THE Chemical Age

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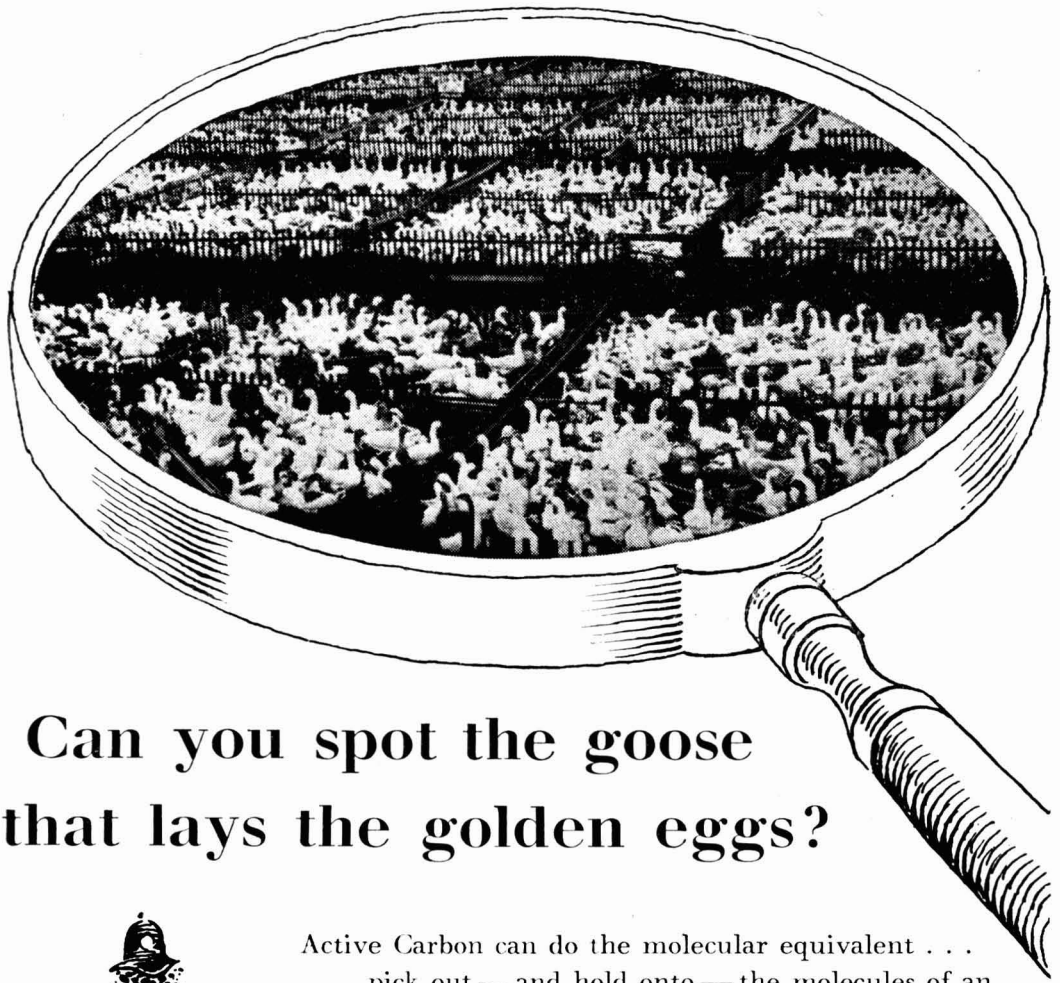
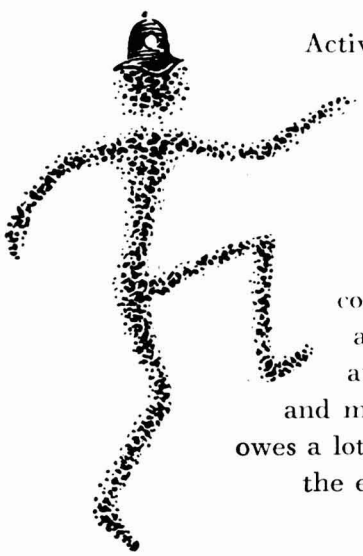


Can you spot the goose that lays the golden eggs?



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Chemicals on Seeds

OUTSIDE the realms of agriculture it is probably not realised that chemicals have been used in the treatment of seeds for many generations. The use of chemicals in foodstuffs and on crops during growth is still popularly regarded as a modern innovation, as something whose consequences did not have to be discussed by our great-grandfathers, an outlook revealed recently in the House of Commons (see THE CHEMICAL AGE, 1954, **71**, 984) when a number of M.P.s joined in a witch-hunt against agricultural chemicals.

Seed-borne diseases are among the most serious that are suffered by farm crops. They are fungal diseases, and for that reason can be carried from one season to another. The spores or threads of mycelium from the developed disease on the mature crop fall on the seed as it is collected; when the seed is sown later it is already infected. Cereal crops have been especially vulnerable to this type of disease, and as far back as farming records go it is clear that farmers were constantly plagued by the attacks of Bunt or Stinking Smut and Loose or Black Smut. Gingerbread was first made by bakers as a means of covering up the unpleasant odour and taste of bunt-affected wheat flour.

Yet bunt, if not its sister disease loose smut, had been given its chemical answer by the middle of the last century. The conquest of bunt began in 1750 when Tillett, Master of the Mint at Troyes, who farmed in a small way, proved by patient experiments that bunt attacked wheat when the seed sown had carried with it black dust from the bunt on the parent crop. Even then Tillet and others sought for a chemical treatment to kill the infection on seed, and the Abbé Tessier is said to have tried everything from brandy and creme de menthe downwards.

Early in the nineteenth century Prévost, whose microscope had unravelled more of the natural life history of the bunt fungus, noticed that the dust particles of the bunt grew rather less well in distilled water from a copper still; later when visiting a farmyard he saw an old copper pan used for making the lime and urine 'steeps' then favoured for pre-treating wheat seed. This double clue of copper was not missed, and Prévost quickly found that very dilute solutions of copper sulphate or copper acetate were able to prevent the germination of the bunt spores. This was the birth of the copper sulphate treatment and by 1856 it had become a common practice.

Loose smut, a different fungus which attacked wheat much less severely than bunt but attacked oats, barley, and maize far more, was not to be conquered by the same treatment, for it penetrated the seed itself. It was left to a Danish schoolmaster, Jensen, who ran an agricultural magazine, to develop the 'hot water' remedy which involved steeping the seeds in water between 127 and 137° F for a few minutes, a temperature which killed the spores but did not damage the germination power of the seed. This was first established in the 1880s and by 1890-95 the hot water treatment was being energetically practised in England and America. It was a diversion from chemical disease control

and it competed with the copper sulphate treatment, for the Danish hot water method could deal with both bunt and loose smut infections at the same time.

But these methods were laborious. They involved floor-space and they presented after-treatment problems of drying the seed. They were effective enough but they produced some damage to the seed as well, especially if the operations were carried out with too little precision, and with too much copper sulphate or over-hot water. In 1917 an idea from Australia was put into operation in America—coating seeds with carbonate of copper as a fine dry powder, By 1925 10 per cent of all the wheat seed sown in the US was dressed dry with copper carbonate—which prevented bunt but not loose smut.

At about this time German chemical research was actively developing organo-mercurial fungicides. Wet treatments with some of the early German organo-mercurials for oats and barley produced staggeringly successful results. Many more plants developed than could normally be expected from barley sowings. It was later realised that a much more serious seed-borne disease, leaf stripe of barley, was being prevented; a disease that had not been recognised as serious until the losses it caused were demonstrated by their prevention.

By 1930, despite their high cost, the organo-mercurials were established as dry dusts for seed treatment. Agrosan, I.C.I.'s well-known seed dressing, had emerged from research by 1933, an organo-mercurial with unsubstituted hydrocarbon groups in place of the phenolic groups, and diluted, because of its great fungicidal potency, with over 90 per cent of inert carrier. Less than one ounce of mercury, if combined with organic groups, could protect 10 acres of wheat from bunt or 10 acres of barley from leaf stripe. Loose smut was still without a chemical answer—and still is today—but its incidence causes much less loss than the other cereal fungal diseases.

New seed fungicides have been developed since the war. Thiram, or tetra-methyl-thiuram disulphide, has become a promising competitor of the organo-mercurials. If the disease spores are in the soil rather than on the seed, it is said to be better than the mercurials. At present in this country something approaching 75 per cent of the wheat seed sown is regularly dressed and organo-mercurials are almost exclusively used; but only about one third of the barley and oats seed sown is dressed.

An entirely modern advance in this field is the use of insecticides as seed dressings. This began with the discovery in the 1940s that BHC in its purer gamma-isomer form could be sufficiently retained on cereal seed to prevent wireworm attacks so long as the wireworm population did not exceed 600,000 per acre. Gamma-BHC on the seed could also control early attacks by carrot fly and flea-beetles. DDT, being less volatile, is not as effective; parathion is too dangerous to use in the operation of seed-dressing. Aldrin and diedrin do not yet seem as effective in this special field, though it is premature to dismiss them.

Since 1949, combined seed dressings of organo-mercurials and gamma-BHC have been increasingly used in seed treatment. Tests have shown that at a cost of about 12s. 6d. per acre (recently made lower by reductions in price) the yield of dual-dressed oats was 7 cwts. per acre higher than the yield of undressed oats, a return of more than £6 in crop value for the small investment in preventative treatment. Seed dressing is a chemical offering to the farmer that should be regarded more as an insurance than as a normal form of costs-outlay.

The much older fungicidal approach has been brought up to date in our own time by combining it with the insecticidal approach. The single operation of seed dressing, which need not be carried out by the farmer himself and is, indeed, preferably done by modern machinery at seed merchants' stores, now prevents some of the principal causes of crop losses, which have had to be endured for centuries. The amounts of chemical substance applied to seed are infinitely minute compared with the large amounts of diverse 'lyes' and copper compounds that were widely used over 100 years ago —grams per acre in the place of pounds per acre. Here is one notable field of chemical aid to food production that surely disarms even the wildest critics.

Notes & Comments

Faith of Industry

THE current issue of the *Esso Magazine* is a particularly striking publication; both in purpose and execution it might well be considered to represent the peak-point so far reached in industry's own house-organs. The major article is a firm statement of the principles by which a large modern industrial company should operate—'Where We Stand.' It is an examination of the beliefs upon which large-scale capitalistic enterprise is founded, and a statement of the obligations of such an enterprise to its shareholders, employees, and the community as a whole. All that is said in this article has been said before, but not always at the same time and rarely with as much simplicity and firmness. In a perplexed world of opposing ideas, testaments of faith are not to be ignored. Modern capitalistic growth has led to such massive economic polymers that they have become abstract and remotely mysterious to the man in the street—though ultimately it is the man in the street who is to decide between continuing private enterprise or expanding State ownership.

Frank and Forthright

HOWEVER, this impressive statement of faith is not the only plum to be found in the *Esso Magazine's* pie. There is a most informative article on the economics of oil production and distribution. 'About 60 per cent of the industry's capital resources go on the single task of getting petroleum out of the earth. No other industry has proportionately such a heavy initial burden.' The costs of drilling and pipelining and refining are all discussed. Another article deals with the oil industry's research work, and again this is an article owing a good deal of its vigour to the fact that it expresses a forthright faith. 'Research is a business within a business. It has one primary responsibility—that of understanding the future needs of the company which it serves. . .' It is increasingly believed today that industry should function with complete frankness, with all the old traditions of autocratic secrecy discarded. A number of companies now present their annual reports in a much more popular form and with quite a new comprehensibility. The *Esso Magazine* is following a similarly enlightened policy, and the issue to which we have drawn attention deserves wide study.

Plating with Ti

HOW far can the special virtues of titanium be utilised if titanium merely appears as a plated surface on other and less costly metals? The question cannot yet be answered for titanium plating is so far only in its laboratory teething stages. However, there is a strong case for developing electro-deposition processes for titanium. Although titanium is relatively expensive, scrap and sponge titanium are said to present a recovery problem to smaller producers and most consumers in the United States; for melting down, the obvious method of recovery, requires a smelting furnace operating in an atmosphere of inert gas. A process by which the waste titanium could be electroplated seems an easier approach to utilisation. Successful laboratory experiments in the US have been recently, though somewhat briefly, described (*Ind. Eng. Chem.*, 1954, **46**, [10], 13-15A). With titanium anodes and fused anhydrous magnesium chloride electrolyte, the continuous deposition of adherent and non-porous titanium plate has been achieved. Plate thickness has exceeded 0.05 mm. The operative temperature was about 900°C and an inert gas atmosphere was necessary. The plate showed high resistance to heat and mechanical stresses. These initial experiments have not thrown any light on the problem of plating other metals with titanium; interest seems more immediately focused upon plating commercial titanium sheet with titanium from scrap and waste sponge titanium. However, the research

organisation concerned appears to take the view that if titanium-upon-titanium electrodeposition can be successfully developed, deposition on other metals should not present greater difficulties. Indeed, a wide range of potential uses for titanium plated steels is suggested.

New Research Company

A NEW company—'Shell' Research Limited—is being incorporated to take over the research assets and activities in the UK of the Royal Dutch/Shell Group of oil companies formerly handled by the Shell Petroleum Company Limited. The new company will, therefore, assume control of Thornton Research Centre in Chester and Woodstock Agricultural Research Centre in Kent.

The work of 'Shell' Research Limited will be co-ordinated with other research activities carried out by the Royal Dutch/Shell Group of oil companies in the Netherlands and in the US. Mr. H. Bloemgarten will be chairman and Dr. C. G. Williams will be a director and general manager.

At the present time research on a wide range of fuel and lubricating oil products, on bitumen, and on chemicals derived from petroleum, is being carried out at Thornton. The staff numbers about 850, and it is probably the largest laboratory in the world for studying world-wide applicational problems of oil products.

In addition, there is at Woodstock an experimental farm with associated laboratories—now in the process of being extended—concerned with agricultural chemicals.

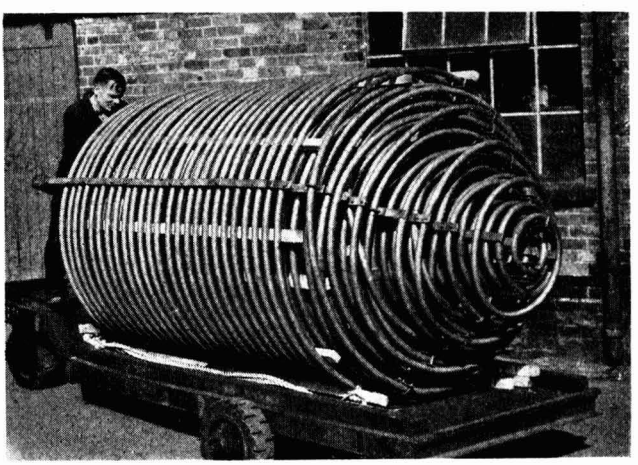
ABCM Chairman in US

SECRETARY of Interior Douglas McKay will be the dinner speaker at the 4th semi-annual meeting and mid-winter conference of the US Manufacturing Chemists' Association in New York on 23 November.

Mr. Walter J. Worboys, commercial director of Imperial Chemical Industries Ltd. and chairman of the Association of British Chemical Manufacturers, and William C. Foster, MCA president, will speak at the luncheon.

The conference will feature eight panel discussions on the topics of basic research, public relations, depreciation, scientific measurements of sales techniques, automation, tariff and international trade, the new tax law and corporate contributions. The moderators and panelists are outstanding authorities in their fields.

The two morning panels will be 'Basic Research, what it is and what we should do about it' and 'Public Relations at the Plant Community Level.' In the first part of the afternoon three panels will be held simultaneously. They are 'Depreciation as Related to Return on Investment,' 'The Application of Scientific Methods Measuring Sales Performance' and 'Application of Automation to the Chemical Industry.' These will be followed by three more panels, also held simultaneously, on 'The Tariff and International Trade,' 'The New Tax Law, its Application and Effect on the Chemical Industry' and 'The Responsibilities of Management with respect to Corporate Contributions.'



A stainless steel coil containing more than half a mile of tube, built by Accles & Pollock Ltd., Oldbury, for an overseas chemical installation. The unit weighs over two tons and consists of 10 coils, connected in pairs and built one inside the other

Sulphuric Acid Returns

Increasing Stocks Attributable to Decreasing Consumption

SUMMARY of monthly returns of sulphuric acid and oleum in the UK for the period 1 July-30 September 1954, issued by the National Sulphuric Acid Association Ltd., shows that stocks again increased, from 58,863 to 74,229 tons, despite a decrease in production. This was due to a further falling-off in consumption from 504,790 to 448,492 tons.

The accompanying tables are extracted from the summary. Figures do not include production of Government plants.

SULPHURIC ACID AND OLEUM
(Tons of 100% H_2SO_4)

Data referring only to acid makers' returns	Chamber and Tower only	Contact only	Chamber, Tower and Contact
Stock 1 July 1954 ..	26,861	42,002	68,863
Production	140,874	348,749	489,623
Receipts	22,021	27,418	49,439
Oleum feed	—	1,235	1,235
Adjustments	−81	−3	−84
Use	77,080	134,626	211,706
Despatches	85,106	238,035	323,141
Stock 30 Sept. 1954 ..	27,489	46,740	74,229
Total capacity represented	197,850	395,650	593,500
Percentage production	71.2%	88.1%	82.5%

RAW MATERIALS
(Tons)

Data referring only to acid makers' returns	Pyrites	Spent Oxide	Sulphur and H_2S	Zinc Concentrates	Anhydrite
Stock 1 July 1954	142,495	150,776	51,678	51,073	585
Receipts	151,666	75,709	76,033	59,221	42,546
Adjustments	+271	+161	+7	—	—
Use	116,965	68,528	62,221	50,549	42,581
Despatches*	1,733	18,193	686	—	—
Stock 30 September 1954	175,734	139,925	64,811	59,745	550

* Including uses for purposes other than sulphuric acid manufacture.

CONSUMPTION IN THE UNITED KINGDOM
(1 July–30 September 1954)

Trade Uses	Tons 100% H_2SO_4
Accumulators	1,914
Agricultural purposes	6,821
Bichromate and chromic acid	*3,925
Bromine	6,483
Clays (Fuller's earth, etc.)	2,912
Copper pickling	559
Dealers	3,285
Drugs and fine chemicals	6,904
Dyestuffs and intermediates	21,019
Explosives	7,400
Export	1,009
Glue, gelatine and size	154
Hydrochloric acid	14,806
Hydrofluoric acid	2,582
Iron pickling (including tin plate)	24,683
Leather	1,155
Lithopone	3,935
Metal extraction	1,054
Oil refining and petroleum products	14,227
Oils (vegetable)	3,003
Paper, etc.	1,623
Phosphates (industrial)	229
Plastics, not otherwise classified	6,208
Rayon and transparent paper	64,927
Sewage	2,834
Soap, glycerine and detergents	13,657
Sugar refining	144
Sulphate of ammonia	67,531
Sulphates of copper, nickel, etc.	5,286
Sulphate of magnesium	1,082
Superphosphates	91,052
Tar and benzole	*5,439
Textile uses	4,788
Titanium oxide	53,147
Unclassified	42,715
Total	488,492

* There have been adjustments in the allocations to these two items. The present figures are not strictly comparable with those in previous quarters.

Cadman Memorial Lecture

'WINNING Petroleum' is the title of the 4th Cadman Memorial Lecture, which Mr. C. A. P. Southwell, C.B.E., M.C., managing director of the Kuwait Oil Company, is to deliver to the Institute of Petroleum at the Royal Institution, London, on 17 November.

Mr. Southwell will discuss the scientific developments on which the production of large oil reservoirs is based, and the problems associated with the world supply of the raw material required by the petroleum industry. The Kuwait Oil Company—a 'fifty-fifty' joint interest of Anglo-Iranian and the Gulf Oil Corporation of the US—is one of the largest producers of crude oil in the Middle East.

After his lecture Mr. Southwell will be presented with the Cadman Memorial Medal, founded to commemorate the pioneer work in the petroleum industry of the late Lord Cadman, a former chairman of Anglo-Iranian. It is awarded in recognition of outstanding contributions to the petroleum industry. Sir William Fraser, Anglo-Iranian's present chairman, was the first recipient of the Cadman Memorial Medal in 1946.

Man-made Fibres

Prospects for Exports Confusing

SPEAKING at the annual general meeting of the British Man-made Fibres Federation in London on 3 November, the chairman, Sir William Palmer, K.B.E., C.B., said: 'It is now about three years since signs of the textile depression became obvious and about two years since there was confidence that the depression was clearing away. During the first of these two years the man-made fibres industry was recovering and during the second it has on the whole continued at a steady and satisfactory rate.

'There seems little or no reason to expect any important change in the near future. The home market for clothing is buoyant, particularly in the section of most interest to our industry, women's and children's clothing. Even in the depressing summer the retail sales were by value substantially greater than in any recent year and retail stocks, though increasing, were not unduly large.'

Sir William said that another satisfactory feature was the continued expansion in production of staple of viscose, acetate and nylon. 'Its use is increasing not only in typical Lancashire fabrics but also in those generally associated with the woollen and worsted industry, the linen industry and in hosiery and carpets,' he went on. 'Mention should also be made of the rapidly increasing use of rayon for industrial purposes, including tyre fabrics.'

Constant Attention Demanded

Exports had recently taken some 25 per cent of the industry's production and the prospects were confusing, he said. Total UK exports for the first nine months of the year were in value 10 per cent higher than in the same period of last year, but there was a marked change in the proportion going to different markets. Australia and New Zealand took much more, but many other Commonwealth countries and some European countries took much less. Although there were well-known reasons for this, the change indicated that the export market was less stable than the home market and would demand constant attention.

'During the year the title of the Federation was changed to the British Man-made Fibres Federation,' Sir William continued. (It was previously the British Rayon and Synthetic Fibres Federation.) 'Probably the chief merit of this title is that it is so wide and all-embracing that the necessity for a further change seems unlikely. Like many new names it seemed clumsy at first, but already there are signs that use is taking off its rough edges. A short, expressive and acceptable name that could be used in commerce over the counters for all man-made fibres would be admirable, but neither we nor any other country is any nearer to finding it. In the meantime we must continue to use a great many names to distinguish the varied fibres embraced in the main title.'

New Foxboro-Yoxall Motor

FOXBORO-Yoxall Ltd. announce the introduction of a new motor, the Stabilflo 6D, which has a number of important new design features. These modifications have resulted in the production of a motor which, it is claimed, gives greater power for the same size, has greater sensitivity, and shows a marked decrease in hysteresis. The most important innovation is the new diaphragm, which has been completely re-designed and is now a corrugated moulding in a synthetic material which gives twice the strength of rubber for only half the previous thickness.

The diameter of the diaphragm has not been altered, but the design of the contours of the moulding enables a much greater effective surface to be presented to the pressure so that more power is now available, while the much thinner synthetic diaphragm is infinitely more sensitive. A further important gain due to the moulded design is that the diaphragm is no longer held in tension at any point in the stroke, thus removing another possible source of hysteresis.

The choice of a synthetic diaphragm was also influenced by the fact that the synthetic material is resistant to a much wider range of fluids than natural rubber. It has a much longer shelf life than natural rubber, so that spare diaphragms may be stored indefinitely without deterioration. The spring has been redesigned in a new alloy and with slightly increased dimensions and now has greater flexibility and a longer life, and in operation has greater linearity and reduced hysteresis. Lastly, a redesigned alloy motor housing of greater rigidity, but less weight, contributes to ease of handling in fitting and maintenance work.

Nobel Prize for Chemistry 1954

'IT is not possible to obtain a sound knowledge of chemistry simply by learning theoretical chemistry. Even if a student were to learn all the chemical theory that is now known he still would not have a knowledge of the science, because a major part of chemistry . . . has not yet been well incorporated into chemical theory.' When he wrote these words—in the preface to 'General Chemistry' (W. H. Freeman & Co. 1947)—Linus Pauling must have paused in thought when he came to the phrase 'not yet.' Few people have done as much as this year's winner of the Nobel Prize for chemistry to inter-relate the theoretical and practical aspects of the science; fewer still have contrived to connect branches of chemical knowledge so widely separated as the mathematical theory of molecular structure and those physiological essentials, the proteins.

The deceptively simple title of Pauling's best-known book—'The Nature of the Chemical Bond'—has been the subject of his work for the past 30 years, and it is this fundamental nature of his study which has been responsible for its importance in all branches of chemistry. Particularly valuable, however, has been his own personal interest in these many branches; listed among his publications in 'Who's Who' are 'numerous scientific articles in fields of chemistry, physics and biology, including structure of crystals, quantum mechanics, nature of the chemical bond, structure of gas molecules, structure of antibodies and nature of serological reactions, etc.' And that 'etc.' includes, among others, rocket fuels and oxygen indicators for submarines.

Linus Carl Pauling was born in Portland, Oregon, on 28 February 1901, received his B.S. from Oregon State College in 1922, and his Ph.D. at California Institute of Technology in 1925. He has been a member of the staff at CalTech ever since, being appointed assistant professor in 1927, professor in 1931, and chairman of the division of chemistry and chemical engineering since 1937. He was a close associate of the great G. N. Lewis, whose original concept of the shared electron-pair bond he has described as the beginning of modern theoretical chemistry, and it was fitting that in 1951 he was the first recipient of the Gilbert Newton Lewis medal, established by the California section of the ACS.

The Lewis Medal is but one of the many honours bestowed on Pauling. He has been invested with honorary degrees by Oregon State College, University of Chicago, Princeton, Yale, Cambridge, London, Oxford, Tampa, Paris, Toulouse and New Brunswick; he has been awarded the ACS award in pure chemistry (1931), the William H. Nichols medal (1941), the J. Willard Gibbs medal (1946), the Theodore William Richards medal (1947), the Davy medal of the Royal Society (1947), and the Presidential Medal for Merit (1948); and he holds membership in all the leading American societies and is an honorary member of the major scientific societies in Britain, France, Switzerland, Italy, Belgium, Norway and India.

Sure indication of his eminence as a scientist in America was the doubt cast on his integrity in 1952, when he was at first refused a passport to visit Britain and France for scientific meetings, and then, after almost an international outcry, granted limited permission for a short period. He was just in time to arrive unexpectedly in Paris for the 2nd International Congress of Biochemistry, and the spontaneous welcome accorded him on his arrival there was proof of the esteem in which he is generally held.

Pauling is a champion of the valence-bond theories of chemical structure, which have recently suffered a slight eclipse in this country, where the exponents of the molecular-orbital treatment are the more vociferous. Either of these theories, however, is but one way of looking at the same actuality, and the practical triumphs of the valence-bond treatment have undoubtedly been greater. We salute unreservedly as a great chemist Linus Pauling, 1954 winner of the Nobel Prize for chemistry.

Non-Ferrous Metals

Europe's Improved Position

THE development of both the production and consumption of non-ferrous metals in the western world during 1953 and in the current year has been uneven, not only in the various countries but as far as individual metals themselves are concerned. While production and consumption of nearly all metals in the US in 1953 have shown an increase over the previous year, the consumption in Europe of all metals diminished, although production was stepped up. In the current year there has been a complete reversal of the position. European consumption has risen, while in America demand has decreased.

It has been established without doubt that, in the case of practically all metals, production in 1953 and the current year has exceeded demand, and that surpluses, which have decreased during 1954, have for the most part been absorbed into the strategic stockpile of the US.

A study of the index of world prices of industrial raw materials shows that these fell in 1953 and have not yet regained the level reached in preceding years. For the various groups of commodities, and particularly for non-ferrous metals, fluctuations are still to be observed.

Apart from developments of supply and demand, political trends have also played their part in affecting metal prices during the period under review, although to a considerably lesser extent than in previous years. The price levels for lead, copper and zinc were particularly influenced by the wavering attitude of the US Government in their stockpile policy.

Full details of production, consumption, imports, exports and prices for aluminium, lead, copper, zinc, tin, cadmium, magnesium, nickel, mercury and silver, by country and by continent, for the years 1938 and 1946-53, are published in 'Metal Statistics.' This is the 42nd issue, published by Metallgesellschaft Aktiengesellschaft, Frankurt am Main.

Olin Mathieson Plants

OLIN Mathieson Chemical Corporation state that construction will begin early in 1955 on a new cellophane plant at Olin, Indiana. Construction will be completed about the same time on a plant at East Alton, Ill., for the fabrication of heat exchangers of aluminium and other non-ferrous metals by a new process developed in the company's research laboratories.

Several new products were introduced by Olin Mathieson during the past quarter: a new Winchester semi-automatic shotgun—Model 50—featuring a non-recoiling barrel; two new cigarette filters, being used in two popular brands of cigarettes; and several new drugs by the Squibb division, including Mycostatin, the first antifungal antibiotic, and Steclin (Squibb tetracycline hydrochloride), the fastest-growing broad spectrum antibiotic.

ABCM Safety Conference

THE Association of British Chemical Manufacturers' safety conference, held at Harrogate from 5 to 7 November included visits to I.C.I. plants at Billingham and Wilton, where the accident rate has been considerably reduced.

In an introductory address to the 400-odd members who attended, Dr. I. J. Faulkner of I.C.I. Billingham Division, said it was becoming increasingly obvious that the emphasis had to move from even safer devices to safer ways of working, from an 'it can't happen to me' attitude of mind to an 'it is not going to happen to me' attitude.

Dr. C. Cockram of Wilton Works also stressed that 'the attitude of the individual is still a most important factor.' Safe working, he said, was only achieved when every individual was familiar with the plant on which he worked and had learned the safe way of doing a job and did it naturally in a safe way. A lot depended on team work between technical staff, supervisors and safety officers.

At the dinner given by I.C.I. to delegates on the first evening of the conference, Mr. W. J. Worboys, chairman of the ABCM, said: 'Safety is something you have to think about and to which you must have the right attitude of mind for every one of the 365 days in the year. We require not only a skilful, vigorous and determined management but the full co-operation of the workers.'

A fuller report and pictures of the conference will appear in THE CHEMICAL AGE next week.

Recent Research on Pressure Vessels*

Work in Hand at BWRA

THE vast majority of pressure vessels and pressure pipe lines are made of mild steel. Other materials are used for special purposes, such as stainless steel, copper alloys and even glass lined pressure vessels. However, in steam generation mild steel is paramount and the following remarks will apply specifically to that material. Most of the comments on stress and design can, however, be applied in principle to other materials.

The general range of carbon content within which the term 'mild steel' is applied is from 0.05 per cent to about 0.35 per cent. Other elements are also present, some of them being intentional additions—such as manganese, silicon, boron, aluminium, and others being unavoidable impurities such as sulphur and phosphorus. The typical composition of a mild steel varies considerably with the process used to make it.

A Source of Weakness

If large quantities of sulphur or phosphorus are present, they combine with the iron to form iron sulphide or iron phosphide; neither of these materials is soluble in the solid iron, and so they appear at the boundaries between the grains. Impurities along the grain boundaries are a grave source of weakness, since they reduce the natural cohesion between one grain and its neighbour, and especially in the case of sulphur, where the compound has a low melting point, the material will be extremely brittle at elevated temperatures.

There are various forms of fracture which can occur with mild steel. In the first place, if we simply put too great a load on the specimen, it will break by a simple tensile fracture. Secondly, the material will fail if a load less than that required to produce fracture after one application is applied and released repeatedly. This sort of failure is called a 'fatigue' failure.

Thirdly, we have failures of the type called 'stress corrosion' failures. These are really cracks caused by corrosive fluids or atmospheres which are enhanced by the fact that the material is in a state of tensile stress. These failures run generally along the boundaries of the grains, and very rarely actually cut across one. A very good example of a piece of pipe bend which was subjected to stress and a corrosive atmosphere at the same time is shown in Fig. 1. It can be seen that the cracks on the inner surface are confined to two areas of the pipe, and these two areas are the most highly stressed ones in a bend such as this one was.

Fourthly, there is the corrosive fatigue failure, which, as its name implies, arises from the combination of fatigue conditions and a corrosive atmosphere. These failures generally pass across the grain without following the grain boundaries. Finally, there is what is known as 'brittle fracture' but this is outside the scope of this discussion.

Now let us return to the first type of failure, that due to simple overloading of the material. With mild steel this is always preceded by yield, when a very large extension occurs for a fairly small increase of load. Because the material yields before it fails in this way there is ample warning of an impeding failure, since there is usually something to see some time before a crack actually appears. Furthermore, yield will obviously occur first at the most highly

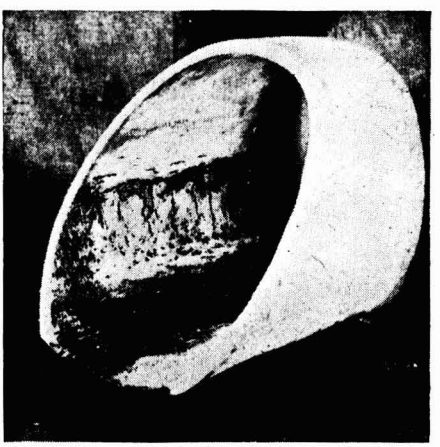


Fig. 1

* From a lecture delivered to the Kent Branch of the Incorporated Plant Engineers on 20 October, by Mr. P. H. R. Lane of the British Welding Research Association.

stressed part and the yielded material does not carry any more load until the surrounding material is loaded to the yield point: thus, it is the average stress occurring in a specimen which is important rather than any high local concentration of stress. It is fairly easy, therefore, to design a conventional structure so that it will not fail in this manner, since a knowledge of the average stresses only is required, and generally speaking the stress concentrations which occur at discontinuities can be ignored.

Catastrophic Failures

The other four types of failure are characterised by the fact that they are not preceded by yield, and catastrophies can easily occur since there is no warning of a failure beforehand. In these types, since yield does not occur, the average stress is not necessarily the dominant one, but highly localised concentrations of stress can cause failure in a structure in which the average stress is not nearly high enough to bring it about. It is in these conditions that detailed stress analysis both by theory and experiment is of first rate importance.

Failures produced by fatigue are easily recognisable as such. In most fatigue failures in plant in service, as distinct from laboratory test specimens, a series of arcs of circles can be seen which represent stages at which the load was taken off from the specimen, and therefore the progress of the crack arrested. These circles will be concentric and the origin of the crack can easily be found by looking towards what would be the centre of the circles.

It can be seen, therefore, that while a simple tensile failure of a vessel or pipe will not occur until the average stress at the cross-section exceeds the maximum stress which the material can withstand, a fatigue or stress corrosion failure can begin in a small particle of the structure which might be subjected to a high stress while the material all around it only experiences a very low stress. Once the crack has started, its apex represents an extremely sharp notch, and this gives rise to stress concentrations of a very high order, and so the crack carries before it an area stressed sufficiently highly to be subject to further fatigue or stress corrosion cracking.

Welding, as a method of joining materials, has followed in the path of riveting or the use of nuts and bolts, or, going back to wooden framed buildings, the use of oak pegs. In most cases where one of these methods is used for making the join, the joint is not nearly as strong as the parent material, and for this reason it is the joint itself which controls the maximum loads which can be carried by the structure.

On the other hand, a weld can be made virtually as strong as the material to be welded, and so the limitation on the loading of a structure imposed by a joint made in other ways ceases to exist. Under these conditions, the structure can be loaded to a considerably greater degree, and details of design, which hitherto have not been of much importance, become of prime importance. Furthermore, in a well-made weld, overloading does not produce anything of the nature of leakage, and the first notification that one has that something is going wrong is usually catastrophic.

It is for these reasons that the British Welding Research Association, which is primarily concerned in the difficulties of welding, interests itself to a large extent in problems of design which have been brought to the fore by the application of welding instead of riveting or bolting.

Strain Measurement

I propose briefly to describe one or two methods of measuring strains. Generally, with mild steel, the strains in which we are interested do not exceed 0.1 per cent, which is one thou. per inch. This is the maximum which we want to measure, the minimum being often of the order of 1/100 thou. per inch.

If the surface of a specimen is covered with ordinary plumber's resin, applied in a very thin coat, and the specimen is then loaded, it will be found that when the steel yields the resin is not able to extend to the same amount as the steel, and therefore cracks. This gives a fairly simple method of estimating when yield first occurs and what part of the specimen yields first. Since the resin cracks at right-angles to the load producing the crack, one also tells roughly in what direction the major stress lies.

Ordinary plumber's resin can only be used in this way when the specimen is loaded so that part of it passes the yield point. It is possible, however, to obtain lacquers which are so brittle that they crack at strains considerably less than those occurring at the yield in steel, and it is thus

possible to estimate the location and direction of the maximum tensile stress without subjecting the specimen to any permanent deformation.

Some manufacturers actually claim that it is possible to measure the stresses by first calibrating the brittle lacquer on a simple cantilever—the process being to apply a coat of lacquer to the cantilever, deflect this by a known amount, and then inspect the specimen to see where the lacquer first cracked. It is, of course, easily possible to calculate the stress in the outermost fibre of a uniform cantilever, and thus the stress at which that particular lacquer commences to crack.

One great disadvantage of the brittle lacquer technique is that the lacquer will not react to comprehensive strains. If, therefore, one has a specimen in which the dominant stresses are compressive, or in which there are compressive and tensile stresses of roughly equal magnitude, the estimate obtained from brittle lacquer is even rougher than usual. The only way of estimating compressive strains by this technique is to apply the lacquer and allow it to set while the specimen is under load, and then observe the formation of cracks on releasing the load.

The photoelastic analysis technique is based on the fact that certain materials which are normally transparent interfere with the passage of light through themselves when they are strained. Glass is one of these materials, though it is not often used in photoelastic studies owing to its poor working qualities. Other materials are Araldite casting resin and other similar synthetic resins. The interference with the passage of light is indicated by the appearance of a series of black or rainbow-coloured lines, depending on the apparatus used. The appearance of each successive line as a model made out of the resin is loaded indicates a certain increase in strain. Hence where the lines are closely packed together the strain is increasing rapidly, and a stress concentration is indicated.

Instrumental Methods

The third method of stress analysis is the use of refined measuring instruments by which the actual alterations in length of a certain small portion of the specimen can be measured. There are many different sorts of instruments which can be used for this purpose. Some are purely mechanical, some optical. Pneumatic, acoustic and electrical gauges are also used. The types that are most generally useful in investigations into boiler drums, pipe lines and the like, are the electrical, mechanical and pneumatic gauges.

Such a gauge needs to measure small changes in length. Often the strain gradient is fairly steep, and so as to get a reasonably accurate measurement it is necessary to measure the strain in a very small piece of the specimen. We use gauge lengths down to 2 mm., which is just under a tenth of an inch, and I am told that the Germans have a gauge which works on a base length of 1 mm.

Must be Robust

Working on these short gauge lengths, the actual amount of movement which we have to measure is of the order of 1/1,000,000 of an inch. The instruments, therefore, need to have a very large magnifying power. Furthermore, they must be equally sensitive to increases and decreases in the gauge length. They must be relatively robust, since one often has to climb on top and underneath boiler drums with them, and work in most uncomfortable situations. Their gauge length must be reasonably well defined.

I should like to mention two particular instruments—one pneumatic and one mechanical—which are rather interesting. The pneumatic gauge is only 30 mm. high; the gauge length is 2 mm., and the magnification between movements of the knife edges and movements on the water column on which the final readings are taken is one of the order of 200,000 times. The principle on which this gauge works is the Solex air gauging principle, which is much used for measuring car cylinder bores and the like. The basic idea is to pass air through a fixed jet and then a variable one. As the size of the variable jet alters, so does the pressure in the line connecting the two jets. This pressure is indicated on a simple water gauge, and one has a very sensitive method of measuring small changes in length.

In this particular case, the extensometer itself constitutes the variable jet. It consists of two legs hinged together, each carrying one knife edge at its base; one of these legs carries a small jet through which the air flows, and to the other is fixed a finely ground plate. As the gauge length alters so does the distance between the jet and the

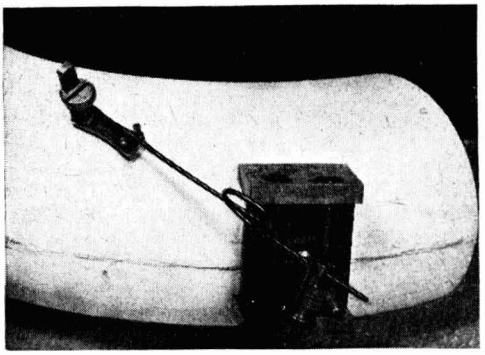


Fig. 2

plate. The air flow through the jet alters correspondingly.

The second instrument is a mechanical one, working on a very interesting and a very simple means of magnification. The complete gauge is shown in Fig. 2. In this instrument, one knife edge is rigidly attached to the body of the instrument. The other knife edge is attached via a very flexible spring to the body, and can therefore move relative to it. It carries a screw which bears on the end of a small phosphor bronze spring when the leg moves. This spring translates the lateral motion of the leg into a vertical movement, which is applied to a thin phosphor bronze strip, running the length of the gauge. This strip is twisted. Starting from the centre one half is twisted righthanded and the other half lefthanded. With this arrangement, when the complete strip is forced to extend, the central portion rotates.

With this instrument a magnification of about 10,000 times is obtained. Among its advantages are the fact that it is extremely light in weight, it is compact, fairly robust and easily attached to awkward parts of a specimen.

I have left until last a description of the

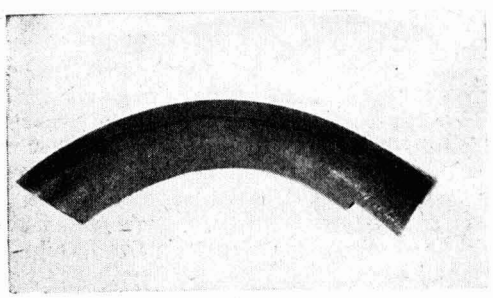


Fig. 3

type of gauge which we use most often—that is, the electrical resistance strain gauge. This is the simplest piece of equipment for measuring minute changes of length which can ever be devised. It consists essentially of a piece of wire stuck on to the specimen. When the specimen expands, the wire is forced to follow. It gets longer, and at the same time its diameter decreases slightly, and so its resistance increases. With the aid of a Wheatstone bridge or some similar piece of equipment, one measures these resistance changes and they give a very accurate measure of the strain in the specimen.

With most cylindrical bodies subjected to internal pressure it is essential to measure the strains on both the inside and the outside of the specimen, and the electrical strain gauge is virtually the only way of measuring strains on the inside. There are other electrical methods of measuring strains, but none of them is so simple as the electrical resistance strain gauge, which is paramount for this type of work.

Recent Research

I propose now to describe one or two investigations which have been carried out in our laboratories during the last seven years, and which may be aptly described as recent research.

During the war, it became impossible, or nearly so, to obtain seamless pipe bends in this country since they were all manufactured in America, and import was difficult. Certain firms over here began making welded pipe bends. These were made by taking a disc of steel with a hole punched in the middle, and forming this by pressing into something like half a motor tyre. Two of these halves were then welded together along the circumferential seams, and the complete ring was then cut into sections depending upon what angle of bend was required. There was some question as to whether bends made in this way were as strong as the seamless ones, and the Association commenced an investigation on this point.

Very soon it was found that there was not sufficiently accurate information on the seamless bends available to permit a simple comparison between the two types. For this reason a comprehensive investigation into the stresses existing in pipe bends was commenced. Bends were tested in two ways, external loading—to simulate what happens

when the adjoining pipe line expands or contracts due to temperature changes—and internal pressure. The first of these methods was found to produce the more severe stresses.

Occasionally service failures such as are shown in Fig. 3 had been noticed. These take the form of longitudinal cracks in the bend, the crack being located where, by a comparison with a curved bar, it was thought that the stresses were low. The investigation aimed at solving this problem also.

When loads are applied to such a pipe bend, not only does its radius of curvature alter, but the central cross-section also deforms, tending to become elliptical instead of the initial circular shape. This change of shape gives rise to bending stresses which will be compressive on the outside and tensile in the inside at this point.

The results obtained from the experiments were compared with those forecast by theory, and found to be in good agreement. Fig. 4 shows that the maximum stress is a tensile one in the hoop direction on the inside of the pipe, located approximately where the neutral axis would be presumed to exist in a curved bar. This explains why failures develop at this point as shown in Fig. 3. The large variation in stress around the cross-section also explains why the stress corrosion cracks in Fig. 1 were confined to two zones. These correspond, of course, to these two points where the stress is a maximum.

New Design Proposed

The agreement between experiment and theory justifies the proposal that this particular theory should be used as a basis for a new design method. The method of design in general use at the present has utilised two factors, one for the longitudinal stress and one for the hoop stress. The maximum values of these two stresses do not occur at the same point in the bend, and so by taking these maxima the bend is designed rather more conservatively than necessary.

Another component in a piping system to which we have given and are giving some attention is the branch connection. Basically one can make a right-angled branch connection in a welded pipe line in one of two ways: by cutting a hole in the main pipe and welding on or welding in the branch pipe, or by using a pre-formed welding tee. This latter is manufactured by taking a length of straight pipe, which has a thickened wall

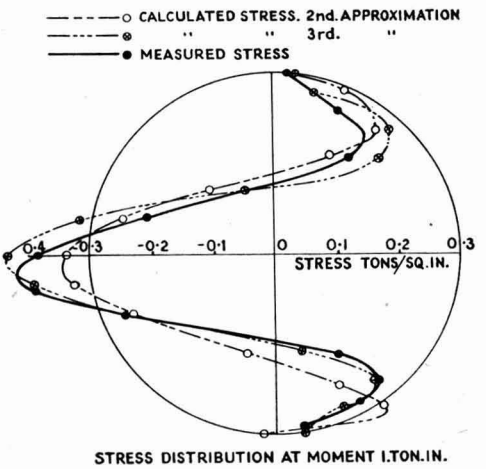


Fig. 4

on one side, heating it up to forging temperature, and then forcing a shaped steel plug through the thickened wall. By the use of successively larger steel plugs, one eventually arrives at an equal branch tee.

We have been measuring the stresses on both surfaces of welding tees and welded branch connections. So far we have looked at four different sorts of branch connections —an equal branch unreinforced specimen, another unreinforced specimen in which a 10 in. branch was attached to a 12 in. main, an equal branch specimen reinforced with a conventional collar, and finally what is called a 'tri-form' reinforcement. This consists of three horseshoes encircling the branch and welded to it and to each other at the intersection of the axes of branch and main.

Each of the specimens was subjected to four different tests simulating the sorts of loads which might occur in service. The tests were: firstly, axial loading on the branch pipe; secondly, bending the branch pipe in the plane of the specimen; thirdly, applying torsion loading to the branch pipe, and finally, subjecting the specimens to internal pressure. In practice, of course, a branch connection would be subjected to some combination of these methods of loading. Provided, however, the specimen remains elastic, for any particular service conditions one can add together the stresses arising from the different sorts of loading taken separately.

The experiments on various sorts of reinforcement are still proceeding, and I cannot

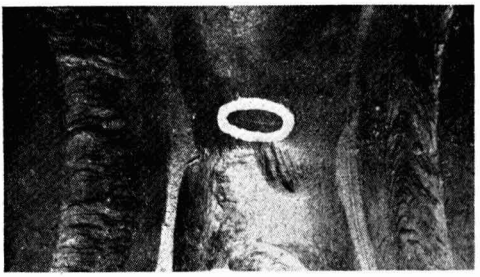


Fig. 5

tell you any final results. However, we have found that in all the types we have tested so far, the maximum stress occurs at the crotch, and that the most severe forms of loading are internal pressure and axial loads on the branch. The location of the maximum stress and the fact that these two forms of loading give rise to rather similar stress patterns, lends support to a statement made some time ago by Dr. Blair, who carried out a large number of experiments on the bursting of branch connections. He suggested that the main function of the reinforcement was to hold in the part of the branch around the intersection of the centre lines. There is a portion here which is virtually a flat plate, and tends to move radially outwards. This causes bending of the cross-section, and hence large stresses on one of the surfaces. If one can restrain this part of the specimen, the bending stresses would be very much reduced. That is the idea behind the triform reinforcement.

We have carried out one fatigue test on a welding tee, and Figs. 5 and 6 illustrate very well the difference between the fatigue test and a simple over-pressure test. The first shows the failure which developed in the specimen, after 590,000 cycles at a maximum pressure of 1,500 psi. The fracture takes the form of a small crack in the crotch, where stress analysis experiments had found the maximum stresses. The direction of the crack is perpendicular to the direction of the maximum stress.

Fig. 6 shows the results of a bursting test, in which the mode of failure is very different. The pressure at which failure occurred was 9,500 psi., and the top of the tee was blown completely off. From a study of the fractured surface we concluded that the crack started at this point on the side of the specimen. Although the stresses measured here while the tee was elastic were fairly small, they were fairly uniform through the cross-section. Therefore, the average stress across the wall at this point was very much greater than the average stress at the crotch, and for this reason failure started here rather than at the crotch.

A problem which has a certain similarity is that of the reinforcement of branch connections in pressure vessels. The conditions are slightly different from those existing in pipe line branch connections in that while a pipe line branch is always of a similar size to the main and very often equal in size, branches in pressure vessels are invariably of rather smaller diameter than the vessels themselves. This fact makes the calculation of the stresses around the hole rather easier than it is for the pipe branch connection, since the conditions approximate fairly closely to those of a branch in a flat plate; and the problem of a stiffened hole in a flat plate is a much easier task for the mathematicians than is the problem of a hole in a curved plate.

We are engaged on an investigation which will not be completed for some time. We have explored the stresses in and around unreinforced branches in a scale model of a boiler drum, and we are now determining the stresses in and around reinforced branches. Some idea of the magnitude of the task each time can be gained from the fact that on the first vessel, which has three unreinforced branches, we attached over 400 strain gauges. Something approaching half of these were inside the vessel and every one had to be made water tight, since it was not considered practical to use anything but water as the pressure medium.

The results show that the maximum stresses occur in a corresponding place to the location of the maxima in the pipe

Fig. 6

branch connections. The three branches attached to the vessel each had the same internal diameter, but varied in thickness. The idea of this was to discover how much reinforcement was supplied by the material of the branch itself.

Fig. 7 shows the essentials of the results. The three points represent the maximum stresses shown by the strain gauges, and the unbroken line represents an approximate calculation of the maximum stresses which should have been found.

These calculations were made by assuming that the junction between branch and shell was broken, and then the movements of each of the two portions separately could be worked out fairly easily. Since, of course, the two could not move separately, suitable forces and moments were then introduced to bring the two back together, and from these forces and moments the stresses could be calculated. It was found from an inspection of the experimental results that the maximum stresses were always in the same place relative to the axis of the shell, and the mathematical operation was therefore only carried out for this one point.

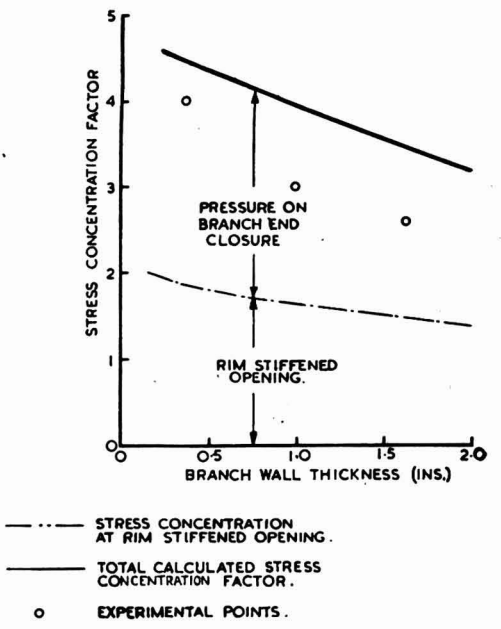


Fig. 7

Reinforced Branches

Having measured and made some approximate calculations of the stresses associated with unreinforced branches, we are now investigating reinforced ones. We are studying six different reinforced branches. In five of these the cross-sectional area of the reinforcement is the same, but in each case it has been differently disposed.

The first has a broad flat plate. This probably would never be met with in practice, but in research work one should examine all the possible methods of doing a job as well as those which every day practice says are most likely. The second type of reinforcement is a fairly square one, in which the height of the branch is similar to the width of the collar.

The third type of reinforcement has a rather tall narrow collar extending a relatively long way up the branch, this being the other extreme. The fourth method consists of a block of similar proportions to the second one, but placed on the inside of the vessel. In the fifth method, we have a similar block cut in half as it were, and applied partly to the outside and partly to the inside of the vessel.

The sixth method consists merely of making the branch penetrate completely through the shell and protrude on the inside. We felt we had to include this, since we were examining reinforcing collars attached to the inside of the shell. A comparison of such collars with a branch which ended flush on the inside of the shell would be rather unfavourable, since the mere fact that the branch extends on both sides of the shell improves the stress conditions very greatly.

The results obtained from these strain measurements are related almost entirely to the surface shape of the various types of branch connection that are studied. There is another problem which cannot be investigated by the use of extensometers or other types of strain gauge, but which is of some considerable importance to the pressure vessel industry. This problem is to determine whether or not it is necessary to have complete interpenetration between the welds connecting the branch to the shell on the inside and the outside.

Most of the Standard Codes for boiler drums require this interpenetration, but a considerable saving in time and material could be obtained by making two independent welds. If this latter design gives rise to more serious stresses than the one required at present they would not be shown up by

strain gauges applied on either of the surfaces. The increased stresses would be in the heart of the connection, and so the method which is being employed to investigate this matter is fatigue testing.

Small models of boiler drums are being made, each one having a branch attached to it. The vessels are being subjected to pulsations of pressure from a minimum of about 100 psi. to a maximum of 2,000 psi. This maximum pressure represents approximately one and a half times the working pressure calculated according to British Standard 806.

We are also fatigue testing seamless pipe bends. With these we are subjecting them not only to pulsating pressure, but also to alternating bending tests. We are pleased that all the specimens which have failed have done so by cracking at right-angles to the maximum stresses found in our strain gauge experiments, and forecast by the theory.

Plastics Tariffs Sought

CANADA'S young raw plastics industry has appealed for tariff protection against United States competitors, prompting similar bids by other industries using the plastic raw material. Canadian Industries (1954) Ltd., with a $15,000,000 polyethylene resin plant established at Edmonton, told the Tariff Board it requires a tariff of 20 per cent as protection if the newly-formed Canadian industry is to survive.

Polyethylene resin comes into Canada duty-free and most Canadian factories get their supplies from the US, which was some years ahead of Canada in getting the fast-growing industry started.

Its suggested tariff of eight cents a pound set off a chain of other requests. The plastic pipe manufacturers told the board that a tariff on polyethylene resins would increase their supply and production costs, so there should be an equivalent tariff imposed against imports of polyethylene pipe

The DuPont Company of Canada Ltd. said that any increase in the cost of polyethylene resin would increase the cost of Canadian-produced plastic film, such as is used in food and vegetable packaging. Meanwhile, Plax Canada Ltd. of Toronto, which makes plastic bottles, said CIL cannot turn out a synthetic plastic suitable for bottle-making and that Plax will have to continue importing from the US.

More Special Steels

Fox's Start Europe's Largest Arc Furnacs

EXACTLY 100 years after they laid down what is believed to be the first cold rolling mill in the world, Samuel Fox and Company Limited of Stocksbridge, near Sheffield (associated with The United Steel Companies Limited), have commissioned the largest electric arc furnace in Western Europe.

The switching-on ceremony, which was performed on 3 November by Mr. Gerald Steel, the managing director of United Steels, took place in the presence of senior officials, managers and workmen of the company. Mr. Steel was presented with a silver running fox, as a memento of the occasion.

Some months ago Samuel Fox and Company announced that they had successfully entered a market exclusively held by foreign manufacturers for many years and had produced all-British watch springs. They are now being made at a rate of 42,000 a week, with a growing demand.

The installation of this new arc furnace therefore has been necessary in order to keep pace with the extreme pressure put upon the works by Fox's customers. The new furnace, which is expected to add 1,200 ingot tons per week of special steels to the output of the branch, will boost up the output to a potential of 300,000 tons per annum.

Top Loading

The furnace has an inside diameter of 19 ft., backed with an 18 in. thick refractory lining and the roof, which is 14 in. thick, weighs 30 tons. Charging is carried out by lifting the roof and swinging it clear of the body, by hydraulic means. The charge of scrap to be melted, all of which has been carefully selected and weighed, is then lifted over the furnace by a crane and discharged by means of a charging basket directly to the furnace.

As a result, 60 tons of scrap metal can be placed inside the furnace in two lifts in a matter of minutes. Heat is generated inside the furnace by arcing between the ends of each of three electrodes (20 in. in diameter) and the metal charge. When this has been melted and refined and the necessary alloys duly added, the furnace is tapped by tilting it forward hydraulically. This enables the metal to run out into the ladle so that it may be cast subsequently into ingots.

Separating Ions in a Single Drop*

By Herbert Weisz, Institute for Microanalysis, Technical University of Vienna (Prof. Dr. Robert Strebinger)

THE classical methods of analytical separation mostly depend on the conversion of one component into an insoluble or sparingly-soluble compound, and its separation by filtration from the other components. This demands a number of operations: precipitation, filtration, washing out the precipitate, resolution of the precipitate and, if necessary, the concentration of the filtrate and of the resolved precipitate. Insufficiency of sample will prove a disadvantage, especially if a large number of ions has to be detected. It is usually not advisable to dilute the test solution, as ions in low concentration will be further diluted; this would bring them below the identification-limit so that it would be impossible to identify them. If, for example, a separation in a drop of 1μl. is to be made, it would hardly be possible to achieve it by one of the usual methods.

It should be possible to place the drop upon filter paper, to let the precipitation reagent for one group of ions react and thus fix them locally. Then the soluble parts might be washed out to the outer zone of the paper by using the capillarity of the filter paper.

This may be illustrated by a simple example: let us assume that a drop placed on filter paper contains Cu and Fe and both ions are to be detected by $K_4[Fe(CN)_6]$. For that purpose a separation will be necessary; we could either fix the Cu by H_2S or the iron by NH_3 and wash the other ion to the outer zone of the paper.

This is the point where things begin to be difficult: when washed out with only a little solvent—one or two drops—the separation will be by no means complete; if washed out thoroughly until, for example, the iron is completely removed from the CuS spot, a big fleck of irregular shape in which the iron is very much diluted will appear round the CuS.

In spite of these difficulties this method of separation in spot-analysis has been carried out successfully in some cases—for example, the separation of Ba and Sr by $K_2Cr_2O_7$.

In order to make this technique generally applicable these difficulties had to be overcome. A method had therefore to be developed which could remove soluble components from a precipitate fixed on filter paper without enlarging the area of the spot, that is to say without diminishing the concentration of the washed out ion. A device,

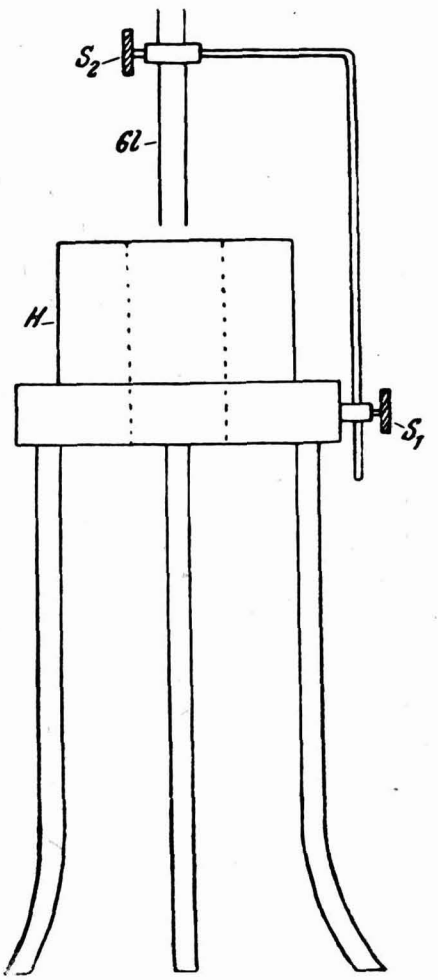


Fig. 1

* From a paper read at the International Symposium on Analytical Chemistry at Birmingham on 30 August. The illustrations are reproduced by kind permission of Springer Verlag, Vienna.

called the 'ring-oven' by us, serves this purpose; by means of this oven, soluble substances can be washed out by any quantity of solvent and the dissolved components can be concentrated at a previously determined place.

A cylindrical block of aluminium bears in its centre a hole of 22 mm. diameter (Fig. 1). A heating element is inserted in this block. An adjustable resistance serves to regulate the temperature. The surface of this heating block H has a temperature of about 105° C. The little glass-tube Gl, which is adjustable (screws S_1 and S_2), is the guide for a capillary pipette. This tube must stand vertically and point exactly to the centre of the bore hole. The mode of operation of this ring-oven is to be explained by the following example:

A drop of an iron chloride solution (100 ppm.) is placed in the centre of a round filter. The filter paper is put on the ring-oven, so that the spot lies just underneath the guide tube. The filter-paper is fixed by a porcelain ring. The spot is then washed out with 0.1N HCl by means of a capillary pipette. The capillary pipette is filled by simply dipping it into the solvent and is then placed upon the spot through the guide tube. The filter-paper sucks in the solvent and the wet spot spreads concentrically. The pipette is refilled and again put in place.

The solvent vaporises on the hot surface of the oven; the diameter of the wet spot can by no means exceed the diameter of the bore hole (measuring 22 mm. in our case) and the dissolved parts stay behind as a sharply outlined ring-zone. After repeating the washing 5 to 10 times, the iron will be completely concentrated quantitatively in this ring-zone. The whole procedure does not take more than one or two minutes. The flow of solvent from the pipette does not exceed the quantity which the filter paper can absorb. There is therefore no need to regulate the flow.

The filter paper is dried in a drying-oven or by means of an infra-red lamp and then sprayed, using a solution of $K_4[Fe(CN)_6]$. A sharply bounded ring of Berlin-blue appears. The inner part of the circle is completely free of iron and is therefore not coloured by the spray.

The area of the ring, which is as thin as a pencil line, does not surpass that of a normal spot. Even if the width of the ring is 1 mm., the area of the ring is less than 70 sq. mm. and is therefore not larger than a spot of a diameter of 10 mm. As, however, the ring-zone of the concentrations usual in micro-analysis is essentially narrower (0.1-0.3 mm.), the area of the ring-zone remains smaller. This means that the concentration of the ions in the ring is even higher than in the original spot. Most of the reactions in this ring form are therefore more distinct.

Division of Ring-Zone

If several ions which might have migrated with the applied solvent are to be detected in this ring-zone, the dried-up filter-paper is cut into several sectors by a pair of scissors. As the ring has a circumference of about 70 mm. it is possible to divide it into 10 sectors. Each single sector of filter-paper, after having been developed with the suitable reagents, shows a circular arc of about 7 mm. length. When the various reactions for identification are carried out, care must be taken that the precipitates, gathered in a sharp ring-zone, are not again made indistinct. If the concentration of an ion in a test drop is sufficient for a normal spot-reaction, it is also possible to identify this ion after washing it out in an aliquot part of this ring-zone.

There are numerous examples of this method. If several ions are to be detected in a single drop without separation, it is often of advantage to wash out this drop into a ring-zone, then cutting up the filter-paper into several sectors; the corresponding reactions for identification can then easily be carried out on the individual sectors. A subdivision of this drop is thus accomplished without dilution.

If a separation is to be carried out, it is necessary to fix one part of the ions locally, and to wash out the others into a ring-zone. For example: suppose one drop contains Cu, Fe and Ni. In this case it will be best to precipitate the Cu by H_2S, which means fixing the Cu; then the Fe and Ni can be washed out into a circular zone. For fixation we use gaseous reagents, the danger of enlarging the spot thus being avoided. For the sake of achieving a more convenient method of these precipitations on filter-paper I use a glass apparatus shown in Fig. 2.

A wide-necked glass flask bears a dropping funnel T and two glass tubes O and U with a plane-ground flange. The two flanges are held together by two spiral springs S; by

the stop-cock H_2 the apparatus is in connection with a water-jet-pump. In the glass tube U there is a small cotton-plug for retaining acid drops.

The test drop is placed in the centre of a round filter paper. The glass bulb is filled with ZnS, the dropping funnel with H_2SO_4. The filter-paper with the test-drop is pushed between the two flanges of the apparatus. By turning the suitable stop-cocks (H_1 and H_2) and opening the water-jet-pump a stream of H_2S is sucked through the filter paper, so that all the Cu is precipitated. In the case of higher concentrations it is advisable to place a drop of alcohol on the spot and to repeat the precipitation.

The filter-paper is then placed upon the ring-oven, and all the Fe and Ni are washed into the ring-zone. When it is dry, the CuS, fixed in the centre, is separated from the filter. This is best done by cutting out the inner spot with a punch of about 12 mm. diameter. This little disc now bears all the Cu in the form of CuS, while the ring-zone bears all the Fe and Ni.

The next step will be the cutting up of the ring with a pair of scissors and the identification of the Fe and Ni (e.g., by means of $K_4[Fe(CN)_6]$ and dimethylglyoxime). The CuS can be oxidised, preferably by gaseous reagents such as bromine vapor. The Cu can then be identified in the usual manner, e.g., by means of benzoinoxime.

More Than Two Groups

The method also makes it possible to divide ions into more than two groups. One drop, for example, contains Pb, Sb, Fe and Ni. The drop is treated with H_2S; all the Pb and Sb is thus fixed. The Ni and Fe are washed out into the ring-zone. After drying, the inner spot (with the Pb and Sb on it) will be punched out as described in the previous example. The Fe and Ni can be identified as usual. The little filter-disc with Pb and Sb upon it is placed on another round-filter and this together with the disc is placed upon the ring-oven. It is then washed out with yellow ammonium sulphide as if the filter disc were nothing but a normal spot; all the Sb_2S_3 is dissolved, sucked into the underlying filter and once more concentrated there in the outer ring-zone.

Disc and filter are dried. The filter disc now holds all the Pb as sulphide; this is oxidised and identified in the usual manner. After drying, the circular ring once more holds all the antimony as Sb_2S_3. If necessary the filter can be cut up. On the various sectors the individual ions of this group can be detected.

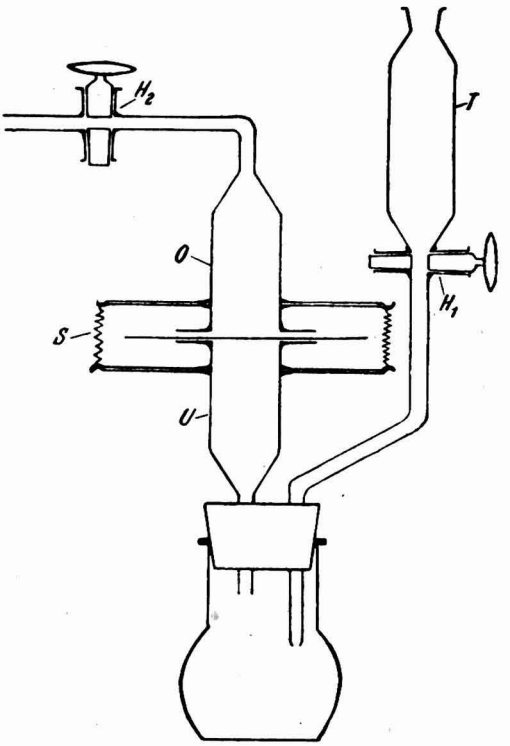


Fig. 2

As it is possible to vary the precipitation reagents—gaseous or liquid—and solvents, and to combine them in various ways with the different operations, such as washing out, punching, washing into a second filter, a great number of ions contained in one single drop can be divided into several groups and identified. Naturally care has to be taken that ions collected in certain groups do not interfere with each other during identification. That is, however, a condition necessary in every analytical scheme.

For general purposes a scheme has been worked out, which deals with the following ions: Pb, Bi, Cu, Cd, Sn, Sb, Fe, Ni, Co, Mn, Cr, Al, Zn, Ti. One single drop is sufficient for the application of this analytical process. The test-drop, which must not be too acid (at the most 2 N HCl) is placed on a filter-paper by means of a capillary pipette. We generally use 1.5 μl.

In the glass apparatus (Fig. 2) Pb, Bi, Cu, Cd, Sn and Sb are precipitated by H_2S. The

filter is then placed on the ring-oven and all the soluble components are washed out by HCl into the ring-zone. After drying, the spot is punched out, and contains all the Pb, Bi, Cu, Cd, Sn and Sb.

The remaining filter contains in a sharply outlined zone all the Fe, Ni, Co, Cr, Mn, Al, Zn and Ti. It is not necessary to separate the ions of this group still further as a decisive identification is possible for each ion of this group.

The punched out filter disc is moistened with a drop of alcohol and oxidised by bromine vapor. After about one minute it is fumed over NH_3 in the same manner. This can be repeated two or three times; a little glass holder helps towards easier manipulation. The disc is then dried in a drying oven, so as to fix the Sn and Sb. It now contains all the Pb as $PbSO_4$, the Cu and Cd as amino complexes, the Sb, Sn and Bi as hydroxides or as basic salts.

After drying, the disc is placed on a new filter paper and by means of the ring-oven all the Cu and Cd is washed out with NH_3 into the ring-zone. The filter thereupon contains all the Cu and Cd in a sharply outlined zone. For various reasons this mode of separation is better than the usual one by yellow ammonium sulphide, which is applied in another stage of the process.

The disc, on which all the Pb, Bi, Sn and Sb is in the original spot, is again placed upon the centre of a new round filter on the ring-oven; all the Sn and Sb is washed out into the ring-zone by means of yellow ammonium sulphide. All ions have now been separated into such groups that individual identification is possible. The whole analytical process which requires but one drop takes less than fifteen minutes.

All reactions for identification are to be carried out on the filter-paper without extraction; this must be done in such a way that the ions, concentrated in a narrow, sharply outlined zone, do not get resolved. For this reason only such reactions can be used for identification which rapidly produce coloured insoluble precipitates as a result of the reaction.

It is a matter of course that the selection of the reagents is a purely personal one. In the course of a further development of spot-analysis other and probably more adequate reagents with a higher degree of sensitivity may be found and be put at our disposal. In some cases reactions have to be carried out in an altered form so as to meet the conditions. For further details I refer to the original papers cited at the end.

It should be possible to apply this method with advantage not only in the inorganic field, but also in testing organic substances. The ring oven can also be used as an extractor for very minute quantities of test material. For the extraction of solid substances a hollow is pressed into the centre of a (possibly moistened) filter paper by means of a glass rod. The substance is placed in this hollow and covered with a little filter disc. This makes it possible to carry out extractions of extremely small quantities in a very simple manner.

As the ring-oven allows us to collect substances in the form of sharp, well-defined rings, it is possible to estimate concentration by comparing the intensity of these rings with that of standard ones, and thus carry out a quantitative or at least semi-quantitative analysis. As it is possible to place several drops on paper and to concentrate the substances at a certain place, very diluted solutions can be used. Naturally the resultant ring-zone is always of the same size, independent of the number of test drops. Several rings prepared with a varying number of drops can therefore be made and compared with a standard scale. The number of errors which the comparison of colour in spot-colorimetry always involves can thus be reduced. It is essential that the drops should be of the same size in all cases, but this can easily be achieved by means of a capillary pipette.

Colour intensities can be compared by direct observation. It is advisable to moisten the filter-papers with paraffin-oil; the colours thus become more visible, especially if the filters are illuminated from below. A very good method is the comparison of intensities by epidiascopic projection; standard scale and test-rings are projected together.

Measurement of the width of the rings does not lead to good results. If reactions which produce durable products of reaction are used, the standard scale can be preserved for some time. This is naturally of great help. We have thus determined Fe by $K_4[Fe(CN)_6]$, Cu by benzoinoxime or by rubeanic acid, Ni by dimethylglyoxime.

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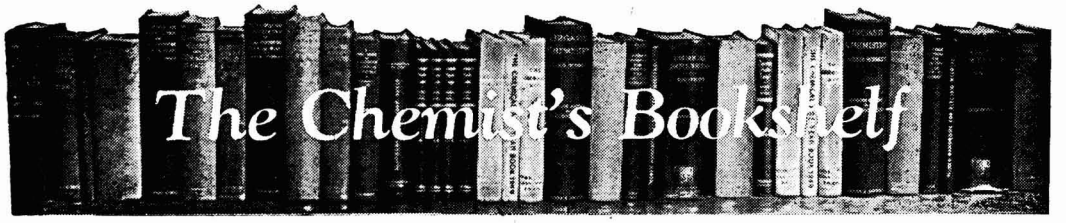


THORPE'S DICTIONARY OF APPLIED CHEMISTRY. VOL. XI: SOIL-ZYMURGY. Longmans, Green & Co. Ltd., London. 4th Edition. 1954. Pp. 1146. 140s.

The encyclopaedic virtues of 'Thorpe' are too well known to require extolling, and the names of the editorial board and the long list of contributors demonstrate beyond doubt its authority. On its way from Soil, Organic Constituents of, to Zymurgy ('the applied chemistry of those industries in which fermentation is employed'), there is time for exhaustive discussions on such varied topics as sorption, stereochemistry, sulphur dyestuffs, tea, terpenes, vitamins, waxes, yeast and zirconium, and many more.

Not only the nature, but the appearance of the work, have remained very little changed since the first edition in 1890, and although a few photographs now replace some of the engravings, it is to be hoped that the fifth edition (which, presumably, will soon be put into preparation) will reflect more worthily the spirit of progress which inspires its many eminent contributors.—B.I.

PHYSICAL CHEMISTRY. By A. J. Rutgers. Interscience Publishers Ltd., London. 1954. Pp. 804. 58s.

In the introduction to this new book of Rutgers, Professor Debye describes how some parts of it correspond to physical chemistry in the classical sense of the word, while others might perhaps be more aptly described by calling them chemical physics. The book presents a picture of the influence which the combination of the methods and ideas that were originally regarded as purely physical or purely chemical has had on the development of science.

After opening his account with a description of the equation of state of an ideal gas, the author discusses the physical properties of molecules, particular attention being paid to the methods available for the determination of Avogadro's Number (the number of molecules in 1 mole of gas). The existence of forces of attraction between molecules follows from an elementary consideration of the pressure of a liquid and as a result the van der Waals' equation of state is more suitable for the calculation of the actual pressure of a non-ideal gas. This subject is discussed fully and the optical and electrical properties of molecules are also considered. The account of the solid state deals in detail with the lattice structure of crystalline matter and with crystal symmetry, and with the use and application of X-ray analysis. The author discusses next the specific heat of gases and solids, showing how the classical and quantum theories of specific heats developed. Considerable space is devoted to thermodynamic problems, including not only the two laws of thermodynamics and the Gibbs-Helmholtz equation, but also chemical equilibrium in gases, the Nernst heat theorem and chemical potentials.

After a discussion of the properties of ideal and non-ideal solutions, the Debye-Hückel theory of strong electrolytes is expounded. Electrokinetic phenomena, the theory of the double layer in colloidal solutions, and the conductivity of electrolytic solutions are also considered. Van der Waals' theory of binary liquid mixtures and some solid-liquid systems of two and three components are described. From the exposition of the principles of classical theoretical mechanics the author passes via the atomic model of Bohr and Rutherford and the atomic theory to Pauli's exclusion principle and the theory of band spectra. In their turn the limitations of the quantum theory paved the way to the development of wave mechanics, which is considered at length. The last three chapters in the book are all extensive, and deal with the calculation of thermodynamic quantities by the methods of statistical mechanics, reaction velocities, and the atomic nucleus (including radioactivity). An appendix by Turner Alfrey Jr. deals with the physical chemistry of high polymers.—G.S.E.

THE SULPHUR DATA BOOK. Edited by W. N. Tuller. McGraw-Hill Book Co. Inc., New York and London. 1954. Pp. 143. 40s.

This book contains most of the data likely to interest the engineer or chemist using sulphur and, as it has been compiled by the technical staff of the Freeport Sulphur Co. of the US, is authentic as well as up to date. Sections deal with the nature of sulphur, its physical and chemical properties, reaction thermodynamics, solubility and analysis. Twelve pages of sulphuric acid conversion tables are included and a two-page bibliography lists general reference works for the period 1905 to 1952. Unfortunately the authors have thought it advisable to use both engineers' and chemists' units of measurement. However, the data most likely to be used by engineers is given in the English system and that of especial interest to the chemist is given in grams, millilitres and degrees Centrigrade.

ORGANIC CHEMISTRY. By R. C. Fuson and H. R. Snyder, 2nd edition. John Wiley & Sons, New York; Chapman and Hall, London. 1954. Pp. viii + 544. 52s.

Owing to spectacular advances in theoretical organic chemistry, the teacher of organic chemistry can now present a far more coherent and intellectually satisfying account of his subject than was possible 20 years ago. However, the task of writing an introductory textbook has become far more difficult, because the first year student can easily be confused by a rigorous comparative approach on modern lines. The authors of this book have attacked the problem by providing an 'accelerated' introduction, which acquaints the student with the terminology of the subject and gives him a balanced view of its contents and importance. Thus equipped, he is able to appreciate the remaining two-thirds of the book.

Another special feature of the book is its emphasis on reactions rather than on methods of preparation. In an introductory course, lists of methods of preparation necessarily introduce unfamiliar compounds out of context. The authors' approach therefore not only saves a considerable amount of space, but also makes for greater clarity. However, it is unfortunate that only some of the early chapters give cross references to methods of preparation. The index also fails in this respect, although it is in other respects an excellent one.

The writers' clear and concise style has enabled them to include a surprising amount of material. The book is intended primarily for students in their first and second years, but final year students will also find much profitable reading in the second part. The excellent chapter on Grignard reagents deserves special mention. Useful suggestions for further reading are given at the end of each chapter, and the book also contains a large number of stimulating problems.

There are few factual errors (on p. 79 the structure of acetaldehyde ammonia is given incorrectly) and misprints amuse rather than irritate.—J.C.P.S.

MODERN CHEMICAL PROCESSES. Vol. 3. By the editors of *Industrial and Engineering Chemistry*. Reinhold Publishing Corp., New York; Chapman & Hall, London. 1954. Pp. 276. 40s.

This is the third volume in a series by the editorial staff of one of the journals of the American Chemical Society and it contains descriptions of 23 recently developed chemical processes now being used on full-scale production. Each process is dealt with fully, including history and origin; a full description (with photographs) of a plant in operation; design details of unusual features; plant operating practice; the economics of construction, operation and replacement; personnel and future possibilities. The technical staff of the various firms concerned have co-operated most full-heartedly and have disclosed information that few British firms would feel inclined to share with their competitors. The articles, as a result, are packed full of practical hints.

The articles in this volume are: Certified Food Colours, Ammonia at 1,000 Atmospheres, An American Fischer-Tropsch Plant, Oil Black, Oil Gas Manufacture, Chemicals from Milk, Formaldehyde from Methanol, Hydroquinone Manufacture, Lactic Acid from Corn Sugar, Animal Glue, Cellophane, Carboxymethylcellulose, Acetophenone, Diatomaceous Earth, Ammonium Nitrate, Dextran, Chemicals from Oranges, Chlorine and Caustic in Italy, Nitric Acid in Great Britain, Peacock Blue: Flushed Colour Production, Catalytic Ashphalt and Wulff Process Acetylene. Anyone interested in any of these topics will find this book of interest.—R.C.H.A.

HOME

Japanese Visit Chemical Works

Five Japanese trade union leaders visited the Staveley Iron & Chemical Works near Chesterfield on Monday, 8 November. They were present at a meeting of the works production council.

Natural Gas

Exploratory drillings for natural gas in Lincolnshire have shown 'interesting possibilities', Mr. Sydney Smith, chairman of the East Midlands Gas Board, said recently.

Paper Mill Production

Sir Eric Bowater, chairman of the Bowater Paper Corporation, said in London last week that the new mill at Calhoun, Tennessee, was already producing more than its initial planned capacity of 130,000 tons of newsprint pulp and 55,000 tons of sulphate pulp.

Scheme Abandoned

The Atomic Energy Authority have abandoned their scheme to deposit radioactive atomic waste from Harwell and Aldermaston in four disused Forest of Dean coal mines. Forest of Dean free miners, whose mineral rights go back about 800 years, refused to agree to the proposal.

Mercury Supplies

In answer to a question from Mr. Harold Wilson in the House of Commons on 2 November, the Minister of State, Board of Trade (Mr. A. R. W. Low), said that, although he was aware of the rise in the price of mercury, he did not think that there was serious difficulty in obtaining supplies because of stock-piling in the US.

New Plastics can be Alloyed

Development of a new range of plastics, which, it is claimed, may be alloyed like metals to meet specific requirements, has been announced by a new British company, Peterlite Products Ltd. Dr. F. A. Freeth, F.R.S., the distinguished industrial chemist, has taken a prominent part in their production, and he is reported as saying that the new materials will resist heat up to 200°C. Products made from them can therefore be sterilised, and although transparent they are hard, and will not scratch easily. They are expected to be of considerable strategic importance.

Rise for Paint Workers

Factory workers in the paint, varnish and lacquer industry are to receive a pay increase from the first full pay period after 3 November. The award by the Industrial Court, announced on 8 November, gives increases of 5s. 6d. for men and 4s. for women with proportionate increases for young people.

British Firm Gets Indian Contract

Simon-Carves Ltd., of Stockport, have received from the Indian Iron & Steel Co. Ltd., through their consulting engineers, the International Construction Co. Ltd., of London, a contract for the building of two batteries of 78 coke ovens each, together with by-product plants and coal- and coke-handling plants, at the Burnpur steelworks in West Bengal. The total cost of the work will exceed £3,000,000, and the contract was secured in face of very strong international competition, especially from Germany.

Record Plastics Output

Total production of plastic materials this year is expected to be about 25 per cent higher than in 1953, according to *The Financial Times*. The value of exports will probably exceed £20,000,000 for the first time. Production of thermoplastic materials, which are in greatest demand, is running at the limit of capacity, despite the substantial additions made this year. The advances for the various materials in this group range from 25 to 66 per cent.

Johnson-Matthey in Paris

Johnson, Matthey & Co. Limited have Stand 1033, Group C, at the III Salon de la Chimie et des Matieres Plastiques, to be held in Paris from 3-12 December. The display will include items of silver and platinum equipment for chemical engineering, bursting discs and bursting disc assemblies, precious metal catalysts, and spinning jets for artificial fibre production. A range of Matthey cadmium pigments will be shown, together with typical pigmented plastic materials and finished articles. Further sections of the display are devoted to platinum laboratory apparatus, spectrographically standardised substances and high purity elements, platinum wound electric furnaces, and products for measurement and control.

OVERSEAS

Australian Sulphuric Acid Plant

Another 30,000 tons of sulphuric acid a year will be added to the company's output when a new contact plant being developed by Commonwealth Fertilisers & Chemicals at Yarraville, Australia, is in full production next summer. The plant will be partly in operation next month.

Price Goes Down in Canada

Du Pont Company of Canada Ltd. has announced a reduction of 1 cent per lb. in the price of tetraethyl lead compounds as a result of improved manufacturing methods.

Loan for Copper Mine

The US Export-Import Bank is to help finance the development of the Toquepala copper mine in Southern Peru, one of the world's largest deposits. The loan—up to a maximum of $100,000,000—will be advanced to the Southern Peru Copper Corporation, a subsidiary of the American Smelting & Refining Company.

German Steel Production Drops

Production of crude steel in Western Germany fell during September to a provisional figure of 1,528,000 tons, compared with 1,537,000 tons in August. In the same month Belgium produced 423,000 tons, Italy 338,000 tons, Luxembourg 254,000 tons, and the United States 6,046,000 tons.

Norwegian Research Centre

At the annual meeting of the Norwegian Technical Research Council it was stated that the construction of an industrial research centre at Blindern, Oslo, is progressing rapidly. The research institute of the paper industry is nearly completed, and the building which will house the Central Institute for Technical Research and 10 other institutes, a library, and a technical information centre, is in course of construction.

Rhodesian Limeworks Sold

Chilanga Cement Company at Rhodesia has completed its purchase of Excelsior Limeworks and the limestone deposits which adjoin it. The price paid was close on £300,000. Chilanga have taken over the limeworks as a going concern as well as 2,000 acres of land on which stand the 10,000,000 proven tons of limestone eminently suitable for cement production.

Firms Buy Synthetic Rubber Plants

Three American companies have completed negotiations to buy Government-owned synthetic rubber plants, of which there are 27 in the USA. Agreements have been reached, it is reported, with Copolymer Corporation, Shell Chemical Corporation and Goodrich-Gulf Chemicals. Agreement is also believed to be near with a fourth firm, American Synthetic Rubber Corporation, a combine of 30 small manufacturers.

Nuclear Reactor for Australia

The Australian Government has authorised the construction of a nuclear reactor, described as the most modern in the world. It will cost about £A5,500,000 and will be located on the coast just south of Sydney so that radioactive effluent can be discharged into the sea.

Italian Chemical Output Rises

The output of Italian chemical industries rose by 20.4 per cent in 1953 compared with the 1952 output, according to figures just released in Rome. In those sectors concerned with the by-products of coal and petroleum, the index figure of 591 (1938 = 100) shows a rise of 27.1 per cent, while output of artificial textile fibres rose by 35.2 per cent over the preceding year.

Synthetic Rubber Output Goes Up

World production of synthetic rubber rose during September by 5,000 tons to 60,000 tons. Consumption went up still more, increasing by 12,500 tons to the same figure of 60,000 tons. Total synthetic production during the first nine months of the year was 520,000 tons, 5,000 tons less than total consumption. Production of natural rubber in the same period was 1,300,000 tons.

Canadian Ore Find

Confirmation was announced on 4 November of a new lead-zinc-copper find near Little River, North-East New Brunswick, where large ore zones discovered by the American Metal Company are described as three times as rich as those found in the Bathurst area. First estimates, it is reported, showed an average lead-zinc ore of 4 oz. silver, 4.5 per cent lead and 10.5 per cent zinc, with a little gold and 0.5 per cent copper.

PERSONAL

Industrialists on Tees-side have made a presentation of J. W. ARMITT, M.C., M.A., Ph.D., former chairman of Imperial Chemical Industries Wilton Council (North Yorkshire). Alderman B. O. Davies, on behalf of the industrialists, presented a silver inkstand to Dr. Armitt inscribed: 'A small recognition from those with whom he associated on Tees-side, and who appreciated his efforts for the welfare of that district.'

The Royal Society announce the award of the Davy Medal to PROFESSOR J. W. COOK, Ph.D., D.Sc.(Lond.), Sc.D.(Dublin), F.R.I.C., F.R.S., for his distinguished fundamental investigations in organic chemistry.

MR. C. H. COLTON and MR. J. G. SMITH have been appointed to the board of Central Rayon Office. MR. G. H. SPILMAN has resigned from the board.

COUNCILLOR KERR-MUIR, a member of Wilmslow (Cheshire) Council, has been appointed executive vice-president of Courtaulds (Canada) Ltd. Prior to this position, he was manager of the chemical department in Manchester. He has been a councillor for 15½ years and is a past chairman of the Council.

The Thickol Chemical Corporation of Trenton, NJ, USA, have appointed MR. W. H. STEVENS, A.R.C.S., F.R.I.C., as technical consultant to advise on their products in the UK. Supplies of these products (chemical rubbers, liquid polymers, plasticisers, etc.) can be obtained from Messrs. J. M. Steel & Co. Ltd. of Kern House, 36/38 Kingsway, London W.C.2.

MR. JOHN CURWEN has been elected a vice-president of the British Man-made Fibres Federation, filling the vacancy caused by the recent death of MR. P. J. GRATWICK. Mr. Curwen was one of those directly responsible for the formation of the Federation in 1943. He also helped to found the Rayon Weaving Association in 1936 and was its first chairman. Only last year indifferent health compelled him to give up the chairmanship of the RWA, when the Association elected him as their president. Mr. Curwen took a leading part in negotiations with the Board of Trade in the introduction, development and administration of the Utility Clothing Scheme as it affected woven rayon fabrics. He was also appointed in 1949 by the President of the Board of Trade to inquire into the supply position of Utility rayon goods and recommend changes which might be required in its future.

To supervise the commissioning early next year of Kwinana Refinery, Western Australia, MR. D. W. K. BARKER, Manager of the Australasian Division of Anglo-Iranian's Refineries Department, has arrived in Australia. The refinery is being built and will be operated by Australasian Petroleum Refinery Limited, one of Anglo-Iranian's Australian associates. Mr. Barker was appointed to his present position in April 1952. He was a member of the company's survey party which chose the site for the refinery.

MR. DONALD ROSS has been appointed general sales manager of Semtex Ltd. at the company's London headquarters, Hendon. Mr. Ross, who is now 41, was 17 when he joined the rubber flooring department of Dunlop's general rubber goods division in London. Just before and immediately after the war he was on the sales staff of the Dunlopillo division. In 1947 he was transferred to the Semtex company whom he served as sales secretary and overseas manager before becoming sales manager. During the war, when he was a captain in the Royal Artillery, he was decorated with the Belgian Croix de Guerre and made a Chevalier of the Order of Leopold for services in the field. Responsible directly to Mr. Ross, MR. W. W. WESTON has been appointed sales development officer for Semtex to whom he came from Brynmawr Rubber (Sales) Ltd., where he was sales manager, as he had also been with Spencer Moulton and Co. Ltd. He is 46.

MR. A. J. N. NASH, B.Sc., A.C.G.I., M.I.E.E., has been appointed general manager of R. Cruickshank Ltd., of Camden Street, Birmingham. Before this appointment Mr. Nash was managing director of Marino Process Ltd., one of the asso-

ciated companies of the Durham Chemical Group.

Spencer Chapman & Messel Limited announce that MR. HARRY HEATHCOTE, chairman, and MRS. ETHEL HEATHCOTE, F.C.I.S., secretary, have now been appointed joint managing directors of the company.

More than half a century's active association with steam generation was recently severed by the retirement of MR. B. SAMUELS, M.I.Mech.E., after 52 years with Babcock & Wilcox Ltd. After some years spent in the Erecting Department, he was transferred to the Testing (now the Service) Department. He was appointed in charge of this work immediately after the 1914-18 war. He is recognised as an authority on combustion problems and is a prominent member of many associations.

Glycol Duty Wanted

CANADA'S two main ethylene glycol producers, seeking a tariff on imports, have repeated their request before the Canadian Tariff Board. Dow Chemical of Canada Ltd. and the Dominion Tar & Chemical Co. Ltd. urged that the board recommend a tariff on the anti-freeze component, similar to the United States duty—three cents a pound plus 15 per cent ad valorem, a duty based on an estimated value of the goods. Dow estimated this would be about a 45 per cent ad valorem charge. The companies at similar hearings in 1952 unsuccessfully asked for tariff relief of 20 per cent.

The tariff bid was opposed by the Interprovincial Farm Union Council on grounds it would increase anti-freeze prices. Interprovincial Chemicals Limited submitted a letter also opposing the tariff. The firm said it began producing anti-freeze in 1953 after investigation showed Canadian suppliers offered a delivered price of ethylene glycol for anti-freeze competitive with, or indeed the same as, the delivered price of that material offered by suppliers from the United States.

Dow Chemical said its $24,000,000 gycol plant at Sarnia, Ont., employing 500 persons, was in serious jeopardy because foreign glycols were flooding the duty-free Canadian market at prices below established foreign prices. The company claimed that foreign producers go to extremes in establishing low prices.

Stream Pollution Research

THE US Manufacturing Chemists' Association Inc. has sponsored a programme of research into stream pollution which is being undertaken on the Schuylkill River, Penn., by a team from the Philadelphia Academy of Natural Sciences.

Speaking at a Press Conference held on 26 October, just before the survey began, Cleveland Lane, assistant to the president of the MCA, said: We know that stream pollution results from many causes, including surface runoff from overcultivation of land, sewage from concentrated population areas, mine wastes and effluents of many industrial processes. There are two basic points of consideration for the chemical industry. First, a number of our plants and processes contribute to stream pollution and we wish to clear up these problems. Second, many of the problems of stream pollution, regardless of source, and many of existing or potential means of cleaning them up are chemical in nature.'

The chemical industry believed it could make major contributions to improving the conditions of American streams, he went on, but many problems remained to be solved.

Breach of Agreement Alleged

Marchon Products Ltd., detergent makers, Whitehaven, Cumberland, were on 5 November granted an injunction restraining a chemist formerly employed by them from working for a trade competitor. Mr. Donald Earl Thornes, of Offerton Lane, Stockport, left in March and is now employed by the Stockport United Chemical Co. Ltd. Marchon Products Ltd. alleged a breach of agreement, dated March 1950, by which Mr. Thornes undertook not to work for a competing British firm for one year after he left them without their consent. If they withheld consent they agreed to pay Mr. Thornes half his salary for 15 months.

Austrian Chemistry Building

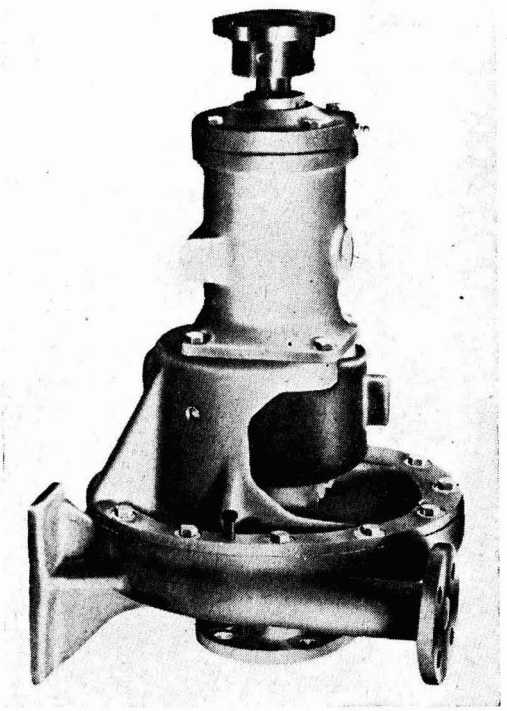
The Graz Institute of Technology, Province of Styria, Austria, is to get a new chemistry building costing more than $1,100,000. Work on it will start on 10 December, and it will be completed after approximately four years. The building will measure more than 100 ft. in height, and over 220 ft. in length, in steel and glass.

Publications & Announcements

THE 1954-55 Calendar of The Pharmaceutical Society of Great Britain contains details of legislation affecting pharmacists, as well as describing the many activities and interests of the society. It runs to 306 pages, slightly more than last year, and gives in full the Supplemental Charter granted in 1953. The main subjects dealt with are general information about the society's membership, its administration, its activities, pharmaceutical education, legal information and statutes and regulations.

* * *

DURING the past eight years the firm of Hayward Tyler & Co. Ltd. has successfully manufactured under American licence a wide range of Hayward Tyler-Byron Jackson centrifugal process pumps. These have been used for some of the most difficult high- and low-temperature conditions and for high operating and suction pressures. This means that for light duties, low-operating pressures, and temperature conditions in chemical processes, the pumps would be unduly heavy and expensive when made in high chrome/high nickel alloys or bronze. Thus for extreme corrosion resistance in the handling of chemical products a demand exists, and is rapidly increasing, for a lighter, simpler type of pump. To meet this demand, a new range of Byron Jackson chemical pumps has been designed with the advice and assistance of many American chemical engineers. It is the intention to make the Hayward Tyler-Byron Jackson chemical pump with stock parts for short period delivery and the cases, covers, and impellers (which are in contact with the liquid pumped) in a range of four materials to cover major demands as follows: cast-iron pumps (with austenitic stainless steel shafts) for non-corrosive liquids, concentrated sulphuric acids at low temperature, etc.; cast steel cases and covers for petroleum and petrochemical products where steel is preferred for any very inflammable liquids; acid resisting aluminium bronze cases, covers and impellers for fatty acids, food products, etc., where contamination is not permissible; high nickel-chrome austenitic stainless steels for corrosive conditions. The pumps are suitable for delivery pressures up to 100 psi. and for operating temperatures up to 250°F. The impellers are designed



to give a good suction performance when handling liquids near to boiling conditions. A full range of capacities up to 600 gallons per minute and heads up to 230 feet is possible with speeds up to 2,900 rpm.

* * *

THE advantages of polythene flexible tube for compressed air lines are described in a brochure issued by Telektron (Great Britain) Limited, 7 Chesterfield Gardens, Curzon Street, London W.1. The firm are sole agents for Bowden (Engineers) Ltd., for polythene tube air lines. Polythene tube, claims the brochure, scores over other piping materials because of its corrosion resistance and its lightness and flexibility. Its weight is about one-third that of copper tubing normally used on compressed air supplies, and friction losses are appreciably less than with normal metal piping. It is supplied in three sizes, from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. internal diameter, and in coils of 100 ft., 200 ft. or 500 ft. The tube is black, the pigment preventing any deteriorating effect of sunlight.

IMPROVEMENTS in industrial methods and processes in recent years have led to a demand for high-grade recorders, and the Cambridge Electronic Recorder, made by the Cambridge Instrument Company Limited, has been designed to meet this demand. The recorder is claimed to possess versatilty, great stability, high speed of response and sensitivity. It can be used for single or multi-point recording or for automatic control of temperature, pressure, *p*H or any variable condition that can be resolved as a change of EMF. Sheet No. 321, which describes the new recorder, can be obtained from the company's head office at 13 Grosvenor Placé, London S.W.1.

* * *

CHEMICAL manufacturers in England, Wales, Scotland and Ireland are listed in the 86th edition of the Chemical Manufacturers' Directory for 1954, recently published. The directory, which costs 8s., is obtainable from Simpkin Marshall (1941) Ltd. and booksellers.

* * *

'RADIOACTIVE-Waste Disposal in the Ocean,' US National Bureau of Standards Handbook 58, has recently been published (pp. 31, 20 c., postage 7 c.). (Order from the Government Printing Office, Washington 25, D.C.). The ever-increasing production and use of radioactive isotopes has raised numerous questions concerning their handling, transportation, and ultimate disposal. It appears that the sea may be an appropriate place for the disposal of intermediate and large amounts of isotopes having long half-lives (more than one year) or high radiotoxicity. It is the purpose of this handbook to bring to the attention of those concerned the many different factors which should be taken into account when radioactive wastes are to be dumped into the ocean, and to make recommendations for the proper use of this disposal method. The recommendations contained in this handbook represent what is believed to be the best available opinions on the subject. since it was prepared by the Sub-committee on Waste Disposal and Decontamination of the National Committee on Radiation Protection.

* * *

LATELY published by the British Rubber Development Board 'The Preparation of Latex Foam Products,' by Dr. C. Falconer Flint, is the fourth in the series of handbooks on applications of natural rubber latex. Like its companion booklets it is written with the needs of the newcomer to latex technology in mind. For this reason the author, while preserving the practical character of the series, does not neglect to explain the theory when this helps towards an understanding of technique. Beginning with the fundamental concept of gelation he goes on to describe the various gelling systems. Next, methods of compounding are explained and, finally, the actual processes of manufacture. Subjects covered in the chapter on manufacture include: wet cure, the hydrogen peroxide system, blowing agents, methods of frothing, continuous production, stabilisers, pore-size, hardness, density, maturation, making moulds, vulcanisation and HF heating. All the data necessary for the preparation of some typical working mixes are given in tabular form. The final chapter consists of twenty pages of abstracts of the principal British Patents relating to the manufacture of latex foam. Copies are obtainable, free of charge, from the British Rubber Development Board, Market Buildings, Mark Lane, London E.C.3.

* * *

ALTHOUGH the 1954 edition of the Soap Makers' Directory, recently published, follows the same form as its predecessors, a number of firms included in last year's edition have been deleted. The directory lists manufacturers of soap and candles in England, Scotland and Ireland, and also contains a classified index showing makers of the principal kinds of soap. It is obtainable from Simpkin Marshall (1941) Limited.

* * *

THE Telektron-Hard pneumatic remote control system for valves has been in operation for several years on a wide variety of applications, and performance and reliability have been fully proved under all types of service conditions. The units have been designed so that they may be fitted to an existing valve *in situ* and the valve may be manually operated at any time. The system is operated by compressed air and remains unaffected by changes in surrounding temperatures and pressures. Units are available in standard two-motor and four-motor sets, incorporating either the standard or the alternative double-power tandem motor. Further details from Telektron (Great Britain) Ltd., 7 Chesterfield Gardens, London W.1.

Law & Company News

Commercial Intelligence

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

Mortgages & Charges

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

EDUCATIONAL & SCIENTIFIC PLASTICS LTD., Coulsdon.—4 October, mortgage to Midland Bank Ltd. securing all moneys due or to become due to the bank; charged on factory premises 71 Brighton Road, Hooley, Coulsdon, with machinery, fixtures, etc. *Nil. 7 September 1954.

Change of Name

The following change of name has been announced: HIRST, BROOKE & HIRST LTD. to HIRST, BROOKE, GOODALLS LTD. on 1 October.

Company News

Manchester Oil Refinery (Holdings) Ltd.

Manchester Oil Refinery (Holdings) Ltd. have resumed the payment of interim dividends, and an interim of 4 per cent is to be paid in respect of the year ending 31 December. For 1953, the dividend was limited to a single payment of 6 per cent, compared with 10 per cent for 1952.

Peter Brotherhood Ltd.

At the 47th ordinary general meeting of Peter Brotherhood Ltd. on 2 November, the chairman Mr. A. Marcus Neal said the value of sales for the year had increased by over 27 per cent, resulting in a net trading profit, before taxation, of £435,854, against £318,446. There had recently been some reduction in the rate of orders, he added, but he looked forward to continued prosperity.

Anglo-Iranian Oil Co.

The Anglo-Iranian Oil Company intends to change its name to The British Petroleum Company, and stockholders have been asked to approve the new name. A four-for-one scrip issue is also announced, with an unchanged interim dividend on the present £20,137,500 ordinary stock, and the authorised capital is to be increased by £87,000,000. The new shares will participate in the final dividend for 1954 but not in the interim dividend. An extraordinary general meeting to give effect to these proposals is to be held on 16 December.

Dunlop

Dunlop announce an interim ordinary dividend of 4 per cent, less income tax, to be paid on 18 December. The final dividend for the year will be considered in May.

Olin Mathieson Chemical Corporation

Olin Mathieson Chemical Corporation, formed on 31 August 1954 by the merger of Olin Industries Inc. and Mathieson Chemical Corporation, reported net profit of $24,521,554 for the nine months ended 30 September equal to $2.17 a common share after giving effect to the 5 per cent stock dividend declared on the Mathieson shares on 9 July 1954. The statement includes one month of combined operations. The earnings compare with $24,983,833 or $2.31 a common share, on a pro-forma basis for the two predecessor companies last year on the smaller number of shares outstanding at that time. Net sales of the company were $355,215,354 for the nine months, down less than 1 per cent from $357,979,786 in 1953.

'Shell' Research Ltd.

'Shell' Research Ltd. has been formed as a private company within the Shell group of oil companies, with a capital of £50,000. The formation of the company is designed solely to streamline the present administration of the group's research activities in the UK under one management. (See p. 1026).

Shell Chemical (Australia) Proprietary Ltd.

A new company, Shell Chemical (Australia) Proprietary Ltd., is being incorporated in Australia to control Shell interests in the Australian chemical industry. This brings Shell's practice in Australia into line with that followed in other industrial countries (among them Great Britain, United States and France) where the rapidly growing importance of chemicals from petroleum has led to the formation of Shell chemical companies. Mr. E. N. Avery, chairman of the Shell Company of Australia Ltd., will be chairman of the new company and Mr. T. W. Henderson will be managing director.

Next Week's Events

MONDAY 15 NOVEMBER

Society of Chemical Industry

London: Chemical Society's Rooms, Burlington House, W.1, 5.30 p.m. Pesticides Group. 'The Statistical Approach in Crop Protection Research' by Dr. C. C. Tanner.

TUESDAY 16 NOVEMBER

Society of Chemical Industry

London: Chemical Society's Rooms, Burlington House, 6.30 p.m. Plastics and Polymer Group. 'The Electrical Properties of Plastics' by H. A. Hawthorn.

Institution of Chemical Engineers

London: Science Museum, S.W.7, 4.30 p.m. Joint meeting with the Low Temperature Group of the Physical Society. 'Gas Refrigerating Machines' by J. L. W. Köhler.

Institute of Metal Finishing

London: British Institute of Management, 8 Hill Street, W.1, 6.30 p.m. Organic Finishing Group. 'Stoving by Radiant Heat' by L. J. C. Connell, and 'Stoving by Convection' by G. Carroll.

The Institute of Metals

Sheffield: British Iron and Steel Research Association, Hoyle Street, 7 p.m. Joint meeting of Sheffield Local Section and Sheffield Metallurgical Association. 'Specifications; Friends or Foes?' by S. Barraclough.

The Institute of Fuel

Birmingham: James Watt Institute, Great Charles Street, 6 p.m. 'Modern Gas Turbine Practice' by H. Farrington.

WEDNESDAY 17 NOVEMBER

The Royal Institute of Chemistry

London: Institute of Metals, Grosvenor Gardens, S.W.1, 6.30 p.m. London Section annual general meeting. Address on 'Professional Status' by Sir Harry Jephcott, President of the Institute.

The Royal Society of Arts

London: John Adam Street, Adelphi, W.C.2, 2.30 p.m. E. Frankland Armstrong Memorial Lecture. 'Science and Food Production' by Dr. L. H. Lampitt.

The Institution of Chemical Engineers

Birmingham: The University, Edmund Street, 6.30 p.m. Graduates' and Students' Section. 'Legal Aspects of Chemical Engineering' by S. J. Green.

London: Park Royal Underground Station, 10.45 a.m. Graduates' and Students' Section. Meet for visit to Guinness' Brewery, Park Royal.

The Institute of Fuel

Sheffield: Royal Victoria Station Hotel, 2.30 p.m. 'Flame Radiation Research' by Professor M. W. Thring.

The Royal Statistical Society

London: London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, 5.15 p.m. Inaugural address of the President, Lord Piercy of Burford, 'The Macmillan Gap and the Shortage of Risk Capital.'

THURSDAY 18 NOVEMBER

The Royal Institute of Chemistry

Chatham: Medway College of Technology, Maidstone Road, 7.30 p.m. Film Display.

Manchester: The Textile Institute, 10 Blackfriars Street, 7.30 p.m. 'An Experiment in Co-operative Industrial Research' by Dr. D. W. Hill.

The Royal Institution

London: 21 Albemarle Street, W.1, 6 p.m. 'Some Aspects of Geophysics—Continents and Oceans, Part 2' by Dr. J. McG. Bruckshaw.

The Royal Society

London: Burlington House, W.1, 4.30 p.m. Special general meeting followed by a lecture on 'Chemotherapeutic Research at the Laboratories of Imperial Chemicals (Pharmaceuticals) Ltd. at Manchester' by W. A. Sexton.

The Chemical Society

London: Large Chemistry Lecture Theatre, Imperial College of Science and Technology, S.W.7, 7.30 p.m. Tilden Lecture, 'Molecular Rearrangements' by Professor M. J. S. Dewar.

Sheffield: Chemistry Lecture Theatre, The University, 7.30 p.m. 'The Regulation of Plant Growth with Chemicals' by Professor R. L. Wain. Joint meeting with RIC and Sheffield University Chemical Society.

Bristol: Department of Chemistry, The University. Social evening held jointly with RIC and SCI.

The Society of Leather Trades' Chemists

Northampton: College of Technology, 2.30 p.m. 'The Leathers we use and how they are Tested' by J. M. Boswell.

The Pharmaceutical Society
Manchester: Council Chamber, Houldsworth Hall, 7.45 p.m. 'Some Fruit Products of Pharmaceutical Interest' by Dr. V. L. S. Charley.

Liverpool Metallurgical Society
Liverpool: Rooms of the Liverpool Engineering Society, 9 The Temple, Dale Street, 7 p.m. 'The Fracture of Metals' by C. E. Phillips.

North-East Metallurgical Society
Middlesbrough: Cleveland Scientific and Technical Institution, 7.15 p.m. 'Aluminium and its Alloys as Engineering Materials' by E. Elliott.

The Royal Statistical Society
Bristol: Library Room, The University, 5.45 p.m. 'The Uses and Abuses of National Income Statistics' by Professor R. C. Tress.

FRIDAY 19 NOVEMBER

The Chemical Society
Birmingham: Chemistry Department, The University, 4.30 p.m. 'The Structure and Properties of Olefine Complexes' by Dr. J. Chatt.

Glasgow: Royal Technical College, 7.15 p.m. 'The Chemical Nature of some Metal Alkyls' by Professor G. E. Coates.

Society of Chemical Industry
London: Chemistry Lecture Theatre, King's College, Strand, W.C.2, 7 p.m. Fine Chemicals Group. 'The Analyst in the Fine Chemicals and Pharmaceutical Industries' by Dr. G. E. Foster.

Incorporated Plant Engineers
Manchester: Grand Hotel, annual dinner.

Market Reports

LONDON.—Business in the various sections of the industrial chemicals market continues along steady lines with a fair volume of new inquiry on home and export account. In some instances spot supplies remain difficult, and the position is unlikely to improve until the effect of the recent stoppage at the docks has been overcome. Following the lower white lead and red lead prices reported last week there has been a reaction, and as from 5 November the basis quotations are —white lead £141 15s. per ton, red lead £137 per ton, and litharge £139 per ton. Otherwise prices throughout the market are steady with the undertone decidedly firm. The coal tar products market is steady and unchanged.

MANCHESTER.—A fairly steady flow of new bookings from home users as well as for export has been reported on the Manchester market for heavy chemical products during the past week and little or no falling off in the number of inquiries compared with recent weeks seems to have been experienced. Some outlets in the textile and allied trades are said to have been taking rather less, but otherwise deliveries under contracts have been fairly well maintained. Trade in fertilisers is largely concentrated on basic slag and the compounds. A steady movement of supplies of most of the light and heavy tar products is reported.

GLASGOW.—A fair amount of activity has been reported, embracing a wide range of chemicals for industrial and agricultural purposes, the tendency being mostly on the agricultural side where fertilisers, etc., are in heavy demand. There have been no major price changes in industrial chemicals, though deliveries in many cases are still slow; the dock strike in London has been the major cause of the delay. A good volume of export business has been conducted and it is interesting to note that coke is once again in heavy demand with orders for considerable tonnage booked for prompt delivery.

Works' Anniversary

At a luncheon held in Glasgow on 5 November to celebrate the 25th anniversary of the founding of Zenith Works of Henry Wiggin & Co. Ltd., Thornliebank, Glasgow, Viscount Weir of Eastwood recalled that he obtained the concession to sell Monel metal in European markets 45 years ago. Its initial development at the Cathcart, Glasgow, works by G. & J. Weir Ltd. soon led to the setting up of a separate company, Monel Weir Ltd. The Zenith Works were officially opened in 1929. Soon afterwards, the merger between the International Nickel Company and the Mond Nickel Company took place, and the works came under the ownership of Henry Wiggin & Co. Ltd., a subsidiary of the Mond Nickel Company. Sir Andrew McCance, deputy chairman and joint managing director of Colvilles Ltd., proposed the toast of the Zenith Works.

CLASSIFIED ADVERTISEMENTS

EDUCATIONAL

UNIVERSITY OF LONDON. A course of two Lectures on **"HEAT AND MASS TRANSFER,"** will be given by Professor H. Kramers (Delft), at 5.30 p.m. on 18 and 19 November, at University College (Anatomy Theatre), Gower Street, W.C.1. 18 November: "Unsteady States." 19 November: "Gas Absorption."
ADMISSION FREE, WITHOUT TICKET.
JAMES HENDERSON,
Academic Registrar.

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.

CHEMICAL ENGINEERING OR INDUSTRIAL CHEMIST, under 35, required for key technical post by progressive company in Gloucestershire supplying process equipment to the Engineering, Chemical and Allied Industries. Degree or equivalent qualifications essential. Specialised experience of filtration, sedimentation, or other separational processes, an advantage. An aggressive approach to technical problems essential. An attractive initial salary, commensurate with qualifications and experience, is offered. Prospects are excellent. Write, giving full details to **BOX No. C.A. 3363, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

CHEMICAL ENGINEERS are required by **BOOTS PURE DRUG CO., LTD.,** for work in their Fine Chemical and Antibiotic Factories at **NOTTINGHAM** and **BEESTON.** The duties include design and maintenance of chemical plant and liaison between production and engineering departments. Candidates should be under thirty-two years of age and should apply, stating qualifications, experience and salary required. Applications should be made to the **PERSONNEL MANAGER, STATION STREET, NOTTINGHAM.**

EIMCO (GREAT BRITAIN), LTD., 190, PICCADILLY, LONDON, require a **SENIOR CHEMICAL ENGINEER** to take charge of their expanding Filter Division. Position initially in London, but later to be based at their new Tyneside factory. Write, giving experience, age and salary.

JUNIOR ENGINEER required by Chemical Engineers, London, S.W.1. Candidates should be 22-24 years of age and have completed National Service. Some drawing office and workshop experience essential. Ordinary National Certificate Standard of education and some knowledge of Hydraulics preferred. Write, giving details of education, experience and salary required, to **BOX No. C.A. 3365, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

LAPORTE CHEMICALS, LIMITED, LUTON, require young, active men who have completed their National Service commitments. Successful applicants will be trained for plant supervisory duties and as shift chemists. Minimum standard required in both cases is General Certificate or equivalent in Chemistry, Mathematics and English. Salary according to age, qualifications and experience. **APPLY TO MANAGER, WORKS LABORATORIES.**

SITUATIONS VACANT

GOLD COAST LOCAL CIVIL SERVICE

A VACANCY exists for a **CHEMIST-ASSAYER** in the Local Civil Service of the Gold Coast. Candidates must possess an Honours Degree in Chemistry with (*a*) Certificate from University of having reached good standard in practical Inorganic Chemistry; two-year course of post-graduate training at Imperial College of Science and Technology, *or* (*b*) at least two years' post-graduate experience in Silicate Analysis and Assaying. Duties will be to take charge of the Geological Survey Chemical Laboratory; assay ore of all kinds; carry out silicate analyses of rocks and minerals; participate in research of inter-relation of rocks and Geochemistry.

Appointment is on contract for two tours in first instance with consolidated salary in the scale of £1,090-£1,950 per annum. Gratuity at rate of £37 10s. for each three months' service. Outfit allowance of £60 if initial salary is below £1,530; £30 if above. Income tax at low local rates. Quarters provided, when available, at rental of £60-£90 per annum. Free first-class passages. Leave at the rate of 7 days for each completed month of resident service.

Apply in writing to the **DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1,** giving briefly age, qualifications and experience. Mention the reference number CDE.105/13/06.

LAPORTE CHEMICALS, LTD., KINGSWAY, LUTON, BEDS, have a vacancy for a **SAFETY AND WELFARE OFFICER.** The successful candidate must have had some experience in the chemical industry and must be fully conversant with the Factories Acts, Building Regulations, etc. He will be expected to co-operate in the administration of the medical and fire services and in the training of personnel in First Aid and Fire Fighting. The salary will be determined by qualifications and experience. Apply to **WORKS MANAGER.**

RESIN CHEMIST or **TECHNOLOGIST** required. B.Sc standard or equivalent. Experience of resin manufacture and control essential. Good salary; excellent opportunity for keen man to make progress. Write full details to **BOX No. C.A. 3367, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

RUBBER CHEMIST or **TECHNOLOGIST** required. Experience with sponge or foamed rubber essential. Good salary; excellent opportunity for keen man to make progress. Write full details to **BOX No. C.A. 3366, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

FOR SALE

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

GRADED BEECHWOOD CHARCOAL for sale. Fine Powder in ½-cwt. paper bags. Also ½-in. cubes. Exceptional quality, low moisture content. **DAVIS, 99, FOXLEY LANE, PURLEY, SURREY.**

FOR SALE

ECONOMIC BOILERS, Two Brand New 14 ft. by 8 ft. by 150 lb. w.p. **IMMEDIATE DELIVERY** 400 other Boilers in stock.
STAINLESS PRESSURE TANK, 19 ft. by 5 ft. diam., 110 lb. w.p. Unused.
TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS.**
SIX Stainless Steel **JACKETED PANS,** 60 galls.
TWO Broadbent **WATER-DRIVEN CENTRIFUGES,** 30 in. diam., 12 in. deep, 1,150 r.p.m.
SIX Aluminium **CONDENSERS,** 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ⅞ in. o.d.
FORTY Riveted **RECEIVERS,** 8 ft. 6 in. long, 5 ft. 6 in. diam., 75 lb. w.p. Numerous other sizes.
Solid Drawn **STEEL PIPES,** 6 in., 8 in., 10 in., 12 in., 14 in., thousands of feet in stock, plain and flanged.
CAST-IRON PIPES. 400 yds. 8 in. **NEW.** Also most other sizes, up to 24 in. bore.
VALVES in Stainless, Gunmetal, Enamel Lined.
CAST IRON TANK PLATES, 2 ft. square. 500 in stock.
Free Catalogue. "Watkins Machinery Record," available.
FRED WATKINS (BOILERS), LTD.,
COLEFORD, GLOS.

ONE BERTRAM TWIN ROLL FILM DRIER, with steam-heated rolls 60 by 28, complete with motor, starter, vapour hood, etc. In first-class condition.
One **SCOTT VACUUM OVEN**—inside measurements approx. 6 ft. by 6 ft. by 5 ft., with vacuum pump and belongings.
Six Brand New **STERILISING VESSELS**—7 ft. long by 3 ft. diam.
One 4 ft. Positive-driven **EDGE RUNNER MILL,** with reduction gear, motor and starter.
One S.J. **WERNER MIXER** with pan approx. 2 ft. by 2 ft., of the tilting type.
Two Steam-jacketed **CAST-IRON FILTER PRESSES,** each with 38 s.j. plates and 39 frames, cake size 2 ft. 4 in. square.
Several Johnson **CAST-IRON FILTER PRESSES,** various sizes and types.
GARDNER Mixers, and Mixers and Sifters combined, sizes "E," "G," "H," "J" and experimental.
HYDRO EXTRACTORS—24 in., 30 in. and 36 in.
Two Gardner "H" size Steam-jacketed **MIXERS.**
Two 18 in. **KEK PLATE MILLS,** with feeders, delivery bins, motors and entablature.
RICHARD SIZER, LTD.,
ENGINEERS,
HULL.
Telephone : 31743.

MORTON, SON AND WARD, LIMITED.
"MORWARD" "U"-shaped TROUGH MIXERS up to 2 tons in s.s. or m.s. with agitators, scroll or paddle type, jacketed or unjacketed.
S.S TROUGHS, tanks and cylinders made to requirements.
2 TILTING trough **MIXERS,** 25 and 50g. by **RICHMOND** and **CHANDLER,** double 'Z' blades, with or without jacket, s.s. interior, 50g, 75g and 100g heavy duty **MIXERS by FALLOWS** and **BATES,** agitators driven through bevel gears from fast and loose pulleys.
3-cwt. **TROUGH MIXERS** by **CHALMERS** and **GARDNER** s.s. lined troughs.
200g c.i. **JACKETED MIXING VESSEL** with nickel chrome impellor type agitator driven through bevel gears from fast and loose pulley.
JACKETED PANS
100g, 150g and 200g **NEW** in mild steel for 100 lb. p.s.i. w.p. with or without mixing gear.
PUMPS
A selection of **MONO** and other pumps in stock, 2 in. to 5 in.—new and second hand.
ENQUIRIES INVITED
MORTON, SON AND WARD, LIMITED
WALK MILL,
DOBCROSS, NR. OLDHAM,
LANCS.
'Phone : Saddleworth 437

FOR SALE

600

STEAM-HEATED DRYING OVEN, TWO-COMPARTMENT, by Mitchell—6 ft. 2 in. i.d. by 9 ft. 6 in. by 6 ft. high, to accommodate four 4-wheel drying trolleys 3 ft. by 32 in., containing 15 steel shelves at 4 in. spacing. Counterbalanced doors back and front of oven. Motorised air circulating fan, exhaust system with trunking. Complete with steam fittings. Temperature 20-120° C.
FOUR VERTICAL TOTALLY ENCLOSED GLASS-LINED VESSELS by Pfaudler—42 in. diam. by 4 ft. deep. Capacity approx. 212 gal. Domed top and bottom. Fitted hinged lid, with quick release. Bottom side run-off and drain cock.
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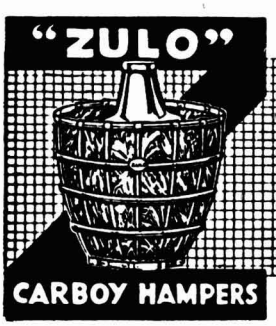

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