reichhold Chemicals (Canada) Ltd., Canadian subsidiary of Reichhold Chemicals Inc., is far advanced with plans to construct such a plant in Canada. Montreal is the most likely location.

There has been only one manufacturer of phthalic anhydride in Canada up to the present, the Dominion Tar & Chemical Company, with a plant at Toronto, recently modernised and expanded at a cost of $1,000,000. Although imports have been sizeable at times—particularly from low-cost European producers—the bulk of the home market has been supplied from this one Toronto plant.

Phthalic anhydride consumption has shown a meteoric rise in recent years and is currently running around 12,000,000 to 14,000,000 lb. a year in Canada, representing a $2,800,000 to $3,000,000 a year market. It has leaped into chemical prominence with the development of new, high quality, high gloss enamel finishes using synthetic, rather than natural, resins.

Although Reichhold Chemicals (Canada) plans to use a substantial portion of its phthalic output in its own plants for manufacture of alkyd resins, at Port Moody, B.C., Toronto and Ste. Therese, Quebec, there will be sizeable additional supply available for the domestic market.

Schools' Speech Day

THE principal guest at the recent Speech Day of the Royal Commercial Travellers' Schools at Hatch End was Viscount Leverhulme who spoke of the long connection his family had had with the Schools. As a trustee of the Leverhulme Charities Trust he told his audience how pleased the trustees were to continue his grandfather's interest by granting scholarships and by contributing to the Maintenance Appeal Funds. With words of advice especially directed to the scholars, Viscount Leverhulme said that the process of education did not consist merely of learning English, mathematics, history and so on. 'You are learning to acquire team spirit and loyalty,' he said, 'two things which you will find will help you when you leave school and have to stand on your own feet.' Life was very similar to a football team where every player had his part to play 'not selfishly, or for his own ends, but as a member of a team.' Concluding his speech Viscount Leverhulme told the scholars not to be afraid of making up their minds for themselves and not to feel that they must imitate other people. The Headmaster and Headmistress in their reports gave an account of the excellent progress made by the Schools during the past year. Mr. L. L. S. Lowe mentioned the fact that in the 1953 General Certificate of Education examinations the boys had obtained a record number of 128 passes.

Some Developments in Analytical Methods

by R. BELCHER, B.Sc., Ph.D., F.Inst.F., F.R.I.C.
Reader in Analytical Chemistry, University of Birmingham

WHEN advances in purely chemical methods of inorganic analysis are reviewed, attention is usually focused on new reagents, titrants, indicators and primary standards. Several new methods have been developed recently which do not involve new reagents, but exploit well-known reactions; also certain long-established methods have been re-examined, as a result of which important modifications have been recommended. The present paper summarises developments in such methods over the last two or three years. Some selection has necessarily been made, and in so doing the author has been influenced by his own particular interests.

Aluminium

The method of Craig and later workers in which aluminium is determined by formation of the cryolite complex, followed by titration of the alkali released, has been modified by Beck and Szabo[1]. After discussing the conflicting conditions which have been advocated, they state that the main cause of error is the formation of basic salts which react, e.g.—

$$AlCl_3 + 2\,NaOH \rightarrow Al(OH)_2Cl + 2\,NaCl$$
$$Al(OH)_2Cl + 6NaF \rightarrow Na_3AlF_6 + 2NaOH + NaCl$$

thus causing negative errors.

If organic salts are used to prevent precipitation of aluminium, their buffering effect interferes. Beck and Szabo recommend therefore in place of the usual method of titrating with alkali in the presence and absence of fluoride, that the solution be treated with excess alkali. Equal aliquots of this treated solution are then titrated with 0.1N hydrochloric acid in the presence and absence of fluoride. The difference between the two titrations represents the aluminium present.

$$Na_3AlO_3 + 3\,HCl \rightarrow 3\,NaCl + Al(OH)_3$$
$$Na_3AlO_3 + 6\,NaF + 3H_2O \rightarrow Na_3AlF_6 + 6\,NaOH$$

Conditions are thus less favourable for basic salt formation.

The aluminium solution (20-100 mg.) is made up to 100 ml. after adding sufficient 0.2N sodium hydroxide to dissolve the precipitate (or if insoluble hydroxides are present, sufficient to make the solution 0.1N as regards free alkali) and 20 ml. aliquots titrated to a phenol red end-point. In the case where fluoride is added, 20 ml. of 4 per cent sodium fluoride is used. Ferric iron, zinc, magnesium, chromium, barium, sulphate, nitrate, and carbonate—the ions usually associated with aluminium—do not interfere.

Boron

Schulek and Szakacs[2] have recently re-examined the method of Schulek and Vastagh[3] for the determination of boron, which is as follows: the mineral is fused with alkali, the melt is treated with concentrated sulphuric acid and methyl alcohol and the ester distilled and collected. The distillate is evaporated to dryness after adding aqueous potassium hydroxide, neutralised, treated with mannitol and titrated with alkali to a phenolphthalein end-point.

Certain discrepancies prompted a more detailed examination of the evaporation procedure being made. Known amounts of basic acid were evaporated with varying amounts of potassium hydroxide, water, and methyl alcohol. It was found that the ratio of these reagents was critical, for excessive losses of boric acid occurred under certain conditions. These losses appeared to be most significant as the proportion of methyl alcohol to water increased. This could be offset to some degree by increasing the amount of potassium hydroxide.

The final recommended procedure is as follows. For 1-60 mg. of boric acid the distillate should be evaporated with 100 ml. of methyl alcohol, 5-10 ml. of N potassium hydroxide, and 80-100 ml. of water. The residue is fused with 0.5-1.0 g. of potassium hydroxide and then treated as in the original method, except that the solution is neutralised to the *p*-ethoxychrysoidine end-point and then, after adding mannitol, is titrated to the α-naphtholphthalein end-point.

Barium

The method for separating barium from strontium by precipitation as chromate, which usually requires a double precipitation, has been modified by Gordon and

Firsching[4]. Barium chromate is slowly precipitated from homogeneous solution by decomposition of urea. The precipitate thus obtained consists of large, readily filtered and easily washed crysals. Reprecipitation does not appear to be necessary except when strontium exceeds 40 mg.

The test solution must be below *p*H 2 before the dichromate is added or some precipitate will form. As the urea hydrolyses there is a gradual rise in *p*H and initial precipitation begins at *p*H 3.5. The final *p*H must be near 5.7; below this some barium remains dissolved. Buffers other than acetate could not be used owing to the strong oxidising properties of the chromate ion.

As much as 100 mg. of barium can be separated from 40 mg. of strontium, but a double precipitation is necessary when more strontium is present. A good separation from calcium can be obtained; the *p*H does not require such close control and a single precipitation suffices in all cases.

For the determination, 6 g. of ammonium acetate and 10 g. of urea are added to a solution containing about 0.1 g. of barium. After diluting to about 150 ml. with water the *p*H is adjusted to 1.7-1.8 with hydrochloric acid or ammonia solution and 20 ml. of a 10 per cent potassium dichromate solution are added. The beaker is heated to 95°-98° for 2½ hr. It is allowed to cool and the *p*H is determined. (Alternatively a high temperature glass electrode may be used in the hot solution.) If it is about 5.7 the hot solution (after reheating if necessary) is filtered. The precipitate may be either weighed after drying at 120° for 2 hr. or dissolved and titrated with standard ferrous ammonium sulphate.

Calcium

As another fairly recent example of the technique of precipitation from homogeneous solution, the determination of calcium by slow hydrolysis of methyl oxalate may be mentioned[5]. Between 20 and 100 mg. of calcium may be precipitated in the presence of up to 100 mg. of magnesium. An initial pH of 4.7 is used and hydrolysis is effected from an acetic acid-ammonium acetate medium. The hydrolysis is allowed to proceed for 2 hr. at 90° with occasional stirring, and a little ammonium oxalate solution is then added as a precaution in case the correct temperature has not been maintained. The precipitate is ignited to the carbonate before being weighed.

Cadmium

In 1937 Mahr and Ohle[6] described a method for the determination of cadmium in the presence of zinc based on precipitation as cadmium thiourea reineckate. Rulfs, Przbylowicz and Skinner[7] have re-examined the method and studied its accuracy and the effect of foreign ions.

They established that the precipitate accorded with the structural formula given by Mahr and Ohle. Over the range of cadmium concentrations studied by Rulfs *et al.* (1-55 mg.) the precision (± 0.62 per cent) and accuracy (+ 0.38 per cent) were similar to those found by Mahr and Ohle. The interference of foreign ions was remarkably low. Mineral acids, alkali and alkaline-earth cations, aluminium, arsenic (III), chromium (III), zinc, iron (II), and (III) had no effect. Nickel, manganese, and cobalt formed complexes with the thiourea, but had no effect when present in small amounts. Interference from larger amounts was overcome by increasing the thiourea concentration. Chromium (VI) was reduced to chromium (III) by thiourea, but restoration of the thiourea concentration overcame this trouble. Lead interfered but was separated first as the sulphate. Antimony interfered by its hydrolysis but was held up by tartrate. Tin caused slightly high results, probably owing to hydrolysis. Copper and mercury interfered, but could be determined beforehand by precipitation with Reinecke's salt in the absence of thiourea; under these conditions cadmium only was precipitated from a very concentrated solution. Bismuth interfered but could be removed as bismuthyl iodide.

The method is rapid and the gravimetric factor is very favourable. Its most striking feature is that as little as 0.03 mg. of cadmium can be separated from as much as 20,000 parts of zinc by a single precipitation.

Carbonate & Bicarbonate

Köszegi and Salgo[8] have discussed the well-known disadvantages of the Warder and the Winkler methods, and have advanced an improved method for the titration of carbonate and bicarbonate. The carbonate is titrated with 1N or 0.1N barium chloride solution to the decolorisation of phenolphthalein indicator. Then either a known excess of standard acid is added and the excess is titrated with alkali, or the total alkalinity of a separate aliquot is determined

to give the total carbonate and bicarbonate. Methyl orange is used as indicator in either of the latter titrations. If the amounts are such that 0.1N barium chloride solution is used, 5 g. of sodium chloride is added. This is unnecessary when 1N solutions are used.

When the new method was compared with the Warder and the Winkler methods using known mixtures of carbonate and bicarbonate, incomparably better results were obtained.

Ferrocyanide & Ferricyanide

Normally when ferrocyanide has to be titrated in a solution containing cyanide, it is necessary to eliminate the latter by passing carbon dioxide when classical titration methods are used. Burriel, Lucena and Bolle [9] have shown that if a cerate solution is used, the titration can be carried out in the presence of the cyanide as, contrary to theoretical expectations, cyanide is not oxidised at any *p*H value. Since an acid medium is used, the titration must be effected in a well-ventilated place, as volatile hydrocyanic acid is evolved. Certain other reducing substances, notably hydrogen peroxide, may also be titrated in the presence of cyanide in the same way.

Burriel, Lucena and Arribas[10] have shown that in the presence of a suitable complexing agent, mercurous ions are stable in alkaline solution and there is an enhancement of their reducing properties. The most suitable complexing agent is iodide and in its presence, ferricyanide is reduced to ferrocyanide and soluble $[HgI_4]''$ is formed. This reaction has been made the basis of a new titrimetric procedure for the titration of ferricyanides. The end-point can be determined potentiometrically or with diphenylamine sulphonic acid.

When the *p*H is below 14, high results are obtained. In the presence of 1-5 M solutions of sodium hydroxide the results are satisfactory. The iodide concentration must be at least 0.2M. At lower concentrations high results are obtained, and below 0.1M a yellow pricipitate is formed. The temperature must be kept below 30°. Using these conditions amounts of ferricyanide ranging from 4.88-29.25 ml. of a 0.1N solution were determined exactly.

Nitrate, chloride, and sulphate do not interfere at a concentration of 5 per cent. Oxidising and reducing agents such as iodate, bromate, sulphide, sulphite, arsenite and cyanide interfere at all concentrations.

The conditions recommended are as follows. To the solution of ferricyanide are added 25 ml. of 4 M sodium hydroxide and sufficient water to give a final volume of 100 ml. Just before starting the titration 40 ml. of 0.1M potassium iodide are added. The titration is then carried out with a slightly acid solution of mercurous perchlorate using diphenylamine sulphonic acid as indicator or potentiometrically. More recently, it has been found preferable to replace the iodide solution with one of complexone[11]. This effects a appreciable saving in costs.

Chloride

An interesting study of the Volhard titration has been made by Schulek, Pungor and Kethelyi[12]. They examined the following variations of the conventional procedure:

1. Filtration of the precipitate without heating at any stage. Error: — 0.63 to — 0.67 per cent.
2. Coagulation of the precipitate by boiling and titration without filtering off the precipitate. Error: — 0.42 to — 0.46 per cent.
3. Filtration of the precipitate without heating and washing with hot dilute nitric acid. Error: — 0.13 to — 0.26 per cent.
4. Coagulation of precipitate by shaking in the presence of potassium nitrate and titration without filtering. Error: — 0.57 to — 0.58 per cent.
5. Coagulation of the precipitate by boiling with potassium nitrate present. After cooling the titration was done without filtering. Error: — 0.07 to — 0.09 per cent.
6. Coagulation of the precipitate by boiling with potassium nitrate, cooling and filtering before the titration. Error: — 0.15 per cent.

These workers consider that the normal error of the Volhard method is due to absorption of excess silver ions in the precipitate. When the precipitate is heated, desorption occurs, and if potassium nitrate is present, it is preferentially adsorbed. If the mixture is not heated, potassium nitrate is adsorbed on the silver layer and thus has no effect. When the precipitate is washed, most of the adsorbed silver ion is removed. Hence it is recommended that after precipitation, the mixture be boiled for three minutes in the presence of 2 per cent potassium nitrate solution. After cooling to 15° the excess silver is then titrated in the usual way, but

without filtering, using a 10 per cent solution of ferric nitrate as indicator.

Fluoride

Fluoride over the range 2-65 mg. has been determined by Belcher and Clark[13] by adding a measured excess of standard calcium chloride and, after standing overnight, back-titrating with a solution of complexone using Solochrome Black as indicator. Other halides, nitrate and carbonate do not interfere, but if phosphate, sulphate, or arsenate is present, the precipitate of calcium fluoride should be filtered off on a pad of paper-pulp, since these ions appear to cause induced solution of the precipitate.

The method appears to be suitable for application to the determination of fluorine in organic compounds since none of the usual elements likely to be present has any effect.

Brunisholz and Michod[14] have developed a method in which cerous nitrate is used as the titrant and murexide as the indicator. The error varies from − 1.8 to + 0.9 per cent over the range 1 to 10 mg. in a 50 per cent methanol-water medium. The method is recommended for the titration of the distillates of fluosilicic acid.

Lithium

The gravimetric method for the determination of lithium as trilithium phosphate has been reinvestigated by Caley and Simmons[15]. In order to reduce solubility losses, a precipitation was effected from a 2-propanol-water medium. However, the results were high in a 50 per cent 2-propanol medium; in a 40 per cent 2-propanol medium quantitative results were obtained but this was due to a compensation of errors. Some trisodium phosphate was co-precipitated, which balanced the slight loss of incompletely precipitated trilithium phosphate. Accordingly, a phosphate of a strong base, more soluble than trisodium phosphate in an alcoholic solution, and preferably one which could be decomposed and volatilised on ignition, was sought. Choline phosphate was found to be very suitable.

The precipitate is digested at 100° for 1 hr. and then for a further 2 hr. after the addition of 2-propanol. It is filtered hot and washed with 2-propanol saturated with precipitate. If more than 10 mg. of sodium were present in the original solution, the precipitate is dissolved and reprecipitated. The precipitate is finally ignited at low red heat and weighed as trilithium phosphate.

Molybdenum & Tungsten

A rapid and simple method for the separation and determination of molybdenum and tungsten has been described by Sousa[16]. After alkaline fusion with sodium carbonate and peroxide the fused mass is extracted with water, and calcium chloride is added to precipitate calcium tungstate and molybdate. The precipitates are filtered off and decomposed with concentrated hydrochloric acid. Calcium molybdate dissolves completely, whereas insoluble tungstic oxide remains unattacked. This is filtered off, ignited, and weighed. The filtrate is made alkaline and calcium molybdate reprecipitated, ignited and weighed.

The method has been applied to the analysis of ores such as molybdenite, wolframite and powellite. Good results have also been obtained with steels; vanadium and manganese do not interfere.

Mercury

The reaction of mercuric oxide with acetone to form $3HgO.2C_3H_6O$ has been utilised by Das[17] for the determination of mercury and for its separation from other salts.

Acetone is added to the solution of the mercuric salt to give approximately a 1 : 10 ratio. A slight excess of sodium hydroxide is added using phenolphthalein as indicator, and the solution is then neutralised exactly with acid. Potassium iodide or sodium thiosulphate is added in excess and the free alkali is titrated.

$$HgO + 4KI + H_2O \rightarrow K_2HgI_4 + 2KOH$$

$$HgO + 2Na_2S_2O_3 + H_2O \rightarrow Na_2Hg(S_2O_3)_2 + 2NaOH$$

Standard solutions of nitric, perchloric or sulphuric acid may be used for the titration. Hydrochloric acid should be avoided unless chloride ions are already present in the solution.

Sharp end-points are obtained with phenolphthalein or thymol blue even with concentrations as low as 0.01N, except for mercuric chloride. The *p*H at the equivalence point lies between 9.4 and 8.8 in thic case and a mixture of 1 part of α-naphtholphthalein to 3 parts of phenolphthalein gives better results.

The method can be applied when copper, nickel, cobalt, lead, bismuth, cadmium, zinc, aluminium or tin is present, by slight modification to the general procedure. Chloride, sulphate, nitrate and perchlorate have no

effect but bromide, iodide, thiocyanate and thiosulphate react with the complex. Thiosulphate may be oxidised to sulphate to prevent interference and the halide and pseudo-halide may be separated as the silver salts and the excess silver then removed as chloride. Phosphate interferes, but can be removed as barium phosphate and excess barium removed by precipitation with sodium carbonate.

Phosphate

The titration of phosphate with bismuth oxyperchlorate originally advanced by Rathje[19] has been examined by Thistlethwaite. The end-point is detected using potassium iodide as indicator. Thistlethwaite prefers to take the end-point at the first yellow tinge appearing on the precipitate, rather than the red colour due to bismuthyl iodide, as recommended by Rathje. The results are reasonably accurate and precise, and the method as a whole is satisfactory, provided the recommended end-point is used.

Phosphoric acid can be determined by adding an excess of a suitable salt which forms an insoluble phosphate, and the hydrogen ions released are then titrated with a strong base:

$$H_2PO_4' + 3M^+ \rightarrow M_3PO_4 + 2H^+$$

Barium, calcium and silver salts have been recommended in the past, but Rancke-Madsen and Kjaegard[20] have described the use of cerous nitrate. Cerous phosphate is precipitated quantitatively at the first equivalence point so that the liberated hydrogen ions can be titrated to the same *p*H. For neutralisation to the first equivalence point, a mixed indicator consisting of methyl orange and bromocresol green is used, and the ionic strength of the solution is increased by adding 2.5 g. of sodium chloride. After adding cerous nitrate, the solution is titrated to the original shade of indicator, which occurs at the first equivalence point.

Magnesium ammonium phosphate hexahydrate is slowly and quantitatively precipitated from solutions containing ammonium chloride, ethylamine and excess magnesium chloride by the gradual evolution of ammonia[21]. The interference of calcium, iron, aluminium, and titanium is prevented by masking them with complexone and lactic acid. Large crystals are obtained which are readily filtered and washed; the method is rapid and accurate. Procedures for the determination of phosphoric acid, alkali phosphates, precipitated phosphates, natural calcium phosphates and superphosphates have been developed.

Potassium

Dilituric acid has been re-examined as a reagent for potassium by Press and Murray[22]. First reported as a precipitant for potassium by Fredholm in 1936 and examined by various other workers, the only previous attempt to develop a quantitative method was due to De Graaf and Noyons. A gravimetric finish was employed.

In the present method, a standard solution of dilituric acid is used to effect precipitation and the excess reagent is then precipitated by a standard copper solution. The remaining copper is determined iodometrically.

The precipitate of potassium dilituric is allowed to stand for 2½ to 3 hr. before being filtered through a No. 4 sintered glass filter. Potassium in the range 10-35 mg. can be determined to within 1 mg. Sodium, lithium, and phosphate do not interfere. The effect of ions has not been investigated.

The accuracy of this method compares unfavourably with that of other methods for potassium, particularly that using the sodium tetraphenyl boron reagent which appears to be the answer to the long-standing problem of determining potassium rapidly, accurately and selectively.

Silica

Several methods have been advanced in recent years based on precipitation of silicomolybdic acid as an insoluble salt with an organic base. Miller and Chalmers[23] examined a number of quinoline derivatives and found that a 2,4-dimethylquinoline gave the most sensitive reaction. The precipitate could not be used directly for the gravimetric determination since it was hygroscopic, hence they converted it to silicomolybdic acid before the weighing. Phosphorus has to be allowed for and is determined colorimetrically in the residue.

Wilson[24] had previously developed a similar method based on precipitation as the quinoline salt. He completed the determination titrimetrically. More recently Armand and Berthoux[25] have studied the method in more detail. They found that two forms of precipitate are obtained according to the *p*H at which the silicomolybdate complex is formed. The precipitate formed by development of the complex at the lower

*p*H is more readily filtered. An excess of quinoline hydrochloride ensures that the precipitate is completely insoluble. It can be dried at 150° for 1 hr. and weighed as $SiO_2.12MoO_3.4(C_9H_7N).2H_2O$. These authors have applied this gravimetric method to the determination of silicon in aluminium and its alloys.

Sulphide

Bethge[26] has examined methods for the determination of soluble sulphides using sodium hypochlorate, potassium permanganate and potassium iodate. The last reagent was found to be the best. It is more stable in an alkaline medium than the other two reagents and theoretical results are obtained.

The sulphide is refluxed for ten minutes in a strongly alkaline medium with an excess of potassium iodate. After acidifying the solution, the excess iodate is determined by adding potassium iodide and titrating the liberated iodine with sodium thiosulphate.

Thiosulphate and Nitrite

A method for the determination of nitrite and thiosulphate in admixture has been devised by Pierson[27]. Silver nitrate is added to the solution which is buffered with ammonium acetate and, during the addition, ammonia solution is added at intervals to maintain the *p*H at 7.1-7.5. The thiosulphate decomposes to yield silver sulphide. When excess silver is present, the precipitate is filtered off, extracted with water to remove adsorbed silver ions, and is refiltered. The washed precipitate is then dissolved in nitric acid and determined by the Volhard method. The original thiosulphate present is then calculated from the titre obtained.

The filtrate containing nitrite is added slowly to a known excess of ceric ammonium sulphate solution and the unconsumed oxidant is then titrated with ferrous ammonium sulphate using ferroin as indicator. Sulphide and sulphite must be absent but chloride does not interfere.

Thiosulphate may be determined in ammonium sulphide solutions when nitrate and sulphite are absent by buffering the solution with ammonium acetate and removing sulphide, polysulphide and hydrosulphide as hydrogen sulphide by bubbling nitrogen through the solution. The residual thiosulphate is then determined iodimetrically.

When nitrate is also present the same procedure may be used, provided that the ammonium sulphide is fresh. After bubbling nitrogen through the solution, the first procedure is then applied. When the method was applied to yellow or brown ammonium sulphide solutions containing appreciable amounts of ammonium polysulphide, low recoveries for nitrite were obtained and thiosulphate recoveries were rather variable.

Complexones as Masking Agents

The use of complexones as masking agents in gravimetric analysis has been extended further by Pribil and his co-workers[28]. Uranium may be separated quantitatively by ammonia in the presence of ethylenediamine tetra-acetic acid (EDTA) from mercury, lead, bismuth, copper, cadmium, iron, aluminium, chromium, nickel, cobalt, manganese, cerium, lanthanum, thorium, and the alkaline-earth metals. Titanium, beryllium, and uranium can be separated from other elements and each other by a method based on precipitation with ammonia in the presence of EDTA; ammonium carbonate may be used to separate titanium and beryllium from uranium.

Beryllium can be separated from uranium by precipitation with ammonia in the presence of oxalate, which forms a stable complex with uranium. After removal of beryllium, uranium can be determined by precipitation with 8-hydroxyquinoline in the presence of excess oxalic acid. Tintanium and beryllium can be separated from uranium after reduction of the solution with zinc amalgam, followed by the addition of EDTA to mask the uranium. A method for the successive separation of all three elements has been worked out.

Calcium can be precipitated with oxalate from an acetic acid acetate in which other metals are bound as stable complexes with EDTA. Mercury, lead, bismuth, copper, cadmium, arsenic, antimony, iron, aluminium, chromium, titanium, beryllium, germanium, molybdenum, tungsten, cerium, thorium, nickel, cobalt, manganese, zinc, magnesium and phosphate do not interfere. The method can be used for the determination of calcium in minerals and in lead-calcium alloys.

Boric acid can be determined by titration with alkali after forming the glycerol or mannitol complex, even in the presence of easily hydrolysable salts, if the cations are masked with EDTA. Boric acid in glass has been determined in this way.

Phosphate can be precipitated quantitatively as magnesium ammonium phosphate in the presence of many common cations by masking with EDTA and catechol-disulphonic acid. Lead, copper, cadmium, bismuth, aluminium, iron, titanium, beryllium, uranium, antimony, tin, calcium, strontium, and barium may be present. The method has been applied to the determination of phosphorus in apatite and pyromorphite.

The coprecipitation of lead, copper, cadmium, mercury, and bismuth, which normally interfere with the precipitation of barium as sulphate, and of iron, aluminium, chromium, copper, nickel and cobalt, which may coprecipitate when sulphate is precipitated as barium sulphate, can be eliminated by precipitating in the presence of EDTA. If heavy concentrations of other metals are present the barium sulphate may be reprecipitated, after dissolving in ammoniacal complexone, by acidifying with hydrochloric acid.

Recently, this property of ammoniacal EDTA of dissolving barium sulphate has been utilised in the development of a titrimetric method for the evaluation of barium sulphate precipitates[29]. The precipitate is dissolved in a known excess of standard EDTA and ammonia, and back-titrated with a standard solution of magnesium using Solochrome Black as indicator.

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Standard Thermometers

BS. 593 was first published in 1935 under the title 'General purpose laboratory thermometers.' In the present revision the scope has been restricted and the title altered to 'Laboratory thermometers' in view of the publication in 1951 of BS. 1704, 'General purpose thermometers.' BS. 593 now specifies four series of thermometers:

Series A.—Thermometers with zeros and about 400 mm. long covering ranges of about 30°-40° or about 55°-75° F and graduated at each 0.1° or 0.2° F.

Series B.—Thermometers similar to those of Series A, but with ranges of about 60° or about 110° F graduated at each 0.2° or 0.5° F.

Series C.—Thermometers without zeros and about 200 or 250 mm. long, covering ranges of about 100° or about 200° F and graduated at each 1° or 2° F. The thermometers in this series are intended for use when compactness is essential.

Series F.—Thermometers of various ranges between −2° and + 400° or 28.5° and 752° F intended for use in the distillation of solvents and mainly based on those specified for this purpose by the American Society for Testing Materials.

The Series F thermometers are for partial immersion only and in the other three series both partial and total immersion temperatures are listed in an appendix. Copies of this standard may be obtained from the British Standards Institution, Sales Branch, British Standards House, 2 Park Street, London, W.1, price 4s.

Prospecting for Oil in Jordan

Application has been made by a Belgian company to the Jordan Government for a concession to search for oil in Jordan. Similar applications received by the Jordan Government from American concerns are under consideration.

Sulphuric Acid Returns

Increasing Stocks Reported in Quarterly Summary

SUMMARY of monthly returns of sulphuric acid and oleum in the United Kingdom for the period 1 April-30 June 1954, issued by the Sulphuric Acid Association Ltd., shows that stocks increased from 57,355 tons at 1 April to 68,863 tons at 30 June. For the previous quarter, 1 January-31 March (THE CHEMICAL AGE. 1954, **70**, 994) the returns indicated that stocks dropped from 58,848 tons to 57,355 tons.

The following tables are extracted from the summary. The figures do not include production of Government plants:

SULPHURIC ACID AND OLEUM
(Tons of 100% H_2SO_4)

Data referring only to acid maker's returns	Chamber and Tower only	Contact only	Chamber Tower and Contact
Stock 1 April 1954	24,780	32,575	57,355
Production	160,817	351,389	512,206
Receipts	21,440	31,685	53,125
Oleum feed	—	1,394	1,394
Adjustments	+20	−262	−242
Use	90,506	141,414	231,920
Despatches	89,690	233,365	323,055
Stock 30 June 1954	26,861	42,002	68,863
Total capacity represented	197,850	394,500	592,350
Percentage production	81.3%	89.1%	86.5%

RAW MATERIALS
(Tons)

Data referring only to acid makers' returns	Pyrites	Spent Oxide	Sulphur and H_2S	Zinc Concentrates	Anhydrite
Stock 1 April 1954	145,896	163,526	51,206	32,143	730
Receipts	123,982	74,494	64,753	72,873	43,766
Adjustments	+64	+1,534	+50	+102	—
Use	123,972	71,668	63,720	54,045	43,911
Despatches*	3,475	17,110	611	—	—
Stock 30 June 1954	142,495	150,776	51,678	51,073	585

* Including uses for purposes other than sulphuric acid manufacture.

CONSUMPTION IN THE UNITED KINGDOM
(1 April—30 June, 1954)

Trade Uses	Tons 100% H_2SO_4
Accumulators	2,208
Agricultural purposes	726
Bichromate and chromic acid	2,196
Bromine	5,948
Clays (Fuller's earth, etc.)	2,574
Copper pickling	671
Dealers	3,647
Drugs and fine chemicals	7,029
Dyestuffs and intermediates	20,740
Explosives	8,900
Export	714
Glue, gelatine and size	140
Hydrochloric acid	14,571
Hydrofluoric acid	2,932
Iron pickling (including tin plate)	26,909
Leather	1,188
Lithopone	4,061
Metal extraction	1,072
Oil refining and petroleum products	14,991
Oils (vegetable)	2,783
Paper, etc.	1,970
Phosphates (industrial)	339
Plastics, not otherwise classified	6,998
Rayon and transparent paper	57,250
Sewage	2,977
Soap, glycerine and detergents	10,490
Sugar refining	142
Sulphate of ammonia	72,753
Sulphates of copper, nickel, etc.	6,343
Sulphate of magnesium	1,363
Superphosphates	111,931
Tar and benzole	6,916
Textile uses	5,231
Titanium oxide	51,873
Unclassified	44,214
Total	504,790

Electron Microscopes

SCIENTISTS visiting the International Conference on Electron Microscopy held in London at the invitation of the Electron Microscopy Group, Institute of Physics, had much to interest them at an exhibition of electron microscopes which took place in conjunction with the Conference, at the London School of Hygiene and Tropical Medicine. Among the instruments on view was the new Philips 100 kV microscope, an instrument of the electromagnetic type, which has an accelerating voltage from 40-100 kV. Two versions are available, one with a resolving power better than 50 A and one better than 25 A.

Instruments shown by Metropolitan-Vickers Electrical Co. Ltd. included their type EM4 designed to meet the need for an instrument giving facilities for a wide variety of research problems. Instrumental magnifications up to 10,000 times can be attained and the specified resolving power is stated to be better than 100 A. Shown by the German firm of Siemens were the Elmiskop 1 with a range from 40-100 kV, and the Elmiskop 2 with a range of 40-60 kV.

Some Industrial Applications of Quaternary Compounds

by E. G. CURPHEY

APPLICATIONS of quaternary ammonium compounds in industrial processes range from their uses as detergents on the one hand, to that of the polyquaternary resins as utilised in ion-exchange mechanisms on the other, and include their employment as anti-corrosion agents for metals in acid baths, as emulsion or foaming agents, and even for the extinguishing of alcohol fires. The sterilising nature of the hydroxyl ion also renders quaternary ammonium hydroxides good bactericidal as well as efficient wetting agents.

Applications in Dyestuffs

As additional ingredients to the spinning baths of artificial threads, complex quaternary salts prepared from triethanolamine hydrochloride and ethylene oxide have been used. Their introduction enhances the dye affinity of the thread. In the preparation of such derivatives, the first product is the tetra-ethanolammonium chloride, the corresponding base being obtained on treatment with alkali[1]. In other applications the quaternary salts of pyridine or quinoline are claimed to be useful as mordants for acid dyes and are prepared by quaternisation of vinyl pyridine with methyl benzene sulphonate or methyl iodide.

In the synthesis of cyanine dyes, useful as photographic sensitisers, quaternary compounds play an important rôle. Thus the simple cyanine dye 1,1′-diethyl-2,2′-cyanine iodide is prepared by the condensation of quinaldine ethiodide and 2-iodoquinoline ethiodide in the presence of a base, the methyne group being obtained by an anionic removal of a proton in the intermediate methylene link. In analogous manner, the carbocyanines may be prepared, employing two molecules of quinaldine ethiodide with an *ortho*-formate in the presence of pyridine. Such reactions may be understood by assuming them to be two-stage processes involving (i) the initial loss of either hydriodic acid or alcohol and (ii) the removal of a proton by the anion of one of the quaternary moieties. Five membered rings may also feature in such processes, as in the condensation of 1-methyl benzoxazole ethiodide with 2-iodopyridin ethiodide[2]. Other sensitising dyes have been prepared from such quaternary compounds as dimethylthiodiazole ethiodide, quinoline ethiodide and formamidine derivatives in the presence of pyridine[3].

Soluble dyes fast to washing have been prepared from organic acid amides, paraformaldehyde and a salt of a tertiary amine. The resulting dyestuff is a quaternary compound, possibly behaving as a cationic wetting agent, which facilitates penetration of the dye into the fibre, and so affords good and even dyeing. The resulting dyes are preferably applied by impregnating the textile with a solution or dispersion of the product. Greenish yellow powders, for example, are prepared by heating β-hydroxynaphthoic acid amide, pyridine hydrochloride and paraformaldehyde, the resulting product being a complex quaternary compound. The formaldehyde appears to react with the amide to give an intermediate methylolamide, which then condenses with the pyridine hydrochloride to give the dye[4].

Wetting Agents

The quaternary compounds find wide applications as wetting agents in industry. In the cleansing and preserving of vegetables, both the wetting and sterilising properties of the quaternary compound are of importance; soluble bases used as foaming and emulsifying agents for such purposes have been prepared by reacting 3-methoxy phenate with N-diethylaminoethyl chloride, the resulting product being quaternised with benzyl chloride. Utilising the wetting properties of stearyl pyridinium bromide, an increased affinity for dyes is conferred on vegetable tanned leather.

Other quaternary derivatives having long alkyl moieties have found successful uses both as textile assistants and as wetting agents in the manufacture of paper. Suitable compounds in this respect have been prepared by reacting cetyl bromide and dimethylamine in methanol, in a closed vessel for fourteen hours at 120°. The resulting N-dimethylhexadecylamine is then stirred with benzyl chloride at 120° for four

hours to give the quaternary salt, benzyl-dimethylhexadecyl ammonium chloride[5].

In the preserving of furs, natural and artificial fibres, good wetting characteristics in conjunction with toxicity are the essential requirements in the protection of such materials against insect and related pests. Suitable starting derivatives for the synthesis of such compounds comprise the dichloranilines, which may be acetylated with chloracetyl chloride and then treated with dimethylamine to give an intermediate N-dimethylamino - acetyl - dichlorobenzene; this is then quaternised with benzyl chloride. The toxicity of such derivatives will be related to the number of halogen atoms present in the molecule.

Other halogen quaternary compounds, having related properties, and claimed to render furs and feathers mothproof, are synthesised from *p*-hydroxydiphenyl and 1,3-dichloropropylamine, the resulting product being quaternised with dimethyl sulphate. Other applications of such substances to textiles include increasing the crease-resistance of cellulosic fibres; *bis*-quaternary derivatives prepared from di-stearyl aminomethane are used for such purposes. They are obtained by treating the latter with formaldehyde, whence the latter condenses at the amino group to yield the corresponding methylol intermediate. The final product is obtained from the hydrochloride by treatment with pyridine[6].

Polymeric Quaternary Salts

Polyquaternary resins have found application as anion-exchangers in medicine; their specific reactivity and insolubility in the medium in which they operate precludes the possibility of contamination, and they have been used in the treatment of gastritis and peptic ulcers[7]. Resins have been prepared by the chloromethylation of a styrene-vinyl-ethylbenzene-divinylbenzene copolymer with chloromethyl ether, which on treatment with dimethylaminopropanol yields a complex quaternary resin. Other anion exchange resins used for the adsorption or removal of acid or acid vapours are prepared from tri-dimethylaminoethylamine and the appropriate polymethylene dibromide. The reaction probably allows quaternisation to be available at all four tertiary nitrogens, rendering the resulting resin a complex reticulate structure.

More linear polymeric quaternary compounds have been obtained by heating a bifunctional linear dihalide such as decamethylene dibromide with ditertiary N,N'-tetra-alkyl-polymethylene diamines. Such derivatives have been prepared by refluxing the reactants in methyl alcohol for nineteen hours, the resulting compounds being soluble in water and alcohol[8]. The resulting polymers find uses as surface tension agents, and as pourpoint depressors for mineral oils.

Elastomer Compounding

In the vulcanisation of elastomers such as GRS, GRN and isoprene-isobutylene copolymers, quaternary ammonium salts such as N-phenyl-3,5-diethyl-2-propyl-dihydropyridine have been used. Other quaternary derivatives have been used to plasticise the Neoprenes[9], and the polymerisation of vinyl esters has been retarded by a wide range of quaternary compounds[10]. The corrosion of metals in acid baths has been reduced using benzyl pyridinium chloride, while lauryl pyrodinium sulphate has been employed as a flotation agent.

Biological Applications

Contact insecticides, toxic to aphides, can be obtained by quaternising bases like nicotine with inorganic acid esters containing alkyl groups with less than seven carbon atoms. The contact insecticidal properties of the nicotine moiety are probably improved by the wetting characteristics of the resultant quaternary base. For these purposes, nicotine has also been quaternised with dodecyl bromide.

Therapeutically, quaternary salts have been used as anticholinesterases by virtue of their effect on the acetyl choline of effector cells, the quaternary salts of *m*-aminophenyl-carbamates being particularly effective[11]. Acetyl choline is produced by the parasympathetic nervous system, and acts as an inhibitor to the muscular activity produced when excitory substances such as adrenaline are released *in vivo*. Such quaternary salts as choline chloride (trimethyl-(2-hydroxy-ethyl)-ammonium chloride) are furthermore related to protein and carbohydrate metabolism; its use prevents haemorrhagic conditions of the kidneys, and the morbid development of fat in the liver of depancreatinised dogs[12].

In organic method, the quaternary salts have important uses. Thus dialkylcyanamide is synthesised by the quaternisation of a tertiary amine with bromocyanogen, heat

decomposing the intermediate quaternary salt.

Olefines may again be prepared from quaternary salts, having appropriate alkyl radicals capable of forming the corresponding unsaturated hydrocarbons[13]. The mechanism consists of an anionic removal of a proton, the unstable polar intermediate undergoing a redistribution of electrons and decomposing to olefine and free base during the process.

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Technical Meetings in Paris

THE III Salon de la Chimie et des Matières Plastiques, which will be held from 3 to 12 December at the Porte de Versailles, Paris, will be the meeting place for a number of international conventions. Specialists in many fields have already signified that they will attend, and the meetings will therefore undoubtedly provide a most useful forum for the interchange of information.

The most recent developments in the production of basic chemical raw materials, their processes of manufacture and methods of use will be the general subject of the series of lectures and discussions. These meetings will be divided into the following groups:—

Friday, 3 *December*: New Vacuum Techniques; *Saturday*, 4 *December*: Perfumery and Cosmetics; *Monday*, 6 *December*: Chromatography and Ion Exchange; *Tuesday*, 7 *December*: The Applications of Microscopy in Chemistry; *Wednesday*, 8 *December*: Antifouling Paints; *Thursday*, 9 *December*: Electronic Techniques in the Service of Chemistry; *Friday*, 10 *December*: Control and Regulation Systems in Sugar Refineries, Corrosion; *Saturday*, 11 *December*: Recent Developments in Plastics, Corrosion.

A detailed programme may be had on application to the Secrétariat, 28 rue Saint-Dominique, Paris, 7.

Oertling's Primary Standard

L. OERTLING Ltd. have completed the manufacture for the Karachi Mint, Pakistan, of what is believed to be the first primary standard weight manufactured commercially in this country since before the war. The weight is of iridium-platinum alloy and is a cylinder having a diameter equal to its height with a mass of 10 tolas (1,800 grains or just over 4 oz.).

The billet from which the weight was manufactured was forged by Johnson Matthey & Co. Ltd. and the production of such a billet to very close specific gravity limits reflects great credit upon their skill. The certification of the specific gravity and the accuracy of adjustment was carried out by the National Physical Laboratory, Teddington. A special pair of forceps, container and carrying case are provided.

The manufacture and adjustment of a weight in the form of a solid cylinder to an accuracy of 2 ppm. represents a skill of a very high order. There is no room for error, as it is impossible to make any adjustment to the weight should it become too light. The weighing and counter-weighing of the mass thus becomes extremely critical as the limits of adjustment are approached. The work was carried out in the weight department of Oertling's.

Packed in its box, with forceps and key to unlock container, after sealing at NPL

Northampton Polytechnic

CHEMICAL and Metallurgical Thermodynamics will be the subject of a course of eight evening lectures to be given by Dr. O. Kubaschewski, the Department of Applied Chemistry, the Northampton Polytechnic, St. John Street, London, E.C.1, on Wednesday evenings beginning 29 September at 7.30 p.m. It is intended to discuss during the course the application of thermodynamics to practical problems of process metallurgy and other metallurgical topics. Fee for the course is £2 2s. On Monday evenings starting 4 October at 7 p.m., in co-operation with the Printing, Packaging and Allied Trades' Research Association and the Institute of Packaging, a course of five lectures is to be given on Corrosion and Packaging. The lecturers will be Dr. W. H. J. Vernon (Chemical Research Laboratory), Mr. J. J. Ferriggi (Shell Petroleum Co. Ltd,), Mr. D. Clayton (Imperial Chemical Industries Ltd.), Mr. D. J. Evans (Ministry of Supply), and Mr. F. A. Paine (the Printing, Packaging and Allied Trades' Research Association). The fee for this course is £1 1s. Beginning on 5 October, at 7 p.m., a course of ten evening lectures on Refractories, their Manufacture, Properties and Uses, will be delivered by Mr. L. R. Barrett. This course, it is stated, has been organised primarily to provide a detailed and up-to-date survey of refractories and the refractories industry for technologists engaged in the metallurgical, fuels, carbonising, glass and chemical industries, although it will also be suitable for students of metallurgy and other related branches of applied chemistry, provided they possess the necessary fundamental knowledge of chemistry. In addition, the course is suitable for those preparing for the examinations of the Institution of Metallurgists and of the Institute of Fuel. The fee for this course is £2 2s.

Recovery of Sulphur

A SPECIAL study of the removal and recovery of sulphur from fuels will be made at the opening conference of The Institute of Fuel, to be held in London on 6 and 7 October. The technical sessions, at The Institution of Mechanical Engineers, 1 Birdcage Walk, S.W.1, will start with an introduction to the study by Dr. A. Parker at the morning session on 6 October. This will be followed by papers from A. Stirling and R. W. Evans on the effect of sulphur in the iron and steel industry. At the afternoon session, papers from A. M. Wandless and Dr. W. R. Chapman and Dr. D. C. Rhys Jones will deal with the occurrence and removal of sulphur in British coal and from Dr. R. H. Griffith and Dr. S. R. Craxford and Dr. A. Parker with its occurrence and removal in town gas and coke-oven gas.

The morning session on 7 October will deal with new techniques for the removal of sulphur from fuel gases. Papers from Dr. H. Schäfer, Dr. J. Bähr, T. H. Williams and A. J. Brockwell and F. F. Rixon will be read. In the afternoon, the occurrence and removal of sulphur in petroleum will be dealt with in a paper from D. A. C. Dewdney and H. Jagger, and the sulphur requirements of industry in a paper from W. A. M. Edwards.

A buffet luncheon (price 6s.) will be served on each day at The Institution of Mechanical Engineers, and on the evening of 6 October a reception and dance is to be held at the Connaught Rooms, Great Queen Street, W.C.2, at a cost of £1 1s. a ticket. All sessions of the conference will be open to the public, admission free, and preprints of the papers, including a copy of the final report, may be obtained for £2 2s. (members) and £2 12s. 6d. (non-members).

AEA Takes Over

ON Sunday, 1 August, the United Kingdom Atomic Energy Authority, which was set up by the Atomic Energy Authority Act, 1954, took over responsibility for atomic energy research and development from the Department of Atomic Energy which, under the Lord President of the Council, has operated the atomic energy establishments transferred from the Ministry of Supply on 1 January. The Lord President will still be responsible to Parliament for atomic energy policy generally and for monies provided for the new Authority. He will be assisted by a small staff of civil servants who will form his Atomic Energy office. The Minister of Supply will continue to be responsible for the provision of atomic weapons to the Services and will place contracts with the Authority for the production of nuclear components of these weapons and research related to them.

Italian Sulphur Crisis

Remedial Measures Discussed

THE announcement on 26 July, by the Regional Sulphur Section of the Sicilian Federation of Industrialists, that all Sicilian sulphur mines would close on 20 August, has precipitated the long threatened crisis in the Italian sulphur industry.

At first, the Ente Zolfi Italiani announced that their policy remained unchanged, that in the course of their programme of reorganisation some uneconomic mines might be closed, and that, for political and social reasons—over 60,000 workers in Sicily are directly engaged in the sulphur industry—this programme was being applied slowly and with 'considerable prudence.' Subsequent events indicate that this view was over optimistic.

On 3 August, a political delegation from Sicily was received by the Italian Prime Minister, Sgr. Scelba, to whom they presented the case of the sulphur industry. It is understood that three measures revoking existing laws, which the Ministry of Industry had earlier submitted to the Interministerial Committee for Reconstruction for consideration at the next meeting, may now be tabled in the legislative assembly after the summer recess.

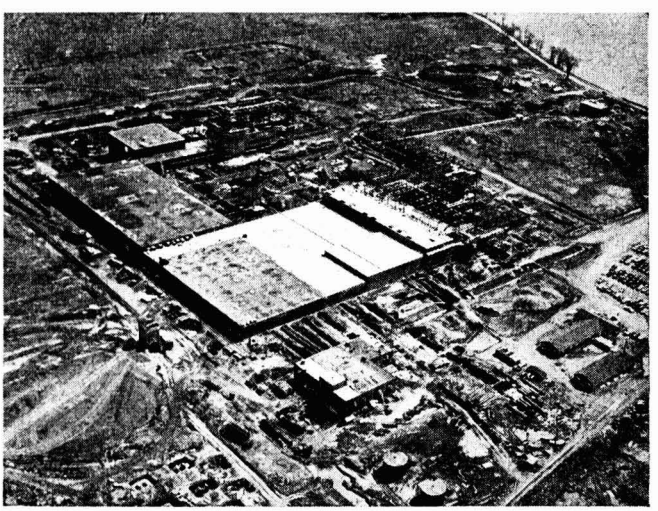
The first proposes the integration of the sum already earmarked for the financing of those mines which intend to modernise their installations, and accepts, almost totally, the demands of the industry. In addition, a further sum is to be set aside for the renewal of plant and machinery.

A second bill provides for the financing of Sicilian mines, limited to working expenses during the entire period of reactivation, to those firms who have effected alterations to their plant. Advances may be refunded in 10 to 15 years up to a maximum sum of 150,000,000 lire to those mines which, starting before January, 1953, are in the process of installing new plant for enriching the ore for flotation, and which are working ore with a smelted yield lower than 9 per cent.

The third measure concerns the problem of accumulated stocks, which at present, amount to 250,000 tons, or at about the same level which was reached before the conflict in Korea. The measure accepts the principle of aid to producers, but in what form is still to be established by the Interministerial Committee for Reconstruction. Two solutions have been suggested: to pay interest on the basis of the price at time of delivery until market prospects improve, or to sell the stock at international prices and charge the loss to the State budget.

Heavy Water & Power in New Zealand

In view of prospects of utilising heavy water in certain types of nuclear power reactors, the United Kingdom and New Zealand Governments have agreed to proceed with a project for producing heavy water and power from geo-thermal steam in the Wairakei District of North Island.



Aerial view of the $20,000,000 Terylene plant of Imperial Chemical Industries of Canada Limited which is nearing completion at Millhaven, near Kingston, Ont. Situated on Lake Ontario, the plant was started just over a year ago and will be completed by mid-1955. The pilot plant was completed in June of this year and the first Canadian-made fibre will be produced this summer. Large-scale production is scheduled for August 1955. The plant's total production capacity will be 11,000,000 pounds per year

A Varied Programme

Many Topics to be Discussed at International Congress

THE 27th International Congress of Industrial Chemistry will be held in Brussels from 11 to 19 September. The proceedings are divided into 10 groups subdivided into 31 sections, covering very nearly all fields of industrial chemistry and related topics, and should prove of interest to technicians, industrialists, research workers, all who have a part in the development of applied chemistry or in any of those industries whose products are dependent on that development.

Six plenary sessions will meet on succeeding days from 12 to 16 September. At the first, after the official opening of the Congress, Professor G. Smets of the University of Louvain will speak on 'High polymers and chemical reactions.' On the following day, Mr. R. Navarre, director-general of the French Petroleum Institute in Paris, is to deliver a paper on 'Organisation of efficient research: Some examples of work carried out by the French Petroleum Institute in petroleum chemistry.'

The subject of the address by Professor A. Lespagnol, of the Faculty of Medicine and Pharmacy at Lille University, will be 'Some recent developments in the chemistry of medicaments,' on 14 September; and on 15 September Professor D. W. van Krevelen, Director of Research, Central Laboratory of Staatsmijnen, Limburg, will speak on 'The organisation of research and its role in industry.'

Two Speakers on Atomic Energy

On the last day of the plenary sessions, Dr. L. Hafstad, director of the Division of Reactor Development of the US Atomic Energy Commission, and Sir Christopher Hinton, Deputy Controller of Atomic Energy (Production) of AEA, will both speak. Dr. Hafstad, who was in charge of the work on the first breeder reactor to be constructed, will describe reactor developments; and Sir Christopher will review the past history of atomic energy in Britain, and discuss plans for the future.

The ten groups of the Congress are as follows. Group I, technical problems of general interest, is divided into six sections concerned with analytical problems; chemical engineering; corrosion and protection; water; lubrication; and refrigeration. Group II, fuels, has four subdivisions: solid and gaseous fuels; chemical constitution of solid fuels; liquid fuels and petroleum products; and petrochemistry. Group III is concerned with nuclear science.

Heavy & Fine Chemicals

Metallurgy is the subject of Group IV, which is divided into ferrous and non-ferrous applications, and Group V, mineral industry, has sections on heavy chemicals and others. Sections on materials of construction, cement, lime, plaster, etc.; glass and enamel; and ceramics, bricks, tiles and refractories, make up Group VI, whilst Group VII is concerned with the organic chemical industries. These are divided into explosives; plastics, rubber, textiles, cellulose and paper; paints, printing inks and varnish; pharmaceutical and plant protection products; photographic chemicals, intermediates and colouring matter; fats, soaps and detergents; and various industries including essential oils, tanning, glues.

The last three groups are concerned with food and agriculture, divided into fermentation and various food products; colonial problems; and industrial organisation of research, welfare and commerce.

As on previous occasions, the last two days of the Congress will be devoted to visits to research establishments and chemical works, about 30 of these excursions having been arranged. The Congress will come to an end in the Grand Duchy of Luxembourg, and delegates may prolong their stay there under the aegis of the European Federation of Chemical Engineering.

The headquarters of the Congress is at present situated at the Federation des Industries Chimiques de Belgique, 32 rue Joseph II, Brussels, and a programme of the Congress may be obtained from this address. From Monday, 13 September, the headquarters will be transferred to the Cité Universitaire, l'Université Libre de Bruxelles, avenue Paul Héger, but will return to the former address on 17 September.

TEXT-BOOK OF METALLURGY. By A. R. Bailey. Macmillan & Co., London. 1954. Pp. viii + 560, with 401 illustrations. 30s.

One would agree in principle with the author's introductory remark that there is need at present for more, as well as for more up-to-date, metallurgical texts. But anyone interested in this field would ask immediately: would this need be better met by one, two or three text books, or one volume, but compiled by several authors? and then: what type of text-book in metallurgy is required?

The author's answer to the first of these questions is clear: his choice was a single volume and one author. His answer to the other question is not so obvious, apart from the introductory statement of the aim of the book which is 'to provide a modern and thorough introduction to physical and process metallurgy.'

In the opinion of the reviewer the author's choice has not been the happiest one. Metallurgy nowadays embraces such a vast field of pure and applied sciences that its presentation in a single volume becomes very bulky as well as hazardous. And furthermore, in order to reduce the size of a single volume to a relatively small text while preserving the clarity, the requirements of one's knowledge of each separate field must be so demanding that they are hardly to be met within the capacity of a single writer. But these points can be considered as controversial, and the most important task by the reviewer is to assess the present book from the point of view of its merits as a text-book.

The corner pillars of a good text-book are three 'C's: clarity, conciseness and completeness. Judged from this standpoint the present book is more difficult to assess as a whole volume than it is in parts. It is because the author has tried to cram in too much material that the clarity has often suffered, and because he is evidently not a master in all branches of metallurgy, that the text is not always concise. In spite of this the book is among the best available in this field and will be welcomed by many students as an introductory course.

A more detailed, but nevertheless serious, criticism of the book is that it contains a fair number of factual errors, such as on pp. 319: 'neither grey nor white iron can be worked,' or on pp. 372: 'it is not practicable to make large shapes by die casting, sizes are usually limited to several pounds.' Unfortunately, such examples are found throughout the book.

The book covers all the main branches of metallurgy from ore treatment to examination and properties of various metallic products. It will be useful to many courses and classes in metallurgy where an introductory and simplified treatment of the subject is wanted. A freely compiled list of examination questions at the end of the book is likely to appeal to students but not to the teachers of metallurgy.—V.K.

INTERMEDIATE PRACTICAL CHEMISTRY COURSE. By Lilian M. Turton. Blackie & Son Ltd., Glasgow. 1954. Pp. 136. 5s.

The book opens with the bending of glass, the manipulation of gases, simple quantitative determinations and other exercises which are part of the routine laboratory course of the lower forms of many schools. Next, Dr. Turton, using oxalic acid as the standard substance, introduces simple volumetric work. Thenceforward sections on qualitative analysis and volumetric methods are treated alternately.

The study of each section begins with a theoretical approach consisting of simple well chosen informative experiments, stimulating questions and helpful notes. Thus, the investigation of the insolubility of selected salts leads to the scheme of qualitative analysis, while the quantitative aspect

of insolubility is made the approach to titrations using silver in neutral solutions. Again, the experimental study of weak electrolytes and of oxidation and reduction precedes the use of potassium permanganate as a volumetric reagent.

The scheme for the identification of anions and cations in simple mixtures is built on familiar lines. Chapter XIV contains additional volumetric exercises; these include the use of potassium dichromate and of silver in acid solutions. Each chapter ends with a set of well chosen problems. Eleven pages written by Dr. Mckail, dealing with the reactions of simple organic compounds, make the last of the book's fifteen chapters.

Undoubtedly, the teaching of qualitative and of volumetric analysis herein given is on sound educational lines, but as a course of practical work at intermediate level the scope of the book is too limited. There are no preparations, organic or inorganic, no semi-micro work, and no exercises on physical chemistry. In the preface Dr. Turton writes 'She believes that the course offered by this book would prove valuable, even exciting, to sixth form pupils, particularly to those pursuing a third year as scholarship candidates.' Yet, except for a few of the exercises in Chapter XIV, the whole of the work covered by the book, and more besides, would be done in many schools as part of the ordinary work at advanced level. Otherwise this is a carefully thought out and well written course of practical work.—G.F.

CHEMICAL ENGINEERING MATERIALS. By F. Rumford. Constable & Co. Ltd., London. 1954. Pp. x + 380. 32s. 6d.

The student of chemical engineering needs to learn something about the choice of materials for the fabrication of chemical plant. The usual courses offered in metallurgy at colleges and universities are often not particularly useful to him and they must be augmented or replaced by a course more appropriate to his special needs. Available information on chemical engineering materials is, however, widely scattered throughout the literature and Dr. Rumford has done a valuable service in gathering together and assessing critically such a large amount of miscellaneous information.

Although the mechanism of corrosion of metals is now fairly well understood, the choice of material for a plant in which chemicals are to be handled is more often than not based upon empirical considerations. As Dr. Rumford points out, no general rules for the choice of materials can be laid down. After reviewing in the first place the general mechanism of chemical attack and the essential methods of testing materials the author deals with the wide range of materials available. These include cast iron, steel, ferrous alloys, lead, aluminium and magnesium, copper and its alloys, nickel and its alloys, silicon iron, and the precious metals (including tantalum and titanium).

The remainder of the book comprises chapters on protective coatings on metals, inorganic cements, organic cements and luting materials; bricks, tiles and stoneware; refractories and insulating materials; vitreous silica and hard glass; wood, plastics and rubber.

An appendix shows in handy tabular form the resistance of common metals to a wide range of specific chemical substances, and a second appendix summarises the mechanical properties of materials. The book is well-illustrated by line diagrams and plates showing items of chemical plant and relative cost figures are mentioned throughout. Attention is paid not only to the properties of chemical engineering materials but also to the way in which they are made up into chemical plant.

A criticism which may perhaps be made is that the mechanism of corrosion is dealt with rather briefly in the first chapter. However, references are given to more comprehensive treatments of this subject. One or two errors were noted: on page 7, '-iron dissolving at the cathode'—should read '-iron dissolving at the anode,-' and the phase diagram for the SiO_2-Al_2O_3 system reproduced in Fig. XVI-6 is inaccurate.

This book is intended to fill gaps in the knowledge of those trained, on the one hand, in mechanical engineering, and on the other, in chemistry, and it succeeds admirably in this. It will undoubtedly prove to be of considerable value not only to the students of chemical engineering for whom it is primarily intended but also to many already engaged in the chemical industry. Each chapter is provided with a list of references which will enhance its value to the latter. —R.L.

• HOME •

Consulting Chemists' Holiday

Dr. M. A. Phillips and Associates, 14 Western Road, Romford, announce that their offices will be closed for the annual vacation from 21 to 28 August.

County Laboratory for Durham

Durham County Council have approved a proposal to build a county laboratory estimated to cost £11,500 at Aykley Heads, Durham, and have appointed as Public Analyst Mr. Joseph Markland, at present the Derbyshire Deputy Public Analyst. He succeeds 71-years-old Mr. Cyril J. H. Stock. In addition to the County Analyst, the laboratory staff will include a deputy and two qualified assistants. Under the new scheme, it is stated, each sample analysed will cost a minimum of £2 10s. 4d., and a maximum of £2 18s. 6d., compared with the present average cost per sample of £1 1s. 8d.

Stanlow Refinery Complaints

A number of authorities have met to consider complaints of obnoxious smells alleged to emanate from the Stanlow refinery at Ellesmere Port, and have decided, after hearing of efforts being made to overcome the difficulty, to adjourn but keep the question constantly before them. Mr. Patrick Williams said at the meeting on 27 July of Runcorn Rural Council that the conference learnt that already £43,000 had been spent in trying to overcome the nuisance and two men were solely engaged trying to track down the trouble.

Employment Up in Chemical Industry

Statistics published in The Ministry of Labour Gazette for July show that the total number of persons employed in the chemical and allied trades in Britain at the end of May was 506,600, compared with 504,200 in April. Of these, 306,300 were males and 146,300 females. The number of persons in the industry unemployed at 14 June were 4,445 (2,705 males and 1,740 females). The previous month's total was 4,965. The approximate number of workpeople in the same trades in the UK affected by net wage rate increases reported to the Department during the six completed months of 1954 was 119,500. The estimated net amount of increase in weekly wages was £29,000.

New Agents for Quickfit & Quartz

Quickfit & Quartz Ltd., manufacturers of interchangeable laboratory and scientific glassware of Stone, Staffs, have appointed selling agents in Dublin and in Wells, Somerset. The Dublin agent is Thomas H. Mason, of 5-6 Dane Street, Dublin, and the agents in Wells are Sutherland & Thomson.

New Nitric Acid Unit

Another nitric acid unit, the last of a series of eight, is to be brought into operation shortly at the Billingham-on-Tees works of Imperial Chemical Industries Ltd., and production of nitric acid at the works will then be double the pre-war figure. Nitric acid is used at the plant for the manufacture of nitro-chalk, nylon and ammonium nitrate.

Licence of Right

Under Section 35 of the Patents Act, 1949, the following patent was endorsed 'Licence of Right,' on 2 July last: No. 652,835, Jefferson Lake Sulphur Co., 'Method of and apparatus for effecting catalytic gaseous reactions.' Any person who claims that the patentee at the time of the endorsement of the above patent was precluded by a contract in which the claimant is interested from granting licences under the Patents Act may apply for cancellation of the endorsement on Patents Form No. 45, within two months after the date of the endorsement.

Exports to Persia

With the announcement on 5 August, 1954, about the accord on points of agreement which has been reached in the negotiations concerning Persian oil, it is expected that there will be fresh opportunities for United Kingdom firms to supply goods and services needed by the Consortium and the National Iranian Oil Company. Exporters requiring specific information about exports to Persia are invited to write or telephone to Commercial Relations and Exports Department, Board of Trade, Horse Guards Avenue, London, S.W.1. (Tel.: TRAfalgar 8855) and, where appropriate, to Export Licensing Branch, Board of Trade, Atlantic House, Holborn Viaduct, London, E.C.1 (Tel.: CITy 5733).

• OVERSEAS •

Dutch Imports & Exports

The annual report for 1953 of the Netherlands Chemical Industry Association shows that imports amounted to 1,970,234 tons, worth 629,336,000 guilders, and exports amounted to 1,758,815 tons, worth 685,072,000 guilders.

Iraqi Oil Production

For the first six months of this year production of crude oil from the Iraq Petroleum Company's Iraqi fields was as follows: from the Kirkuk field, 11,544,533 tons; from the Zubair field, 2,044,538 tons; and from the Ain Zalah and Butmah fields 644,895 tons. The total of 14,233,966 tons compares with 13,119,806 tons for the first six months of 1953.

New Indian Oil Refinery Opened

The first of India's three new oil refineries went on stream on 25 July at the Stanvac Refinery at Bombay. The refinery will now work up to its regular output of 25,000 barrels a day—sufficient to supply 30 per cent of India's needs for petroleum products. Annual production of the refinery will be 206,000,000 gallons of petroleum products.

US Aluminium Dearer

Price increases of up to 0.7 cents per lb. in aluminium were announced by the Aluminium Co. of America last week. The company has raised its price for 99 per cent minimum average A1 pig by 0.5 cents to 20.5 cents, and for 99 per cent ingot by 0.7 cents to 22.2 cents. Other major producers in the US are expected to take similar action.

DDT Factory Near Delhi

A factory for the manufacture of DDT and other insecticides will go into production shortly near Delhi. Mr. S. S. Jaggia, managing director of Hindustan Insecticides, said production would start early next year. The factory would be able to supply about 700 tons of DDT annually, to be utilised mainly for the anti-malaria campaign in the country under the auspices of the Indian Health Ministry.

Mercury Agreement

Agreement has been reached between Italian and Spanish producers of quicksilver, settling differences that have existed since 1949, when Italy sold 80,000 flasks to the United States outside the Mercurio Europeo, the old Spanish-Italian cartel, it is reported in Madrid. Although no details of the agreement have been issued, it has been denied that the talks were aimed at reconstituting the cartel.

Mexican Natural Gas Deal

The Mexican Government oil and gas monopoly, Pemex, is to sign a 20-year contract for the sale of natural gas to the US. It is stated that it will represent the biggest single deal ever negotiated by the Government. Delivery estimates range from 100,000,000 to 200,000,000 cu. ft. daily. The gas will be sold to the Texas Eastern Transmission Corporation.

French Synthetic Rubber Plant

A synthetic rubber plant, estimated to cost 20,000,000 francs, will, it is expected, soon be established in France. At first, production of about 10,000 tons is planned, but later it is hoped to supply all French needs and even markets abroad. The French Dunlop Company will co-operate in setting up the plant with other companies, including Michelin, Pechiney, Esso Standard and Compagnie Francaise du Raffinage and Kleber Colombes. Part of the money will be raised by a loan, which may be guaranteed by the French government.

Minerals Found in Rhodesia

Large deposits of three valuable minerals —beryllium ores, tantalite and monazite— have been discovered at Bikita, 40 miles from Fort Victoria in Southern Rhodesia. News of the discovery was telegraphed by the geologists who were prospecting the area to their principals in Johannesburg, Union Glynn. Germanium and lithium, two very valuable minerals, have been discovered in Northern Rhodesia, Mr. W. G. Dunlop, Member for Commerce and Industry, told the Northern Rhodesia Legislative Council recently. It was too early yet to say how important the discoveries would prove.

• PERSONAL •

On his retirement after 46 years' service with Turners Asbestos Cement Co. Ltd. (Turner & Newall Ltd.), MR. T. OLIVER MACNEIL has been presented with a gold watch by his colleagues in the company's Glasgow office. He was the company's first outside representative.

MR. J. F. LOCKWOOD, chairman and managing director of Henry Simon Ltd., and a director of the National Research Development Corporation, has been appointed deputy-chairman of Electric and Musical Industries Ltd.

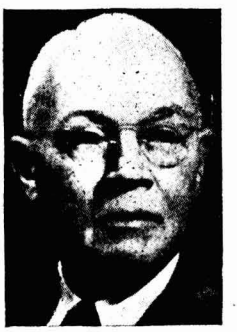
At the request of the Government, the Federation of British Industries has arranged for a civilian survey mission to be formed to study the problems connected with the future maintenance of the Suez Canal Base by civilian contractors. Included in this Mission is MR. W. R. ROBSON, director, Metals Division, Imperial Chemical Industries Ltd. Mr. Robson, along with his colleagues, will be away approximately two weeks.

The president of the Society of Chemical Industry, SIR WILLIAM OGG, M.A., Ph.D., LL.D., is a member of the United Kingdom delegation which will leave this weekend to visit the All Union Agricultural Exhibition of the USSR in Moscow. During their 10-day stay, members will be guests of the Soviet Ministry of Agriculture. Leader of the delegation is PROFESSOR SIR JAMES SCOTT WATSON, C.B.E., M.C., LL.D., Chief Scientific and Agricultural Advisor, Ministry of Agriculture.

MR. ALAN KERSHAW, of Prestwich, Manchester, management accountant to Imperial Chemical Industries Ltd., leathercloth division at Hyde, Cheshire, has been appointed as cost accountant to initiate and develop the National Hosiery Federation's new costing advisory service at Liecester.

The wedding took place at St. Clare's Church, Fagley, Bradford, recently, of MR. DOUGLAS WILLIAM CARR, elder son of Mr. and Mrs. L. W. Carr, of London, and MISS EVELYN MARY ALBROW, third daughter of Mr. and Mrs. F. J. Albrow, of Bradford. The bridegroom is on the sales staff of Imperial Chemical Industries.

MR. GUY N. HARCOURT, who will manage the manufacture of Blaw-Knox 'Buflovak' chemical plant in Great Britain, is well known in chemical engineering circles. He graduated at MIT in 1911, afterwards being employed by National Aniline & Chemical Co. and the M. W. Kellogg Co. Joining the Buffalo Foundry & Machine Co. (which afterwards became the Buflovak Equipment Division of the Blaw-Knox Co.) in 1929, Mr. Harcourt was manager of their New York office until 1939, when he was appointed vice-president (engineering) at the Buffalo plant. He is a prominent member of the A.I.Ch.E., the A.S.Mech.E. and the A.C.S.



The Texas Company, New York, have announced the election of a senior vice-president and three vice-presidents. MR. M. HALPERN, vice-president in charge of refining, has been elected senior vice-president, a new executive post; MR. J. S. WORDEN, former general manager of refining, has been elected vice-president in charge of refining, succeeding Mr. Halpern; and MR. F. H. HOLMES, former assistant general manager of refining, has been elected vice-president in charge of the research and technical department, also a new post.

Shell-Mex and BP Ltd. have announced that MR. G. E. V. THOMPSON, manager, Midland Division, has been appointed manager, London Division, and will be leaving Birmingham early in September to take up his new appointment. He is to be succeeded as Midland divisional manager by MR. W. R. BLAND. Mr. Thompson has spent nearly all the last 20 years of his service with the company in Birmingham; he came to the Midlands in 1934 as an assistant manager and during the Second World War years was assistant regional manager of the Petroleum Board and the

Board's liaison officer with the armed forces and the Civil Defence. Mr. Bland joined the British Petroleum Co. Ltd. 32 years ago, and with this company and with Shell-Mex and BP Ltd., he has held appointments in Sheffield, Manchester, London, Plymouth, Hull, Leeds and latterly as divisional sales manager of Northern Division in Newcastle.

Obituary

A verdict of accidental death was recorded at an inquest at Edmonton, Middlesex, on 3 August, on MR. JAMES WAYWELL, aged 50, an experimental chemist, of Hillbrow Road, Brighton, who was found dead at the laboratory of M. Vanger Ltd., wholesale grocers, Edmonton. Mr. Waywell was found with his feet protruding from a bin in which there was a broken bottle of ether. Beside the bin was a table, two legs of which had been buckled. His secretary stated that Waywell had been in the habit of standing on the table to pour ether into laboratory equipment which was about 4 ft. from the ground. Medical evidence indicated that death was caused by asphyxiation.

The death has occurred of MR. PERCIVAL JOHN GRATWICK, of Brandshatch Place, Fawkham, Kent, a deputy chairman and joint managing director of Courtaulds Ltd. Mr. Gratwick was also deputy chairman of British Nylon Spinners Ltd. Among the other concerns of which he was a director are British Cellophane Ltd., Central Rayon Office Ltd. and Colodense Ltd.

Wills

MR. FREDERICK OXLEY, of 15 Wilmer Drive, Bradford, formerly of 8 Mount Road, Manningham, Bradford, a director of J. C. Oxley's Dyes & Chemicals Ltd., Lighthouse Works, Dewsbury Moor, Heckmondwike, left £4,879 (net £4,821).

MR. HUGH HOGARTH, of Delvine, Murthly, Perthshire, late a director of the Tharsis Sulphur and Copper Co. Ltd., left personal estate in England and Scotland of £234,118.

MR. ARTHUR LEONARD BLACKBURN, of Highmoor, Hartshead Moor, Cleckheaton, founder of Blackburn and Oliver Ltd., manufacturers of synthetic resins and cements, of Wigan, left £11,474.

Bequests in the will of MR. GUSTAVUS PFEIFFER, co-founder of Warner-Hudnut, were announced in America recently. Beneficiaries include the American Foundation for Pharmaceutical Education, who received approximately $867,000, the City College of New York School of Pharmacy, Philadelphia College of Pharmacy and St. Louis College of Pharmacy, all of whom received approximately $87,000. The remaining $10,000,000 from his estate went to the Gustavus and Louis Pfeiffer Research Foundation, from which grants will be made for research in medicine and pharmacy.

MR. ARTHUR WILLIAM COWBURN, of Booths Hall, Knutsford, and Maes-y-Mor, Llandudno, chairman of Cowburn & Cooper Ltd., chemical manufacturers, of Trafford Park, left £122,054 gross (net value £67,850).

'Endeavour' Essay Competition

Fifty-four entries were received for the *Endeavour* Essay Competition and the standard was well up to that of previous years. The first prize-winner's contribution, it is stated, was probably the best received since the competition was started in 1950. The prize-winners are:—First prize, 50 guineas: Mr. Douglas W. Allen (age 23, Ontario, Canada) for an essay on 'Heat of the Earth'; second prize, 25 guineas: Mr. P. B. Tomlinson (age 22, Leeds) 'The Span of Life'; third prize, 15 guineas: Mr. C. D. Lustig (age 21, London) 'Colour Photography'; special prizes of 5 guineas: (competitors under 18 on 1 June), Mr. S. M. F. Sheppard (age 16, London) 'The Upper Atmosphere' and Mr. R. D. William (age 17, Birkenhead) 'Colour Photography.'

Israel's Natural Resources

It will be possible to develop Israel's natural resources to the full in six to seven years, if the present rate of progress continues, is the view of Dr. Dov Joseph, Israeli Minister of Development. He said that a geological survey covering half the Negev has greatly helped the oil companies. Dr. Joseph expressed the hope that in two years potash production would reach 300,000 tons, as compared with the 60,000 tons output this year. There were also prospects for bromide and magnesium production, he added.

Publications & Announcements

PROGRAMME of the Tenth World's Poultry Congress being held in Edinburgh from 13 to 21 August includes a paper by Dr. Paul D. Harwood, director of research of Dr. Hess and Clark Inc., and pioneer in the discovery in America of furazolidone, one of the new series of chemical compounds which has proved effective for the treatment of fowl diseases. Also attending the Congress is Mr. R. H. Macnab, head of the veterinary department of A. J. White Ltd., manufacturing chemists, of 119 Coldharbour Lane, London, S.E.5, manufacturers in this country of nitrofuran poultry products, nitrofurazone (sold under the trade name of Nefco) and furazolidone NF-180 (Neftin).

* * *

PROBLEM of metal pick-up in pea and tomato processing forms the subject of an article in the No. 27 issue of 'Wiggin Nickel Alloys,' published by Henry Wiggin & Co. Ltd. Another example of the successful application of the high-nickel alloy where corrosion resistance is important is provided by tests using an Inconel pot with caustic alkalis and other materials used in the recovery of diamond powder. Other articles in the issue deal with Monel in Ignition Systems, Electrical Resistance Alloys and Pulse-Jet Engine Developments. Copies of 'Wiggin Nickel Alloys" may be obtained from the company at Thames House, Millbank, London, S.W.1.

* * *

THE Quasi-Arc Company Ltd. announce that they are now sole licensees in this country for the Sigma welding process. This is an inert gas shielded consumable electrode process, for the welding of metals of poor weldability such as aluminium and stainless steel, employing a water cooled gun. Water cooling allows the gun to be of very light, well balanced construction, which reduces operator fatigue to a minimum and facilitates welding in the vertical and overhead positions. The cooling water to the gun also cools the welding supply cable, giving a great reduction in its size, and increased flexibility. With water cooling, a 50 A cable is used to carry welding currents up to 400 A and all leads to the gun are therefore light and flexible. The water cooling reduces maintenance on the nozzle of the gun to negligible proportions and eliminates the build up of spatter. One trigger on the gun initiates the flow of water and argon shielding gas and also operates the main welding contactor, thus simplifying welding operations. Details of the Sigma process can be obtained from the Quasi-Arc Company Ltd., Bilston, Staffs.

* * *

SOME thirty exhibits are being displayed in an exhibition, 'The Microscope in Industry and Research' organised by W. Watson & Sons Ltd., 313 High Holborn, London, W.C.1, at Milton Hall, Deansgate, Manchester, from 20 to 25 September. Watsons have always recognised that progress in microscope design can take place only through the collaboration of manufacturer and user, and that it must always be the aim of the designer to provide the tools which will enable the user to achieve his object with the least difficulty. With a view to promoting this collaboration between the manufacturer and user, Watsons staged the first exhibition of their instruments at the Central Hall, Westminster, in December, 1934. This was repeated each year until the outbreak of war. The first post-war display was in 1952. The Manchester exhibition will show specimens and examples of the technique employed by a number of firms.

* * *

FLUROLIER synthetic enamel reflectors in a new range, with Peropal finish, have been introduced by Benjamin Electric Ltd., of Brantwood Road, Tottenham, London, N.17. This finish, it is stated, has been achieved by a new technique of high temperature stove enamelling, embodying a synthetic resin providing the maximum protection and durability. The new range has been specially developed for light industrial needs and those departments of factories where the conditions are reasonably dry and clean. Basically the same as the orginal Flurolier fittings both in design and performance, the new Peropal range is designed to provide the same ease of maintenance and a variety of installation facilities.

* * *

A BOOKLET has been published by Glovers (Chemicals) Ltd., of Wortley Low Mills, Wortley, Leeds 12, covering their Morpan range of quarternary ammonium compounds.

Company News

Anchor Chemical Co. Ltd.

Interim dividend, 10 per cent (against 7½ per cent). The increase does not necessarily indicate any increase in total distribution for the year.

A.P.V. Co. Ltd.

The directors of the A.P.V. Co. Ltd. have decided in future to consider payment of an interim dividend on the ordinary shares in November each year instead of September as heretofore. Group annual accounts, it is stated, cannot normally be presented before May or June because of the delay occasioned by the need to await audited accounts from the subsidiaries overseas. On 11 June a final dividend of 5 5/6 per cent, making 10 per cent for the year 1953 on the £985,690 ordinary stock, was announced.

Matthew Wells & Co. Ltd.

The directors of Matthew Wells & Co. Ltd., oil refiners, have announced a final dividend of 9 per cent (compared with 6 per cent for the previous year), making 13 per cent (10 per cent) for the year to 31 May, 1954. Net profit after tax was £3,791 (£2,308).

Olin Industries Inc.

Second quarter earnings of Olin Industries Inc. (USA) showed a sharp increase over the results of the first quarter, while Mathieson Chemical Corporation maintained its earnings level of the previous period. Stockholders of the two companies last month approved a proposal for merger to form Olin Mathieson Chemical Corporation. The exact date will be announced soon. Olin Industries reported second quarter earnings of $4,349,063. Earnings for the half year on the same basis were $7,725,993. Mathieson's earnings for the half year were $9,266,361, compared with $9,211,133. Second quarter earnings were $4,472,542, compared with $4,542,488 in 1953.

New Registrations

Brand & Innes Ltd.

Private company. (536,508.) Capital £1,500. To carry on the business of wholesale or retail consulting, analytical, manufacturing, pharmaceutical and general chemists, etc. Directors: Alexander Innes and Joyce Charlton. Reg. office: Room 406, 329 High Holborn, London, W.C.1.

Wisa Ltd.

Private company. (536,378.) Capital £100. Manufacturing, research, dispensing, analytical chemists and druggists, etc. Directors: Henry Windsley and Allan P. C. Thiele. Reg. office: 221 Watford Way, N.W.4.

Market Reports

LONDON.—A firm tone persists in the industrial chemicals market, and a steady flow of new inquiry has been reported for most of the routine soda products and for the potash chemicals. Contract deliveries to home consumers have returned to the pre-holiday level with specifications covering good volumes. Quotations generally are unchanged, although a reaction in the basis prices of the lead compounds has been notified. As from 10 August dry white lead was increased to £129 15s. per ton and ground white lead £145 5s. per ton (the price for dry ground white lead in packages of one hundredweight and less are unchanged); dry red lead £123 5s. per ton and litharge £125 5s. per ton. Quiet conditions have prevailed in the coal tar products market owing to the curtailment of activity during the holiday season, but buying interest is fully maintained and there is a ready outlet for most items.

MANCHESTER.—The demand on the Manchester market for textile bleaching, dyeing and finishing chemicals continues on steady lines, due allowance being made for holiday influences. The possibility before long of quieter conditions in this important section of the home trade is not being lost sight of in view of the reduced order books at some of the cotton mills. Other leading outlets are taking fairly good supplies. Prices are mostly on a firm basis still. No more than a moderate business is reported in fertiliser materials, but in the tar products section the demand for most of the light and heavy products keeps up at a satisfactory level.

GLASGOW.—There has been a marked increase in the volume of business in relation to general chemicals during the course of the past week. However, the influence of the holiday period is still being felt. Prices on the whole have been steady and trading conditions are what one would expect at this time of the year.

CLASSIFIED ADVERTISEMENTS

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UNIVERSITY OF MANCHESTER

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SITUATIONS VACANT

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

A major Oil Company require a **TECHNICAL ASSISTANT** in their Geological Laboratory at their London Office. Applicants should be under 30 years o age, have completed National Service and be in possession of School Certificate. Preference will be given to those in possession of Higher School Certificate or Inter. B.Sc. Experience in general scientific laboratory work, or the preparation of thin sections of rocks and microfossils desirable. Salary according to age and qualifications. Write, giving full details and quoting H.3204 to Box 6861 c/o 191, Gresham House, E.C.2.

THE DISTILLERS COMPANY, LTD., are seeking Chemist or Chemical Engineer to carry out **WORK STUDY** investigations in the British Industrial Solvents factory at Hull. Applicants should be between 28-35 years of age and should have a degree in Chemistry or Chemical Engineering. At least three years' experience of plant operations is required and preferably some experience of work study, although this is not essential. Salary will depend on qualifications and experience. Apply **STAFF MANAGER, THE DISTILLERS CO., LTD., 21, ST JAMES'S SQUARE, LONDON, S.W.1.** Quote Ref. BIS.454.

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HEILBRON.—Offers are invited for 'Dictionary of Organic Compounds,' edited by Heilbron and Bunbury, 1943 edition, in three volumes, published by Eyre & Spottiswoode. Vol. I, new revised edition; Vols. II and III, reprinted with 1943 supplement. The volumes are unmarked, practically unused, and are of considerable value for reference purposes. **BOX No. C.A. 3292, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

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EXPORTS

LATIN AMERICA.—A $2,500 million export market must be approached in the buyer's own language. Specimen copies of the Spanish and Portuguese editions of **INDUSTRIA BRITANICA,** the leading British monthly trade journal covering these nineteen Republics, together with details of free translation service available on request to: **INDUSTRIA BRITANICA, BOUVERIE HOUSE, FLEET STREET, LONDON, E.C.4.**

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to advertisers in this issue

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