The
Chemical Age

VOL LXIX 8 AUGUST 1953 No 1778

The
Chemical Age

Established 1919

The Weekly Journal of Chemical Engineering and Industrial Chemistry

BOUVERIE HOUSE 154 FLEET STREET LONDON E.C.4.
Telegrams: ALLANGAS FLEET LONDON · Telephone: CENTRAL 3212 (26 lines)

Volume LXIX 8 August 1953 Number 1778

Chemical Research Laboratory

THE Chemical Research Board's report for 1952—which is, of course, the account of the Chemical Research Laboratory's activities—contains one highly notable feature. During the year two new buildings became available, the Radiochemical Building in May and the Microbiological Laboratories in November. In post-war Government research a single relief from cramped conditions is remarkable and welcome enough, but the double event is a rarity indeed. It is churlish perhaps not to give full credit where it seems due, but we suspect that the expansion in accommodation results from decisions taken before the last economy drive. The current situation is more clearly reflected by the Board's statement that 'the scientific staff complement is still too small in relation to the programme'.

As usual, the report is extraordinarily versatile. It may be doubted whether any other single research establishment pursues activities in such totally different fields. There must always be reluctant decisions not to pursue certain byways of investigation, and the consequent responsibility falling upon the Director and the Board is far more onerous than in the days when chemistry and its aims could be more narrowly defined.

The smaller the staff at the Board's disposal, the greater the responsibility of deciding what to pursue and what to leave alone. This must injure the chances of pure research, for negative decisions are far more likely to fall upon projects that do not possess immediate or reasonably foreseeable applications. As all private industrial research effort must follow a similar course, it becomes more obvious than ever that the very springs of scientific progress—pure research—must increasingly be left to the universities. Yet the traditional view that the pursuit of pure knowledge is indeed the function and privilege of universities is today a dangerous over-simplification. A number of universities—particularly the younger ones—increasingly follow the applied or technological path.

No means by which a balance between pure and applied research can be maintained should be neglected. One brief passage from the Director's personal

report might well be quoted here: 'A large amount of work has been undertaken for other Government Departments in connection with the rearmament programme and the Laboratory's service to industry is evidenced by the increasing volume of advice and material help given . . .' It is difficult to see how this dominance of immediate needs and short-term applications can be reduced in DSIR establishments; when it is the State who pays the piper, the programme of tunes is never more closely scrutinised. The only hopeful corrective lies in well-planned and expanding transfers of the purer and longer-term research projects to the universities. The 1952 Report reveals that during that year the staff of the CRL reached its authorised maximum of 181. As things now stand, therefore, the flexibility of scientific opportunities is matched with a considerable inflexibility in the capacity to grasp them.

The devotion of most of this space to generalised comment is unfair to the CRL effort which has, in fact, been reported in detail. The continuation and intensification of sulphate-reducing bacteria research is commendable for the current easement of the sulphur scarcity situation might well have diminished these boldly conceived investigations. If eventually an economic industrial process emerges, few DSIR contributions to our national wealth will prove as valuable. The work of the Organic Group, though partially re-organised in 1952, has continued to follow a rather purer line than the work of other CRL Groups. The duties assigned to this Group are, in fact, of that nature—the purification of organic compounds, the precise determination of their physical constants, and the synthesis of radio-C organic compounds. Deviation from these aims would be most regrettable, for the immense modern growth of the heavy organic chemical industry has been founded on pure organic research. The CRL remains one of the centres of such research and this policy deserves particular respect. There is an indication that potassium chromate may be more firmly held as a surface corrosion inhibitor than sodium benzoate. Field investigations of buried pipe corrosion are showing that bacterial causes of attack are retarded if as little as 0.001 per cent of tannic acid is present. Another fairly simple chemical means of greatly reducing corrosion wastage may be in the making through this discovery. Even the most reluctant tax-payer can have no grievance about the services rendered by the authorised maximum of 181 members of the Chemical Research Laboratory. Grievance lies elsewhere—in the subtler thought that a staff of 270 (50 per cent more) might prove a far better investment for the nation.

On Other Pages

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

Notes & Comments

Aerosol Business

THE push-button aerosol pack for insecticides, paints, shaving soap, etc., seems to have captured the American retail market remarkably quickly. According to the latest survey there, just under 97,000,000 such packs were sold in 1952 compared with just over 40,000,000 in 1951. Domestic insecticides still comprise the principal class, approximately a third of the aerosol trade being of this kind. The next biggest class is that of shaving preparations—an exceedingly rapid development, for in the 1951 survey aerosols for shavers were not big enough business to classify separately. By comparison, aerosol trade in Britain is not even in its infancy. A limited number of aerosol-packed insecticides are produced and users in general have found them effective and economical, but other developments are not particularly noticeable. Whether aerosol products would in fact acquire as keen a demand as in the United States is possibly doubtful. The cost of the can and the charge for specialised packing add a premium price to these products, and there are none that cannot be packed and distributed in other ways. That is to say, there is no single household job that aerosol products carry out that was not being done by other means before. The USA public is well known for its love of gadgets and novelties; relatively, our own public is ultra-conservative and there are few purse-strings not being pulled tighter and tighter where household costs are concerned.

Packagers and Producers

IN America the aerosol 'boom' has been widespread so far as selling firms and products are concerned but there is a much shorter list of firms behind the technological expansion. Though there is now some tendency for firms to do their own packing, so far most aerosol packing has been carried out under contract—'private label filling'—by a limited number of specialised companies. They began with insecticides and it was because they found this work so seasonal that they sought other sales-outlets for the aerosol idea. A similarly centralised position in this new type of trade is occupied by the manufacturers of the propellant liquids, which are fluorinated hydrocarbons; two well-known chemical firms share most of this business. Cans are made in some variety, and recent signs are that aluminium and glass will enter the field. However, it is the valve that costs more—nearly twice as much as the container itself. An excellent survey of America's aerosol development can be found in *Chemical Week* (**73**, [3] 30-40); it should be of great practical value to anyone considering aerosol potentialities in the British market.

New Vegetable Oils

A NEW vegetable oil derived from rice bran is reported by the American Rice Growers' Co-operative Association. It is said to resemble peanut oil but is mild in odour and flavour and is much less easily turned rancid than other vegetable oils. As a frying-oil it is claimed not to pick up flavours, and food fried in it does not absorb as much fat. Another potential use is likely to be found in the lubricant field, for the rice oil has high penetration properties. Uses in the cosmetic and soap industries are also possible. This is a development that might well have wider implications outside America, where rice, after all, is not a major crop. Indeed, the oil contents of cereal brans in general have received little attention; wheat bran, for example, has an ether extract value for oil of 4.3 to 4.5 per cent, and oat 'dust' has shown as high a figure as 11.0 per cent, though the husk is as low as 1 per cent for oil content. There may be important colonial prospects for rice husk oil, and the general principle of cereal oil extraction might be usefully considered by the oat milling industry which is fairly neatly concentrated in Scotland and therefore reasonably centralised for by-product development.

A Persecution Complex?

AN extraordinary article on the Indian chemical industry appears in the June issue of *Science and Culture* (**18**, [12]. 563-6). The establishment of manufacturing subsidiaries in India by foreign firms is strongly criticised by the writer, H. G. Biswas. This, it is said, will deter Indian industrialists from launching new chemical enterprises and will also restrict the opportunities of Indian chemists who will have to work as clerks or 'underlings.' Such an outlook is surely parochial. Nothing is more likely to stimulate India's chemical industry than ventures that begin with imported capital and imported 'know-how.' A country in a much more advanced state of technological development might reasonably fear the effects of foreign subsidiaries, but India at this stage in her industrial life should welcome businesslike invasions. Criticism, however, goes further when the interest of foreign countries in India's native vegetable drugs is described as an indirect attempt to divert the free energies of India from the establishment of modern factories to produce chemotherapeutic drugs. In a sense this kind of suspicion is complimentary for it credits non-Indians with a subtlety they can hardly have thought of themselves. The idea that some of the vegetable drugs that can be produced from Indian flora might develop a useful world market is, by comparison, quite humdrum.

A Sterile Foundation

SUCH acute sensitivity to outside cooperation will prove to be a sterile foundation for chemical expansion in India. There is some justification for fears about the employment of India's own chemists; for some years the output from her own universities—and of Indian graduates from foreign universities—has tended to exceed the intake capacity of industry. Nothing can put this right except the expansion of industry, though a book on this subject published a few years ago suggested that nepotism rather than qualifications determined employment in India. The development of Indian chemical factories by experienced European or American companies is likely to create more opportunities for competent Indian scientists, though it is perhaps understandable that Indian workers themselves may be doubtful rather than confident on this point. It is certainly to be hoped that the article expresses no more than a minority point of view. Political independence is one thing; technological isolation is another.

Synthetic Fibres

Symposium on Properties to be Held

THE Plastics and Polymer Group of the Society of Chemical Industry has decided to hold as part of its programme for the 1953-1954 season a symposium to be called 'The Chemistry and Physics of Synthetic Fibres.' Papers will be presented and discussed on the chemical and physical basis of fibre formation and the properties of fibres in relation to the molecular structure and conditions of formation. It is believed that this will be a timely opportunity for a discussion of the fundamentals of the subject and their bearing on the synthetic fibre industry.

The symposium will be held on Wednesday, Thursday and Friday, 24, 25 and 26 March, 1954, in the lecture theatre of the Institution of Electrical Engineers, Savoy Place, London, W.C.2. Papers will be presented in full, but will not usually take more than 30-40 minutes each.

It is hoped to have a number of foreign contributions in addition to the papers which have already been promised from all the major organisations dealing with synthetic fibres in the UK. Preprints will be available and authors are asked to submit their manuscripts before 1 November, so that these can be prepared. It is hoped that those who do not have sufficient material for a full paper will be prepared to present it in the discussions.

Further details will be issued later this year, together with procedure for registration for the symposium. A fairly full programme has already been arranged, but any further authors who wish to contribute papers should get in touch with Mr. A. R. Burgess, Plastics and Polymer Group, Society of Chemical Industry, 56 Victoria Street, London, S.W.1.

Raw Materials for Synthetic Fibres

Suitable Sources & Relative Costs

SYNTHETIC fibres are judged today not only on their properties but also on the abundance and low price of their intermediates. It is not sufficient for a fibre to have good properties; it must also be a fibre that can be made cheaply and easily. This factor, important as it now is, was not at first allowed to interfere with fibre synthesis. If a fibre with good or novel properties could be made, then, provided that the intermediates were not impossibly expensive, it was assumed that a synthesis at moderate cost could eventually be achieved. Nylon and Terylene are examples of such fibres.

However, textile manufacturers, through many years of fierce competition, have become very price-conscious. If two cotton fabrics were to be made by two different manufacturers it was clearly necessary for them to ensure that they got their raw material at a competitive price. Today such influences persist, and they may determine which of the synthetic fibres will prevail; Dynel, for example, is a good deal cheaper than the other acrylics and it appears to be meeting with wide acceptance.

Nylon's Raw Materials

When Nylon was first synthesised, adipic acid was comparatively well known but hexamethylene diamine, the other intermediate, was not much more than a laboratory curiosity. The number of chemists who in 1938 had even seen some hexamethylene diamine must have been remarkably small. Nor was the synthesis of this intermediate particularly easy; adipic nitrile was obviously the key intermediate, its reduction to hexamethylene diamine being presumably accomplished by the action of sodium and alcohol:

$$CN(CH_2)_4CN + 4H_2 \rightarrow NH_2CH_2(CH_2)_4CH_2NH_2$$

In fact this reaction, as the author can testify from personal experience, does not go easily; and the alternative method of hydrogenation under pressure using a cobalt catalyst was considered. After initial difficulties in starting the reaction, it went very smoothly, giving an exceedingly good yield of a pure product, perfectly white, melting at 42°, and its adipate also having a good melting point. This behaviour is typical of pressure hydrogenation: conditions must be carefully controlled before the reaction will begin, but, once started, it will proceed very smoothly.

Synthesis of Adiponitrile

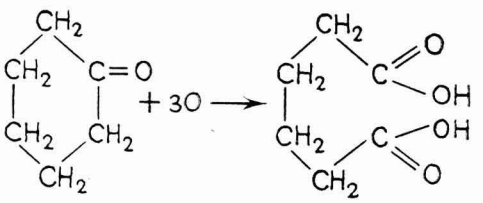
Today adiponitrile is still the essential intermediate for Nylon. The syntheses which are available for its large scale production are as follows:

1. Adiponitrile from benzene: the classical method, in which benzene is the starting material. The benzene is mainly derived from the distillation of coal. It is converted to *cyclo*hexanol by one of the two following routes:

(a) To phenol either through the sulphonic acid or through monochlorbenzene. The phenol is catalytically reduced with hydrogen under pressure to give *cyclo*hexanol.

(b) By reduction to *cyclo*hexane which is then converted to *cyclo*hexanol.

The *cyclo*hexanol, made by either of these two routes, is then oxidised to *cyclo*hexanone which is further oxidised with nitric acid to give adipic acid. This is the weak link in the chain of processes, because the yield of adipic acid from *cyclo*hexanone is low. The reaction is purely one of oxidation:



cyclo-hexanone — adipic acid

Adipic acid is one of the two intermediates for Nylon; the other is hexamethylene diamine. This is obtained from adipic acid through the ammonium salt; this can be converted to the amide by heating under about one atmosphere of ammonia, and the amide can be dehydrated to the nitrile by refluxing with acetic anhydride.

The adiponitrile anhydride can be obtained from ammonium adipate in one step on large scale production.

$$HO.CO(CH_2)_4COOH + 2NH_3 \rightarrow$$

Adipic acid

$$NH_4O.CO(CH_2)_4COONH_4$$

Ammonium adipate

$$\xrightarrow[NH_3]{\text{Heat}} NH_2CO(CH_2)_4CONH_2$$

Adipamide

$$\xrightarrow{\text{acetic anhydride}} NC(CH_2)_4CN + 2H_2O$$

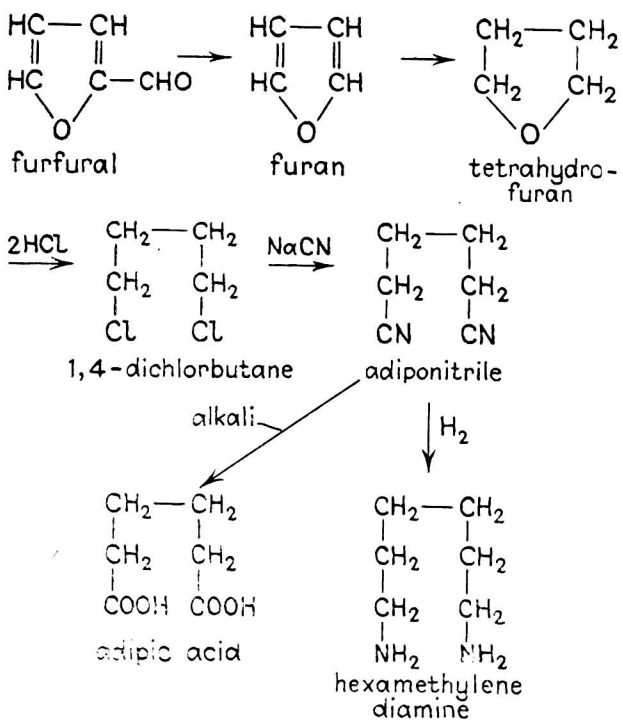
The synthesis is complicated and the product costly. However, Nylon is such an excellent fibre, quite the best of the synthetics that have yet been manufactured, that its production is certain to continue; its future application justifies a search for other and cheaper ways of making it. The problem resolves itself into one of finding a cheap and convenient synthesis for adiponitrile.

2. Adiponitrile from furfural. Furfural is made on a considerable scale from cereal waste, corncobs, husk and bran, and it is reported that the Quaker Oats Co. are increasing their furfural production. Furfural is converted by du Pont to furan and this is reduced to tetrahydrofuran, which on treatment with hydrochloric acid gives 1,4-dichlorbutane; this can be converted by treatment with sodium cyanide to 1,4-dicyanobutane, which is adiponitrile. Reduction of the nitrile gives hexamethylene diamine and alkaline hydrolysis would give adipic acid; it is, however, likely that the *cyclo*hexanone route might always be a cheaper source of adipic acid.

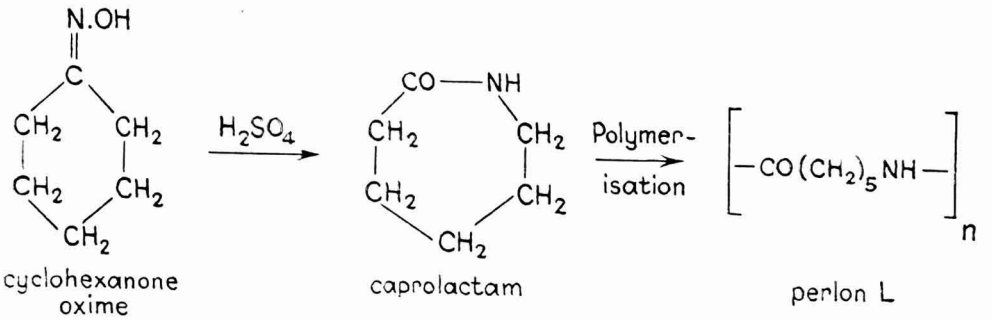
3. Adiponitrile from butadiene. Butadiene has been made in enormous quantities for synthetic rubber and may be easily available. It is made either from petroleum or from alcohol from molasses. The butadiene is chlorinated to dichlorbutene, which is treated with sodium cyanide to give dicyanobutene and on reduction this gives adiponitrile. Reduction can alternatively be taken straight through to hexamethylene diamine.

$$\underset{\text{1,4-Butadiene}}{CH_2{:}CH.CH{:}CH_2} \xrightarrow{Cl_2} \underset{\text{Dichlorbutene}}{ClCH{:}CH.CH.CH_2Cl} \xrightarrow{NaCN} \underset{\text{Dicyanobutene}}{NC.CH{:}CH.CH_2.CH_2CN}$$

$$\xrightarrow{H_2} \underset{\text{Adiponitrile}}{NC.CH_2.CH_2.CH_2.CH_2.CN} \longrightarrow \underset{\text{Hexamethylene diamine}}{NH_2.CH_2CH_2CH_2CH_2CH_2CH_2NH_2}$$



The synthesis of adiponitrile from furfural



4. Adiponitrile from ethylene chlorhydrin. This method has probably been used only experimentally. Ethylene chlorhydrin is readily obtainable by the addition of hypochlorous acid to ethylene; removal of the two chlorine atoms by a condensing metal will yield 1,4-butanediol which can be converted to dichlorbutane and to dicyanobutane successively; the reactions are:

$$\begin{matrix} CH_2 & & CH_2OH \\ \| & \xrightarrow{HOCl} & | \\ CH_2 & & CH_2Cl \end{matrix}$$

$$CH_2OH.CH_2Cl + ClCH_2.CH_2OH \xrightarrow{\text{Metal X}} HOCH_2CH_2CH_2CH_2OH + XCl_2$$

Ethylene chlorhydrin — 1,4-Butanediol

$$HO(CH_2)_4OH \xrightarrow{SOCl_2} Cl(CH_2)_4Cl \xrightarrow{NaCN} CN(CH_2)CN$$

1,4-Butane diol — Dichlorbutane — Adiponitrile

It will be seen that the possible raw materials for Nylon are:

1. Benzene from coal tar distillation or from petroleum.
2. *Cyclo*hexane from petroleum.
3. Furfural from cereal waste.
4. Butadiene either from petroleum, natural gas, or molasses alcohol.
5. Ethylene chlorhydrin from ethylene which may come from petroleum or from alcohol.

Which will be used will depend on cost and availability. Taking a long view, it looks as though the bulk of Nylon may eventually be made from butadiene.

Perlon

At least two types of Perlon are made; the one which is usually meant when 'Perlon' is spoken of is Perlon L, a German fibre; a similar fibre called Amilan is made in Japan. Perlon L is made from the 6 carbon atom amino acid, ϵ-aminocaproic acid. Whereas nylon (a '66' polymer) is built up of the repeat:

$$[-NH(CH_2)_6NH.CO(CH_2)_4CO-]$$

Perlon is a '6' polymer built of units of

$$[-NH(CH_2)_5CO-]$$

Perlon L is similar to Nylon in most of its properties and its applications, the greatest difference being the melting point which regrettably is about 40° lower than that of Nylon.

The amino-caproic acid which is the basis of Perlon L is not isolated as such during manufacture, but is used in the form of its lactam. Phenol is converted to *cyclo*-hexanone, as described above, the *cyclo*hexanone is converted to the oxime by treatment with hydroxylamine, and the oxime is caused to undergo the Beckmann re-arrangement by treatment with sulphuric acid. When the resulting lactam is heated it behaves as if it were aminocaproic acid (of which it is the internal anhydride) and forms the linear polymer which constitutes Perlon L.

For Perlon L, therefore, *cyclo*hexanol is the key intermediate and this can be obtained either from benzene through phenol or from *cyclo*hexane. In essentials, therefore, Perlon L requires the same raw material that Nylon was first made from, but it could not be conveniently made from the alternative raw materials for Nylon, furfural, butadiene or ethylene chlorhydrin.

Perlon U

This fibre has not gained the popularity which had been expected, although it has been manufactured and marketed in a comparatively small way in Germany. It is formed by the condensation of butane diol with hexamethylene di-isocyanate

$$HO(CH_2)_4OH + OCN(CH_2)_6NCO \rightarrow [-CO.NH(CH_2)_6NH.CO.O(CH_2)_4O-]$$

Perlon U
(polyurethane)

Butane diol might be easy to synthesise on a large scale, but the hexamethylene di-isocyanate has to be made from hexamethylene

diamine; this is dissolved in dichlorbenzene, carbonated, and then treated with phosgene, the reactions being as follows:

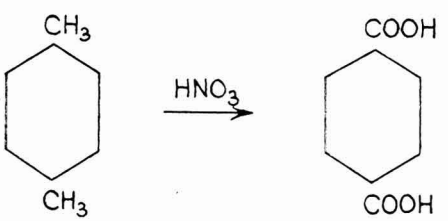
$$NH_2(CH_2)_6NH_2 + CO_2 + H_2O \rightarrow NH_2(CH_2)_6NH_2.H_2CO_3$$
Hexamethylene diammonium carbonate

$$NH_2(CH_2)_6NH_2.H_2CO_3 + COCl_2 \rightarrow HCl.NH_2(CH_2)_6NH.COCl + CO_2 + H_2O$$
Hexamethylene diamine carbamyl chloride (hydrochloride)

$$HCl.NH_2(CH_2)_6NH.COCl + COCl_2 \rightarrow OCN(CH_2)_6NCO + 4HCl$$
Hexamethylene di-isocyanate

It is clear that so far as concerns raw materials a polyurethane would be at a disadvantage compared with a polyamide.

Next to Nylon, Terylene (or Dacron as it is called in America) is probably the most promising of the synthetics. Its intermediates are ethylene glycol, which is cheap and abundant, and terephthalic acid, which until the advent of Terylene was just another chemical curiosity. Phthalic acid is cheap and common enough, but this (the *ortho* acid) when condensed with ethylene glycol gives an unsuitable polymer for fibre formation; the *para* isomer, terephthalic acid, is not easy to prepare, free, as it must be, from its isomers. At present, terephthalic acid is made by the nitric acid oxidation of *p*-xylene:



This involves the necessity for pure *p*-xylene, which is not easily separated from its *ortho* and *meta* isomers. At present, the petroleum industry is the best source of the *p*-xylene. Before Terylene can become cheap to produce, some way will have to be found of making terephthalic acid from a cheap *para* compound, one which is easily freed from its isomers.

Both Nylon and Terylene are excellent fibres and both have been made largely without concern as to the cost of their intermediates. Once manufacture has been undertaken, every effort is naturally made to reduce the prices of the intermediates and with some success. There is, however, no likelihood that the intermediates required will in the foreseeable future ever be very cheap. It is, therefore, unlikely that Nylon and Terylene can become really cheap fibres.

The Acrylates

Polyacrylonitrile has long been recognised as a potential fibre-forming material; clearly, it had the necessary fundamental structure —the long linear molecular chains. The difficulty was that it could neither be melted nor dissolved, so that there was no practicable way of spinning it. An intensive research programme carried out by du Pont showed that the insolubility of polyacrylonitrile was probably due to hydrogen bonding and that certain strongly polar liquids could break down these hydrogen bonds and so dissolve the polymer; dimethyl formamide was one such solvent. Since then three fibres which are mainly or wholly polyacrylonitrile have been marketed.

Orlon, the first of these, was made by du Pont and is probably wholly polyacrylonitrile. Acrilan is a more recent fibre made by Chemstrand; it is a co-polymer of acrylonitrile (mainly) and a minor constituent, possibly vinyl pyridine. X-51 is the newest of the acrylates and is made by American Cyanamid; it is a co-polymer of acrylonitrile (mainly) and an unknown minor constituent. Whereas Orlon and Acrilan are spun from solution, X-51 appears to have been spun from a melt.

Acrylonitrile is made in large quantities in two ways:

(1) By the addition of hydrocyanic acid to acetylene

$$CH \vdots CH + HCN \rightarrow CH_2 : CHCN$$

(2) By the reaction of hydrocyanic acid with ethylene oxide

$$\begin{matrix} CH_2 \\ \\ CH_2 \end{matrix} \diagdown\!\!\diagup O + HCN \rightarrow \begin{matrix} CH_2 \\ \| \\ CHCN \end{matrix} + H_2O$$

The supply of hydrocyanic acid is not inexhaustible although it is being increased and the cost of acrylonitrile is high; at

present it is about 43 cents (3s. 1d.) per lb. in America. This means that the polyacrylonitrile fibres cannot be really cheap. They have proved themselves to be of great value for industrial uses owing to their excellent resistance to chemical and biological attack. For a similar reason, they are particularly good for outdoor uses, equally in the UV-rich light of the tropics and in the chemically-laden atmospheres of industrial cities.

For apparel their future tends to be rather more obscure; they are easily washed and they will retain creases and pleats well so that only little ironing or pressing is necessary. The main trend at present seems to be to blend them with wool.

For special industrial purposes such as filter cloths and diaphragms, protective clothing and so on, their high price is no great obstacle, but for extensive use at home, matters may be different. It has been suggested that the market for such fibres may not be very great until the price of acrylonitrile has been reduced. With acrylonitrile at 43 cents, the new fibres sell as staple at about $1.80 (12s. 6d.) per lb., which is fairly high. If acrylonitrile could be reduced to about 9d. per lb. the acrylate fibres might sell at about 3s. 6d. per lb., and then there would be no doubt about their use on a colossal scale. There are three or four factories being built to make acrylate fibres each at a cost in the region of £10,000,000 and it is quite likely that this high capital investment may eventually drive the technicians to find a cheaper synthesis for acrylonitrile.

Dynel

Dynel (staple fibre) and Vinyon N (continuous filament), which are made by Carbide & Carbon Chemicals, are in a rather better position; they are co-polymers of vinyl chloride (60 per cent) and acrylonitrile (40 per cent). Because vinyl chloride is much cheaper, about 14 cents (1s.) per lb., Dynel is correspondingly much cheaper than those fibres which are made mainly from acrylonitrile. Dynel staple sells at about $1.28 (9s.) per lb. It has found extensive uses; in chemical and biological resistance it is similar to the polyacrylonitriles and it has been used on a considerable scale industrially. Also it has been used for blankets which are very easily washed and quickly dried. There can be little doubt that the much lower price of the raw materials for Dynel has contributed to its great success.

Polyvinyl Chloride Fibres

Various fibres have been made from polyvinyl chloride. The first of these to be successful was Pe-Ce, which was made in Germany and used during the last war for airmen's uniforms, mainly because of its non-flam property. Pe-Ce consisted of polyvinyl chloride which had been after-chlorinated. However, since the war, some fibres have appeared which are made from polyvinyl chloride that has *not* been after-chlorinated; such are PCU made by Badische Anilin und Soda Fabrik, and Rhovyl, Fibravyl, Thermovyl and Isovyl made by Société Rhovyl in France.

These fibres have found specialised applications in industry on account of their chemical resistance and non-flam properties, but they are so susceptible to heat (they cannot, for example, be boiled or ironed) that their employment at present for traditional textile purposes is ruled out. Thermovyl is a little better than the others because it has been pre-shrunk. All these fibres are potentially capable of very low production cost, but at present their large scale application is likely to be mainly in industry.

Polyvinyl Alcohol Fibre

A Japanese fibre which is known as Vinylon consists of polyvinyl alcohol; after having been spun it is cross-linked with formaldehyde. The fibre which is exported under the name 'Kuralon' has considerable interest. In the first place it is made from cheap and abundant raw materials, and in the second its possession of a multitude of hydroxyl groups confers on it a measure of hydrophilic properties.

Such properties are a characteristic of all natural fibres and are singularly missing in all the well-known synthetic fibres with the partial exception of Nylon. These hydrophilic properties lend moisture absorbency to a fibre and make it more suitable for clothing: it may well be that the Japanese have adopted the right policy of fibre synthesis in making Vinylon, embracing as it does (1) synthesis from low priced raw materials, and (2) hydrophilic characteristics.

How cheaply Vinylon might be made can be seen from an examination of its synthesis. Acetylene is converted by hydration and oxidation to acetic acid

$$C_2H_2 + H_2O + O \rightarrow CH_3COOH.$$

The acetic acid is then reacted with more

acetylene, using zinc acetate as a catalyst, to form vinyl acetate.

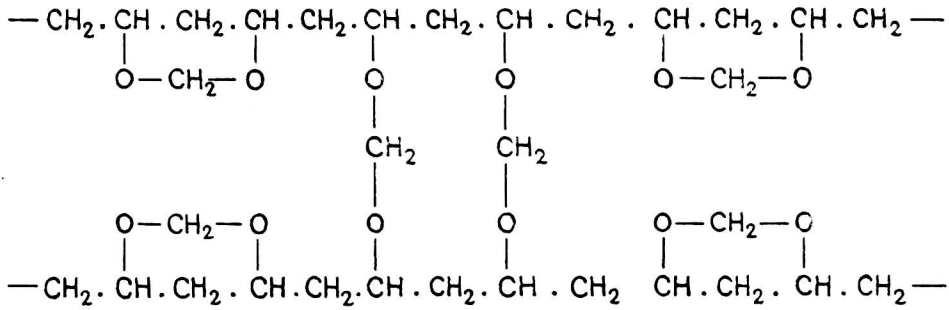
$$CH_3COOH + C_2H_2 \xrightarrow[\text{Acetate}]{\text{Zinc}} CH_3COOCH : CH_2$$

Vinyl acetate

The vinyl acetate is dissolved in methanol and, using a peroxide as a catalyst, is polymerised to polyvinyl acetate. Caustic soda is added to the methanol solution, and saponifies the polyvinyl acetate to polyvinyl alcohol, which is precipitated.

The polyvinyl alcohol (known as poval) is pressed and dried. It is dissolved in hot water to make a 15 per cent solution which is spun into a coagulating bath of sodium sulphate solution, and subsequently the fibre is cross-linked or hardened with formaldehyde. The whole synthesis is very attractive and the fibre itself has a moisture content under standard conditions (65 per cent R.H. 70°) of over 5 per cent. For comparison, wool has one of about 14 per cent, viscose rayon 12 per cent, acetate rayon 6 per cent, Nylon 4 per cent, and Terylene, Dynel, Orlon, etc., less than 1 per cent.

The chemical structure of the final product is approximately as shown:



Its moderately hydrophilic properties may make Vinylon outstanding. In 1952 its production was about 6,000,000 lb. and it is expected to reach 53,000,000 lb. per annum by 1957. This fibre seems to have the right essentials, abundant and cheap raw materials and a modicum of hydrophilic properties to lend kindliness to fabrics and garments made from it. Very possibly in its present form it may have defects, but it seems to indicate a new line of attack in the synthesis of fibres.

Aluminium Development

Progress Recorded in Annual Report

DURING 1952 more than 2,750 inquiries were dealt with by the Aluminium Development Association; nearly 132,000 publications were issued; and the staff gave 38 lectures and more than 400 film shows.

These interesting figures, denoting the progress made by the Association during the eighth year of its existence, are given in the abridged annual report.

The report summarises the Association's work under headings corresponding to its main activities. Information services are sub-divided into publications—of which 12 new or revised editions were issued during the year apart from the Association's periodicals—library and inquiries services, and the issue of technical memoranda. Under education it is noted that the mailing list now comprises nearly 2,000 names and that there has been a further increase in the number of directors of education who make known the Association's facilities.

Research has been a major activity as usual. Particular attention has been given to the jointing of aluminium electrical conductors, large diameter aluminium rivets, welding problems and investigations of various aspects of the corrosion problem.

The Association's development work is described under the headings of Structural Engineering, Marine, Building, Road and Rail Transport, Mining Equipment, Electrical Engineering, Castings and Standards. Considerable work has been undertaken on investigation strut instability with particular reference to BS. 1161, and there have also been some interesting inquiries in connection with roof structures and cranes. The Association's work on standardisation has been pursued and members of the staff, covering between them 77 BSI Committees, attended some 54 meetings.

The Analysis of Fluorine-containing Organic Compounds*

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

IT is usually necessary to modify the conventional method for the determination of any particular element in an organic compound when fluorine is present. Furthermore, the determination of fluorine itself is complicated because of the difficulty of decomposing completely many of its compounds and the lack of convenient and precise methods for determining the fluoride ion itself. Information on the subject is meagre; and those methods which we have attempted to apply have not proved satisfactory for a wide range of compounds.

Some years ago, we began a detailed investigation in an attempt to develop satisfactory methods for the analysis of fluorine-containing compounds. The present paper describes the point reached in this investigation, which is not yet complete.

Determination of Carbon & Hydrogen

Although several methods have been described where carbon and hydrogen separately have been determined, there is little in the literature concerning the simultaneous determination of both elements. It was known that some laboratories absorbed silicon tetrafluoride in lead chromate heated to 800°, but the life of the tube was very short and a better method was sought.

We found that a packing of sodium fluoride heated to 270° was extremely satisfactory,[1] there being no attack on the tube. In most other respects the method follows closely that of Friedrich. We have used this method with success for some years for a wide variety of compounds.

Originally some trouble was experienced with certain types of fluorocarbon, and it was thought that the presence of water vapour in the system was necessary to ensure complete combustion. We have since found that the best solution to the problem of decomposing very refractory fluorocarbons is to raise the temperature of the combustion zone to 900°.

Determination of Fluorine as PbClF

Heating at 600-650° with metallic sodium or potassium in a nickel bomb of special design† was found to be the most effective means of decomposing the sample.[2] Several ways of completing the determination were tried, and eventually the gravimetric lead chlorofluoride method was selected. The results are generally slightly low, owing to the solubility of the precipitate, but the method is free from the uncertainties of many alternative methods.

When other halogens are present, the method can be operated without modification, for lead chlorofluoride is the least soluble of the lead fluorohalides. When sulphur, phosphorus or arsenic is present, it is necessary to complete by the Volhard method, since insoluble lead salts are formed which interfere with the gravimetric determination.[3]

There is one drawback to this method. The minimum permissible amount of fluorine is *ca.* 25 mg.; below this amount the results are significantly low.

Determination of Fluorine with Thorium Nitrate

More recently a truly micro method has been developed. It is not as accurate as the preceding method for amounts above 25 mg. of fluorine, but it gives a fair accuracy in ranges where the lead chlorofluoride method is unsuitable. It is only used, therefore, when the amount of sample is limited.[4]

The compound is decomposed in the same way as in the previous method, and the fluorine is determined by titration with thorium nitrate using the procedure of Dahle *et al.*[5] This is the only satisfactory way we have found of using thorium nitrate as a titrimetric reagent when the amount of fluorine present is not known.

The unknown is titrated to a definite shade

* *Lecture given at the 26th International Congress of Industrial Chemistry in Paris, 22-27 June, 1953.*

† *This bomb is manufactured by Charles W. Cook and Sons, Ltd., Perry Bar, Birmingham. The cup of the bomb is made of nickel. Originally, the sealing nut was constructed of H.R. Crown Max. (Firth Vickers) steel, but more recently it has been found that Firth Brown "NACCH" 4½ per cent Ni-Cr is much more suitable. The slight differences in coefficients of expansion give a better seal.*

of pink (Alizarin S indicator). An equivalent amount of thorium nitrate and indicator is transferred to another vessel and back-titrated with standard sodium fluoride solution until the colours in the two vessels match. Water is added to the second vessel, of course, so that the volumes are exactly the same at the end-point. The sodium fluoride titre will then be equivalent to the fluorine in the sample.

Since it is necessary to neutralise the bomb-washings with a suitable mineral acid (hydrochloric acid), it is necessary to add an equivalent amount of sodium chloride to the comparison solution. The amount required is established by acidimetric titration of an aliquot of the bomb-washings.

It is essential to follow this procedure because of the interfering effect of sodium or chloride ions on the titration. When potassium is used for the decomposition it is necessary to titrate with standard potassium fluoride and to add potassium chloride to the comparison solution, because the effect of this ion is different from that of sodium.

When nitrogen or sulphur are present, cyanide or sulphide ions are formed. These can be eliminated by a controlled boiling which does not affect the fluoride present.

Determination of Other Halogens

Chlorine, bromine, and iodine can be determined individually, as any pair or all three simultaneously. Since fluorine is determined on a separate aliquot all four halogens may be determined on the one sample.

The decomposition is effected as before. Chlorine is determined by the mercuric oxycyanide method; bromine and iodine by oxidation with sodium hypochlorite and bromine respectively, to bromate and iodate, followed by an iodometric titration. When all three are present, the total halides are determined by the mercuric oxycyanide method, bromine plus iodine by hypochlorite oxidation, and iodine by bromine oxidation, using separate aliquots. Chlorine is then obtained by difference.

Determination of Nitrogen

Preliminary work has shown that the method of Kirsten[6] is very suitable. The high temperature used in this method readily decomposes the most resistant fluorine compound. However, our work in this field is still far from complete and the method is not yet on a routine basis.

Determination of Sulphur

It is hoped to apply our new reagent for sulphate ions, *p*-chloro-*p'*-amino diphenyl[7] to the determination of sulphur, but work has not yet been started.

Determination of Traces of Hydrogen

It is of some importance to determine very accurately traces of hydrogen in fluorocarbons. If a compound of MW 500 had one atom of hydrogen in it, the value of 0.2 per cent could not be determined satisfactorily by the conventional method. In the method we use[8] the compound is decomposed at 1,300° in a platinum tube, using a sample weight of about 200 mg. The hydrogen is converted to hydrogen fluoride which is absorbed in water and determined alkalimetrically. The accuracy of the method is ± 0.01 per cent.

The originators of the method only applied it to fluorocarbons and chlorofluorocarbons. At the present time we are investigating its applications to the determination of hydrogen in all other types of fluorine-containing compounds, but it is anticipated that the method will have to be modified considerably for this purpose.

REFERENCES

[1] Belcher, R., and Goulden, R., *Mikrochem.*, **36-37**, 679 (1951).
[2] Belcher, R., and Tatlow, J. C., *Analyst*, **76**, 593 (1951).
[3] Belcher, R., Caldas, E. F., and Clark, S. J., *ibid.*, 77, 602 (1952).
[4] Belcher, R., Caldas, E. F., Clark, S. J., and MacDonald, Miss A. (Unpublished work.)
[5] Dahle, D., Bonner, R. U., and Wichmann, H. J., *J. Assoc. Off. Agric. Chem.*, **21**, 459 (1938).
[6] Kirsten, W., *Anal. Chem.* **25**, 74 (1953).
[7] Belcher, R., Nutten, A. J., and Stephen, W. I., *J. Chem. Soc.*, 1334 (1953).
[8] Miller, J. F., Hunt, H., Hass, H. B., and McBee, E. T., *Anal. Chem.*, **19**, 146 (1947).

Dacron for Insulation

DACRON polyester fibre will soon be used as an electrical insulator, E. I. du Pont de Nemours announce. Dacron has high tensile strength, resistance to deterioration by heat and chemicals, stretch resistance and low moisture absorbance; it can be made tougher than asbestos and is easy to apply as an insulating cover.

Du Pont's Orlon acrylic fibre also shows promise as an insulating material, being used at present as insulation for electro magnet wire. It winds readily, and resists weathering and acid gases in the air.

Complaints Against Chemical Works

Alkali Inspectors Report Another Busy Year

THE recession in trade experienced by the chemical industry last year, particularly in the first half, afforded manufacturers an opportunity to catch up with arrears of maintenance and certain improvements in that direction were manifest according to the 89th Annual Report on Alkali, etc. works for 1952 (HMSO, 2s. 6d. net).

In 1952 there were 964 works registered under the Act, involving the operation of 1,785 separate processes. Compared with the previous year there were seven fewer works, but an increase of 12 in the processes operated.

The total number of visits and inspections paid during the year was 3,786, including 232 special visits by the Chief Inspector (Mr. W. A. Damon) or his deputy, Dr. J. S. Carter. Of these visits 319 were to or in connection with works not registered under the Alkali Act and 141 further visits were to or in connection with spoilbanks. During the inspections 1,839 quantitative analyses were made of gases evolved from the processes in operation and in addition 154 special samples were drawn and submitted to the Government Laboratory for detailed examination. The services of the Government Laboratory in this connection were greatly appreciated.

Another Inspector

Recalling that in his 1951 report he drew attention to the increasing size and complexity of works, necessitating more time for each inspection, the Chief Inspector went on to express pleasure at the Treasury having agreed to the recruitment of an additional inspector, who would operate from Manchester. It was intended to enlarge the boundaries of the existing District 2 and to split it into two parts, so that Liverpool would remain the headquarters of the western part and Manchester that of the eastern part. Boundaries of other districts would be adjusted in conformity.

The Act is specific in its provisions relating to escapes from alkali, sulphuric acid (chamber and concentration processes) and muriatic acid works, requiring that they should not exceed certain stated concentrations of acid gases. The requirement with regard to other scheduled works is that the best practicable means should be furnished and used efficiently so that offensive gases are either eliminated or rendered harmless or inoffensive.

In the latter cases there is no well defined line between legitimate and illegitimate operation, and a decision as to whether a given set of conditions constitutes an infraction rests first with the district inspector and finally with the Chief Inspector.

During the year 67 infractions were recorded in formal letters to the owners of the works concerned, but as remedial steps were promptly taken and suitable assurances given in each case, it had not been considered necessary to enforce the penal clauses of the Act.

Technical Advice and Assistance

Complaints or requests for technical advice and assistance totalled 116; most of these came through local authorities, but some came direct from aggrieved persons and others from Members of Parliament. All received or were receiving attention; 43 cases concerned registered or registrable processes, 62 non-registrable processes and 11 spoilbanks.

Commenting further on adverse conditions in the chemical industry, the report states that repercussions arising from the slump in the textile industry were widespread and particularly affected the production of dyestuffs and dyestuff intermediates. Some signs of recovery in that field were apparent towards the end of the year.

Chemicals used in the paint and leather trades were also in poor demand. Sulphuric acid production was restricted in those areas where it was dependent on viscose rayon and paper manufacture; it was not affected so much where it was chiefly absorbed for the manufacture of sulphate of ammonia or explosives, or for oil refining purposes. Coke ovens, gas works, iron and steel works and cement works had been in full production.

Although superphosphate manufacture seemed to be recovering in the later months, the year's production was probably below the average. A reduced demand for nitric

acid in the dyestuffs trade was at least partly offset by increased demands for nitrochalk and explosives. This had helped to sustain the production of synthetic ammonia. Chlorine production had been reduced but even so the shortage noted in 1951 completely disappeared in 1952. Non-ferrous metals experienced a lean year.

The duty of securing smoke abatement rested primarily with local authorities which had the necessary powers, but in practice they co-operated closely with the Ministry of Housing and Local Government and the Ministry of Fuel and Power, and the Alkali Inspectors attempted to deal with cases of excessive smoke produced by industrial undertakings such as gas works, coke ovens, lime kilns and so on. The Fuel Efficiency Branch of the Ministry of Fuel and Power offered expert and practical advice in cases where faulty furnaces or the inefficient use of fuel caused smoke production.

Visits in connection with processes not registered under the Alkali Act (exclusive of those to spoilbanks) totalled 319. Detailed progress reports were submitted to the Minister and where a local authority had been concerned it had also been kept informed.

In this field complaints were directed at some new coke ovens soon after they went into operation. At a meeting of interested parties with the Alkali Inspector, it appeared that the complaints referred chiefly to vibration and noise, although the discharge of noxious fumes was also alleged. This discharge was traced to an occasion when a foul gas main became blocked and there was also a temporary emission to atmosphere. Some smell was said to emanate from a brook into which liquid effluents were discharged. All these matters had been or were being dealt with by the National Coal Board, who had been at pains to remove any reasonable cause for complaint.

New Projects

The Alkali Inspectors had continued to keep in touch with the development of projects for the building of new gas works and had consulted with the Gas Boards in that connection. From information received, it was apparent that full consideration was being given to the necessity of keeping noxious or offensive emissions to a minimum.

Dealing with complaints of dust and fumes from metallurgical processes, the report states that continued attention was given to the problem of the treatment of fumes from a drier used to remove cutting oils from aluminium swarf and turnings, but little progress had been made. The removal of oil was necessary to enable the efficient magnetic separation of adventitious iron with which the scrap is contaminated. Self-discharging centrifuges could not remove oil sufficiently effectively to enable magnetic separation to function properly and the company did not feel able to install this somewhat expensive plant for the sole purpose of reducing the oil content in the scrap presented to the drier. Further consideration was being given to the design of a furnace in which the fumes from the drier could be burned and the heat thus generated usefully employed.

Detrimental Dust

A complaint alleging the deposition of a dust detrimental to vegetation was traced to a slip past the bag filters attached to an elutriation plant for the separation of copper powder into sizes appropriate for commercial uses. As a temporary expedient, the escapes were vented into the roof loft of the factory building and strips of felt were fitted under the slates to form a makeshift filtering chamber. Later, the escapes were conveyed by light trunking to a canopy with side curtains of duck, sealed in a tank of water. More regular inspection of the bag filters had also been instituted and, as an additional safeguard, in case of an excessive escape (e.g., due to a burst bag), provision had been made for water spraying within the canopy.

Complaints continued to be made regarding emissions of phosphorus fumes from certain works. One specific complaint was traced to the liquid effluent treatment plant, where a large volume of warm water containing traces of elemental phosphorus was neutralised. By reason of agglomeration, particles of phosphorus tended to rise to the surface and ignite spontaneously; there was also a liberation of phosphine gas which immediately fired.

The result was that there was a tendency to fog formation in the vicinity of the plant because of the presence of phosphorus pentoxide and steam. Elemental phosphorus in the water arose mainly from the hot con-

densers at the furnaces and experimental work had shown that this could be substantially reduced by filtration and chlorination. A plant which was being built for that purpose was expected to be completed early this year.

Improvements in the design of electrical precipitators had resulted in an appreciable reduction in the quantity of 'mud' requiring redistillation with an accompanying fume hazard. In the operation of the electric furnaces greater attention had been paid to the size of the tapping holes and new tapping blocks were fitted at more frequent intervals, although the practice involved an increase of idle furnace time. Some success had been achieved with a venturi jet, which reduced the pressure at the furnace tops and thus also reduced the escape of fumes from the openings through which the moving electrodes passed. There were, however, still some technical difficulties to overcome.

Complaints of smells from pesticide manufacture included one involving the use of *para*chlorocresol in the production of a selective weed killer. It was thought the trouble had been overcome by draughting of the chlorocresol melting cabinet and the reaction vessel to a caustic soda scrubber, but complaint continued. Not only was the plant moved from the open into a large hangar, but the ground on which it formerly stood was evacuated and thoroughly decontaminated. The local authority having served an abatement notice, the company offered to enclose the plant more closely and ventilate to a caustic soda scrubber. The report adds: 'The smell from the process is extraordinarily persistent and it is difficult to see what further steps can reasonably be taken, short of abandoning it.'

New Basis of Efficiency

There were 15 registered alkali works, comprising 28 mechanical and 13 hand-operated furnaces. A total of 55,600 tons of salt were used in the saltcake process in 1952, compared with 61,000 tons the previous year. In calculating the efficiency of condensation, allowance was now made for undecomposed salt remaining in the saltcake. The average weighted efficiency of all works, on the new basis, was 96.8 per cent, compared with 95.8 per cent in 1951. Tests made by district inspectors throughout the year showed an average escape from absorbers of 0.080 grain of HCl per cu. ft. Three infractions were recorded of the provision of the Act, which requires that the escape shall not contain more than 0.2 grain of HCl per cu. ft.

The 51 registered sulphuric acid works comprised 61 sets of leaden rectangular chambers, 11 sets of tower chambers and five sets of mixed rectangular and tower chambers. Compared with 1951, the total output of sulphuric acid was less by 71,000 tons (as monohydrate). The use of brimstone sulphur had been reduced and that of pyrites increased. The position with regard to the supply of brimstone had markedly improved to the extent that all statutory control had been removed on the supply and use of sulphur for purposes other than that of sulphuric acid manufacture..

Ensuring Supplies

To ensure that acid manufacturers had sufficient sulphur to meet essential requirements it was necessary that economies should be continued and that as much acid as possible be made from other materials.

The average of tests made by the Alkali Inspectors on exit gases during the year showed an acidity, calculated as SO_3, of 1.69 grains per cu. ft. On six occasions only were tests recorded in excess of the statutory limit of 4.0 grains.

Dealing with Class 2 sulphuric acid works, the report states that there were 29 such works registered for the manufacture of acid by the contact process and 20 for the concentration or rectification of acid. At the former 29 works there were 23 two-stage, six three-stage and 15 four-stage units. There were also 19 Grillo type plants and one Collins plant. Seven occasions were recorded when the escapes failed to satisfy the standards previously set forth. Misty escapes continued occasionally to cause local complaint.

Of the 42 chemical manure works registered, nine were intermittent superphosphate plants, 18 continuous superphosphate plants, 40 for granulating compound fertilisers and two for the production of fertilisers from organic materials.

With regard to the superphosphate processes there had been some deterioration in that the number of infractions rose to nine. In all cases the offence related to inadequate scrubbing of the waste gases so that the Department's provisional standards—a final escape with a total acidity less than

the equivalent of 0.1 grain, calculated as sulphur trioxide, per cu. ft., or a scrubbing efficiency greater than 99 per cent—was not met. In four cases satisfactory conditions were speedily restored by relatively minor adjustments to the existing scrubbers, e.g. by cleaning or readjustment of sprays.

Gas liquor works to the total of 147 were registered. Of these, 116 were engaged in the production of crude concentrated ammonia liquor, 25 in the production of purified concentrated ammonia liquor and the remaining six operated other processes involving the desulphurisation of ammoniacal liquor. The number of infractions recorded for the year against plants for the production of concentrated ammoniacal liquor was higher than for any other class of registered works. Eleven works were involved.

There were 78 registered nitric acid works —three at which nitric acid was produced by the ammonia oxidation process and 75 at which acid-forming oxides of nitrogen were evolved and/or recovered. The acidities of the escaping gases at the first three works were much the same as in the previous year and conditions at the remaining 75 works were reasonably good.

Six muriate of ammonia and 89 sulphate of ammonia works were registered. The latter group comprised six direct recovery works, 46 indirect and 36 semi-direct, as well as two synthetic works. The present total of 95 works compared with the 344 registrations in 1932 and 614 in the peak year, 1916, this being especially interesting in view of the fact that production of ammonium salts was now three times the 1916 figure. The fall in the number of registrations was almost entirely due to the cessation of ammonia recovery at many of the smaller gas works. Operations were conducted reasonably well, but there were three occasions during the year when conditions were such as to constitute an infraction of the Act.

Less Chlorine Used

Chlorine was produced and, in some cases, also used, at 16 of the 92 registered chlorine works; in 76 works chlorine was used only. The production and use of chlorine had been affected by adverse trade conditions. On the whole, plants had been operated reasonably well, but, the report points out, chlorine is a particularly unpleasant gas and escapes, even of short duration, seldom pass unnoticed by the general public.

Muriatic acid works to the total of 171 were registered and of six infractions recorded, three related to operations at fibre-separation or wool carbonising works, an industry confined to the West Riding of Yorkshire. The other three were concerned with a phosphoric acid purification process. With regard to the manufacture of synthetic hydrochloric acid, operations had been well conducted.

There were 116 registered sulphide works, these being engaged in many processes involving the use of evolution of hydrogen sulphide.

The 19 registered arsenic works comprised three at which arsenious acid was made, five at which the use of nitric acid was involved and ten at which volatile arsenic compounds were evolved. Operations on the whole had been conducted in a satisfactory manner.

The Only Offender

Registrations of nitrate and chloride of iron works included eight works for the manufacture of nitrate of iron and four for the manufacture of chloride of iron. The only offence, ironically enough, occurred at the most modern unit, where an appreciable emission of nitrous fumes at both high and low level was found to be due to bad cracking of the new stoneware towers as a result of overheating.

Of the 72 registered bisulphite works, 30 produced sulphites and bisulphites, 22 produced sulphurous acid, four produced liquid sulphur dioxide and 32 processes from which oxides of sulphur were evolved. Generally speaking, conditions had been satisfactory and there were no infractions to record.

There was a further fall in the number of tar works registered—148 compared with 155 in 1951—this again being due to the continued tendency to concentrate distillation in large central installations, the tar distilled being half as much again as it was 20 years ago. Eight infractions were recorded.

The number of benzene works registered fell from 381 in 1951 to 362, this being almost entirely due to a fall in the number of plants in operation at gas works, where a number of those registered were now used primarily for the removal of naphthalene with benzole recovery as a secondary incidental. Four infractions were recorded.

Larger Chemical Sales in Germany

New Processes Operated Under Licence

TOTAL sales by the West German chemical industry in the first five months of this year amounted to DM.4,285,000,000 compared with DM.3,940,000,000 in the corresponding period of 1952, an increase of 8.8 per cent achieved against a background of declining prices. The ex-works price index for chemical products which had receded to 195 (1938 = 100) in 1952 had fallen further to 187 by May and was thus substantially below the general industrial price index of 221.

The higher level of sales is expected to continue during the remainder of the year because of the favourable trend in the home market. Chemical exports in January-May this year amounted to DM.885,000,000, against DM.770,000,000 in the whole of 1952, while imports of chemical raw materials totalled DM.170,000,000 in the first five months of 1953, against DM.430,000,000 in the whole of last year. German chemical manufacturers point out that the industry's foreign trade position has improved; chemical exports were five times the industry's raw material imports.

Special attention is being paid by German chemical manufacturers to the utilisation of research findings by foreign, especially USA, companies and a number of licence agreements under which German firms benefit from developments in other countries have become known. Thus Degussa Deutsche Gold- und Silber-Scheideanstalt, Frankfurt, has entered into a ten-year licence contract with Godfrey L. Cabot Inc., of Boston, for the production of furnace black in Germany.

Surplus for Export

It has not yet been decided whether the new plant is to be set up at Dortmund or at Kalscheuren, in both of which towns Degussa is operating carbon black factories. The cost of the new plant will be between £400,000 and £800,000, and its capacity will be designed to leave a surplus for exports after meeting domestic needs. The Mutual Security Administration has undertaken a transfer guarantee for the licence fees of up to $1,000,000.

Other important licence agreements in operation between USA and German companies are those between Dow Corning and Wackerchemie GmbH, Munich, concerning the production of silicones in Germany and between General Electric Co. and Farbenfabriken Bayer AG, Leverkusen, for the production of methyl chloro-silane. The last-mentioned German company is at present erecting a plant designed to cover all West German requirements, for which General Electric is reported to have provided data based on its latest technical experience. Bayer also holds General Electric licences for silicone resins, oils and rubbers and is about to start production of silicone rubber.

Oil Refining

The utilisation of foreign licences is particularly important in the West German oil refining industry. Thermofor catalytic cracking plants have been erected under Socony-Vacuum licences by Deutsche Erdöl AG, at Heide, Holstein, and by Deutsche Vacuum Oel AG at Bremen-Oslebshausen, and other German subsidiaries of foreign oil combines are also using processes developed abroad. Mention may be made in this connection of the new 'platforming' unit to be set up with an annual capacity of 330,000 tons by BP Benzin-und Petroleum-GmbH. at Hamburg-Finkenwärder.

The production of aluminium silicate (pearl) catalyst under licence from Socony-Vacuum was started towards the end of last year by Kali-Chemie AG at Nienburg/Weser. This plant will supply TCC crackers in Germany and other countries of Europe with the special catalyst required.

An instance of foreign buyers providing finance for the erection of new industrial plant in Germany was reported last month. Kalle & Co. AG, Wiesbaden-Biedrich, in June opened new extensions to its cellophane plant, raising its output capacity by 40 per cent. A large part of the output is being exported, and one of the principal foreign customers, the British-American Tobacco Co., is reported to have provided part of the finance for the extensions.

Leading manufacturers in various branches of the West German chemical industry were able to report at this year's annual meetings that postwar rehabilitation and rebuilding

have been concluded. In view of the decline in prices some of them have been making special efforts to reduce production costs by plant modernisation and rationalisation of operations, especially in the field of heavy chemicals and fertilisers, in which excess capacity is having adverse effects on prices.

In the pharmaceutical industry progress is being maintained at a satisfactory pace. In view of the general rise in consumption of pharmaceuticals in the world, which has had the result of German consumption falling below the average of countries in a similar position, German manufacturers expect to be called upon to meet larger demands at home in the next few years.

British Industries Fair

Statement by ABCM

THE following statement has been issued by the Association of British Chemical Manufacturers:—

Critical comment has been made on the declining interest shown both by exhibitors and buyers in the Chemical Section of recent British Industries Fairs, and of the rapid decrease in the size of the section.

The Council of the Association is concerned at this trend because it considers that an exhibition is one of the important means of securing essential publicity for the chemical industry, and in principle supports the British Industries Fair as a suitable vehicle for this purpose. It is clear that the present arrangements were unsatisfactory and that a new approach is needed. To give time for proper consideration of a long-term policy, therefore, the Association has decided not to organise a Chemical Section at the 1954 British Industries Fair.

To avoid misunderstanding, the Association wishes to make it clear that this temporary withdrawal does not mean that the chemical industry has decided to leave the Fair permanently. The sole object of this blank year is to provide a breathing space, during which time the Publicity Committee and the Chemical Section Advisory Committee will examine ways and means of organising a satisfactory and comprehensive display in future years. Such displays may well be at the British Industries Fair in London or Birmingham, and either alone or in co-operation with allied industries such as plastics and chemical plant. This decision is still open and depends on what members consider will provide them with the most attractive conditions and useful results.

There is almost unanimous agreement, however, on the need to stay out of the 1954 Fair to allow proper consideration of long-term policy. Another partial showing like 1953 labelled as a Chemical Section might well destroy any possibility of a successful section in future Fairs.

All members of the Association have, of course, been notified of this decision, and this statement is issued to make the Association's position and intentions clear, and in the hope that potential chemical exhibitors will act in concert with members of the Association in the matter. The Board of Trade have been informed of these views and intentions and asked to co-operate as far as possible in the long-term interests of the Fair.

Industrial Civil Defence

THE Home Secretary, Sir David Maxwell Fyfe, recently announced the creation of the Industrial Civil Defence Service, and outlined plans for the managements of industrial and commercial premises and local authorities. The new service will be independent of the Civil Defence Corps and the allied services, but its training and working will be in close collaboration with them. It will comprise industrial units and groups of units which will take their place in local authorities' plans.

Price Control Revoked

THE Minister of Materials has made Orders which free sulphuric acid and ground sulphur from price control. The Sulphuric Acid (Prices) Order, 1951 (S.I. 1951 No. 551) and the Sulphuric Acid (Prices) (Amendment) Order, 1952 (S.I. 1952 No. 647) which provide maximum prices for sulphuric acid, and the Ground Sulphur (Prices) Order, 1952 (S.I. 1952 No. 646) which provides maximum prices for ground sulphur, are revoked with effect from 4 August. Copies of the orders, the Sulphuric Acid (Prices) (Revocation) Order, 1953, S.I. 1953 No. 1160 and the Ground Sulphur (Prices) (Revocation) Order, 1953, S.I. 1953 No. 1161, may be obtained from HM Stationery Office, or through any bookseller, price 2d. each.

THE REFINING OF OILS AND FATS. By A. J. C. Anderson. Pergamon Press Ltd., London. 1953. Pp. vi + 204. Price 45s.

This excellent monograph was originally planned as a section of a contemplated up-to-date English edition of Dr. H. Schoenfeld's well-known hand book 'Chemie, Technologie und Verwendung der Fette und Oele.' Unfortunately the larger project was abandoned but Mr. Anderson completed his own work in such a manner as to form a self-contained text. Although primarily intended for the specialist and worker in the field of edible oils, the book has a wider appeal to all chemical engineers, and particularly to students and those engaged in the teaching of chemical engineering. The unit operations employed in refining of oils, filtration, sedimentation, neutralisation, bleaching and deodorisation are discussed in separate chapters with sufficient theoretical background to enable the process worker to understand the fundamental chemical engineering principles involved. The equipment used is then described in detail with excellent drawings and illustrations. These have been carefully selected from a variety of sources supplemented by many of the author's own drawings.

The book is divided into five parts dealing with 'Removal of Fat-Insoluble Impurities,' 'Removal of Fat-Soluble Impurities' 'Process Control,' 'Complete Refinery Plants' and 'Statistical Information.' Of these, part II is the most important and constitutes the greater part of the book. It covers degumming, neutralisation, bleaching or decoloration and deodorisation. Almost every chemical engineering unit operation is used in these processes. Distillation (batch and continuous), adsorption, solvent extraction, filtration, mixing and a number of chemical operations are described. Modern developments are dealt with in detail with appropriate references to the current technical and patent literature, thus providing an up-to-date reference work for process and research workers alike.

Above all the book is readable, and presents a fascinating story of an industry which for some reason has not been widely known to workers outside it. This book should do much to remedy this, for it will prove of interest to chemists and chemical engineers in whatever industry they are engaged.—F.M.

CRIME INVESTIGATION: PHYSICAL EVIDENCE AND THE POLICE LABORATORY: Paul L. Kirk. Interscience Publishers, Inc., New York. Interscience Publishers, Ltd., London. 1953. Pp. xxii + 784. Figs. 161. $10.00.

The title does not suggest, at first sight, that this book should have any other than a general interest for the chemist. When it is remembered, however, that Professor Kirk, in addition to being an authority on forensic science, is Professor of Biochemistry in the University of California and is internationally known as one of the foremost exponents of ultramicro analysis, it is clear that one may look to find the influence of a chemical training and background. This is indeed so, and those chemists whose work leads them, from time to time, into forensic fields, will find here what is, in the opinion of the reviewer, one of the few really scientific approaches to the many problems of crime detection.

Professor Kirk rightly starts from the premise that in modern crime detection a mind and hands trained to cope with microscopic clues are essential, and that all too often failure to realise this, or to take advantage of it with sufficient speed, may result in failure to serve the ends of justice.

It is most interesting, too, to observe how, in fields strictly non-chemical (such as, for example, the identification of handwriting or the proof of identity of two samples of fibres) the approach of the trained chemist—indeed of the trained analytical chemist—is

recognisable. So we find that Professor Kirk, undoubtedly a pioneer in this respect, makes a serious attempt to apply statistical interpretation to these most difficult problems.

The book is divided into two broad sections. The first of these, which is presented in a way suitable for 'lawyers, laymen and police officers,' shows the importance of 'physical evidence' (a widely interpreted classification, but one which so often means microscopic evidence); the many ways in which such evidence may be collected and preserved; the methods available for examining it; and the probability of being able to evaluate it.

The second section is directly concerned with laboratory practice, and deals first with the laboratory itself, and then with the detailed problems which arise in the various fields of forensic science. In a book of this size, covering such a wide range, it is clear that only an elementary approach can be provided and that each worker must then build on the sound foundation provided here. Professor Kirk has been able, however, both from his own experience of forensic investigation and from his experience in teaching the subject, to choose wisely regarding the material which ought to be included. It seems extremely likely that this book, which is a most satisfying basic text, will come to be regarded as an essential supplement, based on modern knowledge and techniques, to Gross's 'Criminal Investigation,' by all — chemists, lawyers or police — who are concerned with the application of scientific methods to crime detection. It may even, in the last resort, provide the writer of detective fiction with reliable information on a side of crime that is too often inaccurately presented in print.—CECIL L. WILSON.

JUSTUS VON LIEBIG in eigenen Zeugnissen und solchen seiner Zeitgenossen. By v. Dechend. Verlag Chemie, Weinheim Bergstrasse. 1953. Pp. 141 with 3 plates. Full cloth, DM8.40.

Liebig not only helped to lay the foundations of modern chemistry, but was also one of the first to apply the rapidly expanding chemical knowledge of his time to such fields as agriculture, physiology and medicine. He contributed new theories and techniques to practically every subject with which he came in contact and, although he spent all his working life in universities, he was not slow to appreciate the industrial importance of his discoveries. However, this book is not concerned with his work as a chemist, but with the fascinating personality which made such a deep impression on many of his contemporaries. He was arrogant and yet humble, optimistic and yet often in the depths of despair, slow to accept the ideas of others but lavish in his praise of those whose work he respected.

In this book we are given a selection from the letters and writings of Liebig and his contemporaries. The material is arranged chronologically, the left-hand pages being reserved for Liebig's own letters, leaving the other side for the writings of his contemporaries, including Faraday, Berzelius, Schönbein, Dumas, Mohr, Merck and Wöhler. The last was Liebig's closest friend and lifelong collaborator, and the correspondence between these two gives us an intimate insight into Liebig's ideals and values. Liebig had many friends, although his fiery attacks on those who did not agree with him made him many enemies and provoked bitter polemic which wasted much of his energy. Dr. v. Dechend has given us both sides of the picture. Her selection provides an illuminating narrative of the main events of Liebig's life, and gives us a wealth of minor incidents and comments which leave us with a vivid and detailed portrait of the man himself.

The book is well printed and attractively bound. It was published to mark the 150th anniversary of Liebig's birth, but no such excuse is necessary for the production of this excellent little volume.—J.C.P.S.

Chemical Research Fund

THE Research Fund of the Chemical Society provides grants for the assistance of research in all branches of chemistry. About £700 per annum is available for this purpose, the income being derived from a donation of the Worshipful Company of Goldsmiths, from the Perkin Memorial Fund, and from other sources. Applications for grants will be considered in November next and should be submitted on the appropriate form not later than 14 November. Applications from Fellows will receive prior consideration. Forms of application, together with the regulations governing the award of grants, may be obtained from the General Secretary, The Chemical Society, Burlington House, Piccadilly, London, W.1.

HOME

Wolfram Price Reduced

The Ministry of Materials has reduced the domestic selling price of wolfram to UK consumers by 7s. 6d. per unit to 327s. 6d. and Scheelite ore by 12s. 6d. to 312s. 6d.

Prize-winning Fire Brigade

In the Chester and District Fire Committee competitions recently held at Crewe, between 97 teams, the 'A' team of Albright & Wilson Limited, Widnes, obtained the best aggregate score of any team and the best aggregate score for a private brigade.

New Premises for BSI

The British Standards Institution will be in full operation at its new premises at 2 Park Street, W.1 (Tel.: Mayfair 9000) by Monday, 17 August. The new building is expected to contribute to more efficient working by concentrating the Institution's scattered departments under one roof.

Fires at I.C.I. Plant

The I.C.I. premises at Billingham were recently the scene of three outbreaks of fire within eight hours, necessitating the attendance of firemen from Stockton and other brigades. The first fire burned for about three hours in the sulphur store and damaged about 50 tons of sulphur. The other fires, in the dry coal plant and the sulphuric acid plant, caused little damage and were soon extinguished.

No Need for Depression

Speaking during the debate on scientific research and productivity in the House of Commons recently, Mr. Hugh Molson, Parliamentary Secretary to the Minister of Works, said that it would be a mistake to be depressed because there was a certain deficiency of technologists. The universities had doubled the output of scientists in a shorter time than the Barlow Committee believed was the minimum, and by 1962 the Imperial College of Science would be turning out 3,000 technological students a year, compared with 1,650 at present. The Government intended to build a science centre, probably on the South Bank.

Copper Manufactures

The Monopolies and Restrictive Practices Commission has been requested by the Board of Trade to extend its factual investigation of semi-manufactures of copper and copper-based alloys to the bearing of the facts upon the public interest.

Coronation Bonus

Employees of the Yorkshire Copper Works, Ltd., are to receive a 'Coronation bonus' of one week's wages. The board has also decided to pay the ordinary stockholders a similar bonus of 5 per cent, subject to tax, as an interim dividend in respect of the year to 31 July, the company having had 'a satisfactory year.'

Russian Matches for GB

In a Parliamentary written reply last week, Mr. R. H. Mackeson, Secretary for Overseas Trade, stated that agreement had been reached with the Soviet trade delegation in London that during the next twelve months the British Government would issue import licences for Russian matches to a total value of £500,000. In return, the trade delegation had agreed to place orders in the UK for an equal value of woollen and worsted piece goods.

Modernisation Nears Completion

Dogged by repeated delays caused mainly through an acute shortage of building materials, the final phase of a £100,000 modernisation scheme at the Barton-on-Humber, Lincs, chemical works of the Farmers' Co., Ltd., has at last been reached. The scheme, originally decided on in 1949 to meet the growing demands for concentrated fertilisers, was scheduled for completion last summer but had to be postponed for an 'unpredictable period.' The latest, and final, addition to the original scheme is a new phosphoric acid and sulphuric acid concentrating plant, said to be the first of its type in the country. The whole of the new plant is expected to be fully operational by the beginning of September.

OVERSEAS

Penicillin in China

According to the Communist New China News Agency, China's first penicillin factory, at Shanghai, is producing large quantities of the drug 'up to international standard.'

Chilean Copper for Germany

An Argentine concern has arranged for the sale to West Germany of 5,000 tons of Chilean copper refined at the national foundry at Paipote. The price is stated to be 36.5 US cents per lb.

Dutch Nitrogen Output

The 1952 output of nitrogen in the Netherlands totalled 131,137 tons, corresponding to a total quantity of 622,000 tons of fertiliser. The chemical plant of the State Mines is reported to be struggling with a serious shortage of skilled labour. It now employs 6,500 workers, twice as many as in 1945.

Mexican Fertiliser Expansion

The Mexican Government has announced that new investments of 60,000,000 pesos will be made in the Mexican fertiliser manufacturing industry this year to bring production up to 590 metric tons daily. Production of 100,000 metric tons a year is reported by Guanos y Fertilzantes, a dependency of a Government financing agency, Nacional Financiera. Sixty-five per cent of current production is ammonium sulphate and 30 per cent superphosphates.

A Chemical Centre

Cornwall, Ontario, is fast becoming an important chemical manufacturing centre. The new plant of Howard & Sons (Canada), for manufacturing special chemicals, is due to come into operation this month; TCF of Canada, Limited—a subsidiary of Courtaulds Limited—and another British subsidiary, Kemball, Bishop & Company, producers of citric acid, will be in production shortly; and Charles Pfizer & Company, who have purchased a plant site in the city, intend manufacturing a wide range of chemicals for the food and pharmaceutical industries.

Indian Oilseed Exports

The Indian Government has decided to continue the free licensing of exports of nigerseed and kardi seed and their oils to all permissible destinations until the end of September.

Tungsten-Molybdenum Committee

A message from Washington states that the International Materials Committee has dissolved its Tungsten-Molybdenum Committee in view of the continuing improvement in the supply and demand position of molybdenum in the 'free' world.

New Canadian Company

Ontario Aerosol, Ltd., packagers of spray products, has recently been incorporated in Canada. With premises at 295 King Street, Montreal, the company will package spray products such as insecticides, room deodorants and shaving cream, under a new method in pressurised containers yielding pressure of 45 lb./sq. in.

Fluorine in Drinking Water

The International Dentists' Congress, meeting in Oslo last week, resolved that to prevent dental decay 'it is the duty of public health authorities in every civilised community to find out whether their drinking water contains sufficient fluorine and, if not, to investigate the possibilities of adding fluorine artificially.'

Sugar Industry Research Institute

A bill has been published which gives details of the proposed establishment of the Mauritius Sugar Industry Research Institute, the general objects of which will be to promote by means of research and investigation the technical progress and efficiency of the sugar industry. The Institute will take over the work of the present Government sugar cane research station and expenditure will be financed from funds to be raised by means of a special tax on sugar.

PERSONAL

MR. K. BYARD, technical manager for Dunlop Limited in Durban, succeeds MR. A. T. ROBERSON (now general works manager at Speke) as Dunlop works director in South Africa.

DR. GEOFFREY J. DUTTON, of Chester, has been awarded the Gunning Victoria Jubilee Prize for Chemistry in the Faculty of Medicine, Edinburgh University, as a result of recent research he has carried out.

The accompanying photograph of MR. GEORGE KING, senior research chemist, Albright & Wilson Limited, was taken after he attended a recent investiture at Buckingham Palace, where he received the M.B.E. at the hands of H.M. the Queen. Born in 1899, Mr. King graduated from the University of Birmingham. He studied at Göttingen, Germany, until 1914, when he began his career with Albright & Wilson.

Mr. George King

MR. R. S. ROBINSON, chief chemist at Styrene Copolymers, Ltd., for the past five years, has left the company to take up residence in Canada, for reasons of health. Mr. Robinson has played a most important part in the creation and successful development of the products now manufactured by the company.

Mr. W. R. Moon

Mr. D. J. I. Davies

MR. W. R. MOON, sales and technical service manager at Styrene Copolymers since soon after the company was formed and who has worked very closely with Mr. Robinson, has now taken over from him the position of chief chemist. Mr. Moon is a Manchester man and he graduated at the Manchester College of Technology. He was with British Titan Products Co., Ltd., before going to Styrene Copolymers.

MR. D. J. I. DAVIES has joined Styrene Copolymers as sales manager. Mr. Davies is a Jesus College, Oxford graduate and he served during the war in the Royal Engineers. After experience as a chemical engineer with I.C.I. (Billingham) and the Mond Nickel Co., Ltd., Mr. Davies joined L. A. Mitchell & Co., Ltd., Manchester. There he was concerned with the design of alkyd resin plants and their sale.

Because of continued ill-health, MR. H. STUART EBBEN has tendered his resignation both as chairman and a director of Manchester Oil Refinery, Ltd., and the board has reluctantly accepted this with effect from 1 August. DR. G. TUGENHADT is to be recommended for re-election as a director.

Publications & Announcements

DESCRIPTIONS and illustrations of the latest types of conveyors, hoists and trucks in use in America are given in 'Materials Handling Equipment and Methods in the USA,' the latest report of OEEC. The report begins with an outline of the typical features of materials handling technique in the United States, and goes on to consider the principal handling devices from the standpoint of their use and manufacture. Zipper conveyors, vibrating conveyors, shakers, belt conveyors, etc., are described in detail, and there is a similarly detailed description of manufacturing processes. Overhead chain, roller and pulling conveyors cranes and elevators, fork-lift trucks, platform trucks and trailers are dealt with, together with many of the new types of trolley which are constantly being evolved. The report has been made by a mission of industrial experts from every member country of OEEC, is profusely illustrated, and is obtainable from HMSO, price 9s.

* * *

AT the invitation of the Regional Advisory Council for Higher Technological Education, the Chemistry Department of Chelsea Polytechnic is arranging a series of post-graduate lectures on 'Aspects of Technology in the Fine Chemicals Industry.' These are to be held on Wednesday evenings at 7.15 p.m. throughout the autumn and spring terms, and are intended primarily for graduates who have recently entered the industry. The subjects chosen deal with the structure, economics and techniques of the fine chemical industry, and each lecture will be given by a prominent industrial chemist. Further details and application forms may be obtained from the Secretary of the Polytechnic, Manresa Road, S.W.3.

* * *

NO small part of the June issue of the quarterly Bulletin of the British Whiting Research Laboratories, published by the Research Council of the British Whiting Federation, 245 Ampthill Road, Bedford, is devoted to abstracts from recent literature. These, although necessarily brief, are nonetheless interesting and are given under 12 general headings, including 'Chemical and Physical.' The contents also include articles on 'The Use of Whiting in the Pottery Industry' and 'Standard Test Sieves.'

NEDERLANDSCH Verkoopkantoor voor Chemische Producten N.V.—the Netherlands Sales Office for Chemical Products — has issued a most attractively produced catalogue—in English—which should prove a useful guide for business friends in this and other countries. Condensed information is given about the sales organisation, which came into being on modest lines in 1947, and there is a short description of the associated interests, whose products are listed alphabetically. A useful index includes synonyms and cross references. To facilitate the conduct of international trade, a London office has been established at Greyer, Brecheisen & Company Ltd., Bush Lane House, Cannon Street, E.C.4.

* * *

THE Institution of Metallurgists, 4 Grosvenor Gardens, London, S.W.1, has published in book form the lectures given at the Institution's refresher courses held in 1951 and 1952 at Ashorne Hill, Leamington Spa. The first, 'The Joining of Metals,' costs 14s. and the second, 'The Metallurgy of the Rarer Metals,' is priced at 15s. 6d. In each case the contributors are men of high standing in the metallurgical world and the books should have a wide appeal. Application for copies should be addressed to the Registrar-Secretary at the address given.

* * *

CAREFUL balancing of physical and chemical properties has resulted in 'Pyrex' chemical resistant glass enjoying a high reputation among its many users. The extremely low expansion coefficient practically eliminates breakage from thermal shock and by allowing the use of more robust construction gives a considerable increase in mechanical strength. A comprehensive catalogue of 'Pyrex' laboratory and scientific glassware is now available from James A. Jobling and Company, Ltd., Sunderland.

* * *

BRITISH Iron & Steel Research Association was founded in 1945 to take over and broaden the scope of co-operative research in the iron and steel industry. Since then close collaboration between the Association staff and the staffs of member firms has made possible substantial contributions towards the solution of some of the industry's major

problems. The second annual BISRA Survey, just published, helps further by bringing to the notice of the industry some of the research results which are ready or nearly ready to be used. Subjects dealt with include new coatings for steel, ingot moulds, zinc from dross, sintering, wire die measurement, flame efficiency and gas turbines for the blast furnace. Copies of the survey are obtainable from the head office of BISRA, 11 Park Lane, London, W.1.

* * *

ADVANTAGES attaching to the use of Isomantles for the heating of chemical and other plant are described in a new publication by Isopad Limited, 13/17 Rosemont Road, London, N.W.3. Electric surface heating of the Isomantle type was introduced in 1947 and is now being applied to vessels, pipes lines, valves, processing and many 'special' applications. It is based on the direct heating of the surface concerned. Standard units cater for temperatures up to 400°C., when made of glass yarns and glass wools, but special quartz units are available for temperatures up to 800°C.

* * *

THE Atomic Energy Research Establishment at Harwell is to hold its seventh specialised course on the design, use and maintenance of electronic instruments used in nuclear physics, radio-chemistry, and work with radioisotopes. It will take place at the Isotope School, from Monday 28 September to Friday 2 October, and applications are invited from physicists and electronic engineers holding a degree, or equivalent qualification. The course, which is limited to 12, will include lectures and practical work concerned with counters, DC and pulse amplifiers, coincidence units, scalers and ratemeters, and the lecturers and demonstrators will be specialists from the Atomic Energy Research Establishment. The Isotope School is outside the security fence and the subjects will be entirely unclassified. The fee for the course is 12 gns., and living accommodation (at Buckland House, near Faringdon, one of the AERE Senior Staff Hotels), transport and morning and evening meal will be provided at a charge of 7 gns. Application forms can be obtained from the Electronics Division, AERE Harwell, near Didcot, Berks. These must be returned by Friday 11 September 1953.

New Potash Organisation

THE International Potash Institute, recently founded in Berne, Switzerland, in close association with the Société Commerciale des Potasses d'Alsace, Mulhouse, and the Verkaufsgemeinschaft Deutscher Kaliwerke GmbH, Hanover, held its first general meeting in Zurich on 21-22 July. The meeting was attended by prominent agronomists and research workers from several European countries.

The first day was devoted to an account of the purposes and organisation of the Institute by the respective directors, Mons. P. Rouquerol and Herr W. Schmidt. The Institute was designed to function as a centre for collecting and disseminating throughout the world the published data on all problems relating to soils and fertilisers, with particular reference to the potassium nutrition of crops. Papers were read by Professor Dr. M. G. Barbier, Director of Researches at the National Agricultural Research Institute, Versailles, on 'Some General Problems of Potash Usage' and by Professor Dr. L. Schmitt, President of the Agricultural Experimental Stations Associaton, Darmstadt, on 'Soil Analysis as a Method of Increasing the Efficiency of Mineral Manuring.' The second day was spent on an excursion to the Bernese Alps.

Those who attended the meeting from the British Isles by invitation were Dr. E. W. Russell, head of the Soil Science Department, Oxford University; Dr. T. Walsh, of the Department of Agriculture, Dublin, and Dr. G. A. Cowie, chief technical adviser to Potash Ltd., London.

Italian Mercury

ITALIAN mercury output in 1952 (1,926 metric tons) shows a five per cent increment in comparison with the figures registered in 1950 and four per cent compared with 1951. Exports (1,155 metric tons) show on the contrary a 59 per cent diminution and a 22 per cent increase respectively in comparison with the figures for 1950 and 1951 The price in the United States, who are the principal consumers (they purchased 36 per cent and 41 per cent of the world output in 1950 and 1951), has reached an average value of $199.10 per flask, representing a 145 per cent increase and a six per cent diminution respectively in comparison with the values for 1950 and 1951.

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.)

ELLIOTT BROTHERS (LONDON), LTD., engineers. (M., 8/8/53.) 2 July, £250,000 first debenture stock with a premium of 1 per cent in certain events secured by a Trust Deed dated 26 June, 1953; charged on properties described in schedule to deed and general charge (except, etc.). £548,438. 22 May, 1953.

Increases of Capital

The following increases of capital have been announced: NICHOLAS PRODUCTS LABORATORIES, LTD., from £1,000 to £100,000; WHEELER & HUISKING, LTD., from £12,000 to £18,000; GRAHAM TATFORD & CO., LTD., from £10,000 to £25,000; BIOREX LABORATORIES, LTD., from £1,000 to £10,000. NEW METALS & CHEMICALS (SALES), LTD., from £100 to £20,000.

New Registrations

E. W. Townshend Ltd.

Private company. (521,708). Capital £100. Merchants, importers, exporters, bankers, factors; buyers and sellers of and dealers in metals, chemicals and merchandise of all kinds. Directors: E. W. Townshend, J. R. Callaghan. Reg. office: 4 New Burlington Street, W.1.

Universal-Matthey Products Ltd.

Private company. (521,570.) Capital £100. Manufacture, disposal and marketing of catalysts and other chemical substances. Subscribers: J. A. S. Hamilton, D. Drummond. First directors are to be appointed by the subscribers. Reg. office: 73/83 Hatton Garden, W.C.1.

Longworths (Chemists) Ltd.

Private company. (521,601.) Capital £1,000. Manufacturing, wholesale and retail pharmaceutical chemists. Directors: W. N. F. Longworth, R. Fletcher, Miss R. Fink. Solicitors: Skelton & Co., 90 Deansgate, Manchester.

No-Perch Ltd.

Private company. (521,787.) Capital £100. Wholesale and retail chemists, druggists, manufacturers of and dealers in chemical products. Directors: P. C. B. Shirreffs, W. F. H. Newington. Reg. office: 37 King Street, W.C.2.

P.V.C. Ltd.

Private company. (14,702.) Capital £100. Manufacturers of and dealers in polyvinyl chloride, natural, synthetic and reclaimed rubbers. Subscribers: Rose C. 'Doherty, Betty Boland. First directors are not named.

Contract Sprayers Ltd.

Private company. (14,728.) Capital £1,000. Chemists, exporters, importers and manufacturers of and dealers in all kinds of insecticides and other preparations for use in connection with the prevention and destruction of pest and plant diseases. Directors: W. J. Bunbury, J. J. Mayo Perrott, Mrs. M. D. D. Bunbury.

Kirkby Chemicals Ltd.

Private company. (521,954.) Capital £1,000. Manufacturing, consulting and research chemists and makers of chemical products of all kinds. Directors: N. A. Hornstein, W. Fletcher. Reg. office: 5 Rampayne Street, S.W.1.

Evans Sons Lescher & Webb Ltd.

Private company. (521,860.) Capital £100. Manufacturing chemists, wholesale druggists, drug grinders. Directors: I. V. L. Fergusson, H. A. Mason, W. A. Kinnear, C. W. Robinson, F. S. Gorrill, D. Riding. Solicitors: Linklaters & Paines, 6 Austin Friars, E.C.2.

WILKINSON PRODUCT

MAKING RUBBER SERVE INDUSTRY

Linatex Ball Mills for Laboratory use give finer grinding

- BARREL FORMED OF ABRASION-RESISTING RUBBER
- SPECIAL DETACHABLE END
- SEPARATE CYLINDERS CAN BE RESERVED FOR DIFFERENT PRODUCTS
- NO METAL EXPOSED INTERNALLY

. . . with no contamination!

Linatex—processed from the toughest natural product in the world—is 95 per cent. pure rubber! Resistant to corrosion and abrasion; resilient; completely non-absorbent . . . it brought a revolutionary change in Ball Mill design. The drum itself is made of compressed Linatex rubber rings with metal tie-rods embedded for structural strength. This construction has quickly proved a success in the Laboratory as well as in the Works. Much quicker grinding time, to a finer size . . . no contamination . . . These advantages will surely interest *your* Laboratory? Model C (shown here) has a completely detachable end for easy cleaning. Supplied if required in a composite in-line system employing a common drive, available with a cylinder as small as 8 in. in diameter. Why not let us carry out a test grind on *your* material? Our resident engineer in your district will gladly call to discuss it.

LINATEX 95% *pure natural* RUBBER

BALL MILL . . . *with the longer life*

Patent No. 576410

All Enquiries to: **WILKINSON RUBBER LINATEX LTD., FRIMLEY ROAD, CAMBERLEY, SURREY**

Tel: Camberley 1595

Also in Canada, Australia, South Africa, India, U.S.A., Belgium, Holland, Portugal, Scandinavia, Malaya, etc.
Makers of Linatex, The Linatex Pump, Linatex tank and pipe linings, The Linatex Safety Valve, and Flexatex Hose

★ See our **STAND NO. 10** *outer row gallery National Hall,* **Eng., Marine & Welding Exhibition,** *Olympia, London,* **Sept. 3—17.**

B.M.7

Company News

Universal-Matthey Products Ltd.

This is the name of a new company which has been formed as an equal partnership between Johnson Matthey & Company, Ltd., and Universal Oil Products Company, of Illinois, USA, to manufacture and make available in the sterling market the UOP platforming catalyst for use by refineries in producing premium quality petrol. A large plant to manufacture the catalysts is to be built in this country and production is expected to begin by mid-1954. The first UOP Platformer was introduced in 1949 and now 58 are operating or are being erected in various parts of the world.

Griffiths Hughes Proprietaries, Limited

In a statement issued in connection with the annual meeting of Griffiths Hughes Proprietaries Limited, the chairman, Mr. C. B. Green, points out that the operating company, E. Griffiths Hughes Limited, with its subsidiary companies, returned a consolidated profit of £365,979, an increase of £117,929 over the previous year. A feature of the accounts was the complete discharge of the bank overdrafts, amounting to £435,064. Moreover, the cash in hand and at banks had been increased by £22,514. The board recommended an ordinary dividend of 7½ per cent.

Yorkshire Dyeware & Chemical Company

Reviewing the past year's activities of the Yorkshire Dyeware & Chemical Company, at the recent annual meeting, the chairman, Mr. F. A. Helme, said the company had again augmented their manufactures by introducing a number of new dyestuffs of very high fastness and their position as manufacturers of fundamental intermediate products—the complex organic chemicals from which dyestuffs were manufactured—had been greatly strengthened. They were now considerable makers of these important products and were almost independent of outside supplies. Much had been done towards modernising the plant and strengthening the company as a whole. Net profit for the year was £103,313, after allowing £70,635 for taxation, which was £85,151 less than for the previous year. The final dividend of 12½ per cent brought the total for the year to 15 per cent, the same as for the previous year.

A. Boake, Roberts and Company (Holding) Ltd.

A preliminary statement issued by A. Boake, Roberts & Company (Holding), Ltd., in connection with the annual meeting on 15 September, shows that profit fell sharply from £571,129 to £24,933 for the year ended 31 March last, after transferring £75,000 (nil in 1951-52) from stock reserve. The decline in profit is stated by the directors to be due to 'the very heavy decrease in sales from the industries we serve, severe competition from the Continent in export markets, coupled with import restrictions imposed by certain overseas countries, sales throughout the year made on falling prices of raw materials and writing down stock values at 31 March, 1953, to conform with current market values.' An ordinary dividend of 10 per cent, less tax, is recommended, compared with a total of 17½ per cent for 1951-52.

Market Reports

LONDON. — Conditions on the industrial chemicals market are little changed on the week both as regards prices and the demand. While the movement to the consuming industries is somewhat less, due to holiday influences, buying interest remains active, especially for the textile and paint chemicals. Export trade has been on a fair scale with the recent improvement about maintained. There is nothing of interest to report from the coal tar products market.

MANCHESTER. — The Manchester market for heavy chemical products during the past week has been decidedly under the influence of the holiday season, which is now at about its height, and from now on a gradual but steady increase in home-trade business may be looked for, including a reasonably good demand from the cotton, woollen and rayon industries, and from most of the other leading outlets. Export bookings during the week have been on a moderate scale. The market for fertiliser materials has been on the quiet side, and it is likely to be a month or so yet before business gets into its swing.

GLASGOW. — Business in general has steadily improved of the last few days and it is evident that recovery is being made by many firms purchasing for their immediate requirements, having previously held off owing to the holiday period operating.

CLASSIFIED ADVERTISEMENTS

EDUCATIONAL

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.**

HER MAJESTY'S COLONIAL SERVICE

VACANCIES exist for a **GOVERNMENT CHEMIST** and **ASSISTANT GOVERNMENT CHEMIST** in the Colonial Chemical Departments of (*a*) Uganda (CDE. 97/9/01) and (*b*) Nigeria (CDE. 97/14/01).

QUALIFICATIONS:

(*a*) Fellowship of the R.I.C. (Branch E) and B.Sc. (Chemistry), 1st or 2nd class honours; three years' experience of analytical work in applied chemistry desirable.

(*b*) Fellowship or Associate of the R.I.C. (Branch E) or Honours Degree in Chemistry of British University or its equivalent.

DUTIES:

(*a*) (Chemist.) Routine chemical estimations and investigations; teaching of African staff; the care and accounting for Government stores and giving expert evidence in court.

(*b*) (Assistant Chemist.) General analytical including bacteriological and chemical analysis of water and forensic work.

TERMS OF APPOINTMENT:

(*a*) On agreement for period of 30-36 months on pensionable terms with salary in the scale of £865-£1,320 per annum, plus cost-of-living allowance of 30 per cent. of substantive salary subject to maximum of £300.

(*b*) Pensionable with salary in the scale of £570-£1,290 per annum, plus overseas allowance of between £180 and £270 per annum.

Applications should be made in writing to the **DIRECTOR OF RECRUITMENT (COLONIAL SERVICE), COLONIAL OFFICE, SANCTUARY BUILDINGS, GREAT SMITH STREET, WESTMINSTER, S.W.1** (from whom further particulars can be obtained) quoting appropriate reference number and brief particulars of age, qualifications and experience.

CHEMICAL ENGINEER required for industrial instrument manufacturers. Some sales experience preferred and willingness to travel essential. Salary, £600-£700 per annum plus allowances. Interesting job, with good prospects. Apply to **BOX No. C.A. 3240, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

CIBA LABORATORIES, LIMITED, GRIMSBY, have a vacancy with good prospects of increasing responsibility for a **CHEMICAL ENGINEER.** Applicants should have had not less than three years' experience in a chemical works. Good salary and generous Contributory Pension Scheme. Applications should give full details of education, qualifications, industrial experience, and be addressed to **THE CHIEF ENGINEER.**

SITUATIONS VACANT

CHEMIST (graduate or equivalent) required by cellulose film manufacturers. Experience essential in the development of synthetic resins, adhesives or printing inks used in this particular industry. Salary in accordance with experience and qualifications, and assistance towards housing, if necessary, after a probationary period. Details to **SECRETARY, TRANSPARENT PAPER, LIMITED, BRIDGE HALL MILLS, BURY,** marked "CHEMIST."

TWO CHEMISTS of Degree standard or equivalent, with some commercial experience required: one for **LABORATORY** (either sex) and the other for **PROCESS CONTROL WORK** (man only) in modern West London factory. Excellent opportunity for young man or woman to follow progressive career with company having up-to-date ideas, methods and equipment. Full particulars to **BOX No. C.A. 3244, THE CHEMICAL AGE, 154, FLEET STREET, LONDON E.C.4.**

LABORATORY APPARATUS MANUFACTURERS DISTRIBUTORS have a vacancy (semi-senior) in their Quotations and Sales Promotion Department. Trade or laboratory experience, or suitable scientific training essential. Five-day week, bonus and pension schemes. Write, stating experience and salary required, to **SECRETARY, GRIFFIN & TATLOCK, LTD., KEMBLE STREET, KINGSWAY, W.C.2.**

FOR SALE

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

MORTON, SON AND WARD, LIMITED
offer
HYDRO EXTRACTORS

72 IN., 60 in., 48 in., 36 in., by **BROADBENT**; 48 in., 42 in., by **WATSON LAIDLAW**; and 42 in., by **MANLOVE ALLIOTT.** All electric, 400/3/50, with starters.

MIXERS

WE SPECIALISE IN "MORWARD" TROUGH POWDER MIXER MADE TO REQUIREMENTS UP TO 3 TONS.

JACKETED PANS

ONE new 200g. **STAINLESS STEEL,** open top, jacketed pan.

TWO 200g. New **JACKETED PANS,** all welded, on three legs.

Any can be fitted with mixing gear as required.

ONE 500g. **JACKETED AUTOCLAVE** with detachable cover, 150 lb. in jacket.

ONE 350g. totally enclosed **HOMOGENEOUS LEAD-LINED JACKETED PAN** arranged with lead-covered agitator driven through bevel gears from fast and loose pulley.

PUMPS

Large selection of **MONO** and other **PUMPS** in stock 2 in. to 6 in., new and second-hand.

INQUIRIES INVITED.

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

FOR SALE

C. BARBER, LTD.

BOILING PAN, C.I., jacketed, 150 galls.

BOILING PAN, 30 galls., copper with C.I. jacket, arranged for hand tilting.

Three Welded Horizontal Cylindrical, 500 gall. **STORAGE TANKS,** double compartment.

FILTER PRESS, flush plate and distance frame type, by "Johnson," cake size 29 in. square by 1 in. thick; 40 plates and 41 frames.

FILTER PRESS, recessed plate type by "Johnson," cake thickness 1 in.: 24 plates, each 24 in. square.

STORAGE BINS in stainless steel cylindrical with covers, 40/20/14/10 galls. capacity.

Cannon Steam jacketed enamel lined **PANS,** 10 and 25 galls. All new and unused.

Doulton 25 gall. **COPPERS** with lids. New and unused.

Several new and unused double trough type steam jacketed **MIXERS,** Fitted twin contra-rotating Z blades. Arranged for hand tilting and suitable wet or dry mixing. Capacity 25 galls.

C. BARBER LTD.
SILVERDALE GARDENS
HAYES MIDDLESEX
Telephone—Hayes 2735/6

TWO M.S. HIGH PRESSURE AUTOCLAVES 4 ft. I.D. by 18 ft. 6 in. long over domed ends. Riveted construction, fabricated from 1⅛ in. thick plate, 625 lb. per sq. in. working pressure.

M.S. HORIZONTAL "U" TROUGH MIXER 3 ft. by 1 ft. 9 in. at top by 2 ft. deep at centre. Fin type agitating gear belt driven through helical gearing from f. and l. pulleys. Arranged for hand tilting.

WERNER TYPE MIXER having G.M. trough 13 in. by 12 in. by 12 in. and double "Z" G.M. agitators belt driven through spur gearing from f. and l. pulleys. Hand tilting.

GARDNER M.S. POWDER MIXERS, sizes D. and E. Belt driven.

STEAM JACKETED COPPER BOILING PANS, 30 galls. capacity. Arranged for hand tilting. Jacket working pressure 40 lb. p.s.i.

STEAM JACKETED COPPER BOILING and EVAPORATING PANS, 50 and 100 galls. capacity. Open top. Jacket working pressure 40 lb. per sq. in.

KESTNER HORIZONTAL TUBULAR EVAPORATOR, having six turns 1½ in. bore copper tube, complete with copper reception pot.

TWIN PORCELAIN PEBBLE MILL, 12 in. by 12 in. Belt driven.

Belt driven **DISINTEGRATORS** by **HARRISON CARTER.** Size 00 and 2½.

STEAM JACKETED M.S. VACUUM DRYING OVEN, 3 ft. I.D. by 7 ft. long internally fitted 5-bank steam heating coil supporting 15 aluminium trays in five tiers of three. Rear end dished; domed door secured by eight swivel clamps. Jacket and coil working pressure 20 lb. per sq. in.

DITTO 3 ft. I.D. by 5 ft. long internally having 10 **STAINLESS STEEL** trays in five tiers of two. Quick release C.I. door with handwheel operated spider locking device. Jacket and coil working pressure 20 lb. per sq. in.

PROCESS & CHEMICAL ENGINEERING CO., LTD.,
6/8, NORTHUMBERLAND PARK,
TOTTENHAM,
LONDON, N.17
Phone: **TOT**tenham 2436 (3 lines).

FOR SALE

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

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

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

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

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

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

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

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

1—Johnson **FILTER PRESS,** 42 cast-iron plates, 32 in. square, centre feed.

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

1—Johnson **FILTER PRESS,** 46 plates, 32 in. square, centre feed, bottom corner open delivery.

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

1—24 in. and 1—30 in. **HYDRO EXTRACTOR,** self-balancing, swan-neck type, self-emptying bottom, belt driven.

1—30 in. and 2—36 in. Ditto with enclosed motors, 400 volts, 3-phase, 50 cycles.

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

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

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

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

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

"U"-shaped Horizontal **MIXER,** 7 ft. long, 3 ft. wide, 3 ft. 3 in. deep, belt and gear driven, end outlet, square horizontal centre shaft with cast radial type mixing arms, last used for linoleum paste.

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

No. 1 and No. 3 Size **MIRACLE MILLS** with fans and cyclones.

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

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

1—4½ Christy & Norris **DISINTEGRATOR** with 60 h.p. A.C. motor and starter.

RICHARD SIZER, LTD.,
ENGINEERS,
HULL.
Telephone 31743.

FOR SALE

600

DRYING PLANT

KESTNER No. 12-35 PATENT T.V. DRIER, M.S. construction, with inlet and outlet fans, separator with automatic air lock to outlet fan and stocking collector. Structural steel work and platforms. Motorised 400/440/3/50.

KESTNER SINGLE EFFECT 2-PASS FILM EVAPORATOR, cap 750 lb./hr., with structure, tanks and vacuum pump. Stainless steel contact surfaces, stainless steel feed and liquor tanks. New 1946.

KESTNER No. 6, 10 ft. by 42 in. diam., **SINGLE ROLL SPRAY FILM DRIER,** drum of close grain C.I. carried on two hollow forged steel trunnions in roller bearings. Steam W.P. 60 lb. sq. in. 18 spray nozzles supplied for liquor and air manifolds, liquor feed gauge and all gauge. Stainless steel sectional scraper knife, M.S. hood fitted over drum. Direct drive through totally enclosed worm gear, 5 h.p. required.

New 1953 and unused **KESTNER No. 5 ROTARY FILM DRIER,** C.I. drum 7 ft. by 30 in. diam., stainless steel knives. W.P. 60 lb. sq. in. Feed tray and product worm convevor.

KESTNER No. 3 ROTARY FILM DRIER, C.I. drum 63 in. by 24 in. diam., stainless steel knives. W.P. 60 lb. p.s.i. Feed tray and product worm conveyor.

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

ECONOMIC BOILERS—9 ft. diam. by 12 ft. 6 in. Foster Yates, 200 lb. w.p.; 8 ft. diam by 14 ft. Paxman, 180 lb. w.p. Twenty others, all sizes.
NEW GALVANISED PIPING. Immediate delivery.
Johnson Filter **PRESSES,** 25 in., 18 Frame, practically new.
TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS.**
Stainless Steel **FILTER TANK,** 3 ft. 6 in. diam.
ONE Stainless **CONICAL HOPPER,** 7 ft. 3 in. diam., overall depth, 7 ft. 6 in.
TWO Broadbent **WATER-DRIVEN CENTRIFUGES,** 30 in. diam., 12 in. deep, 1,150 r.p.m., 150 lb. pressure.
SIX **O.T. TANKS,** 7 ft. diam., 14 ft. deep, rubber and brick lined.
Six Aluminium **CONDENSERS,** 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ¾ in. o.d.
FORTY Riveted **RECEIVERS,** 8 ft. 6 in. long, 5 ft. 9 in. diam., 76 lb. w.p.
CAST-IRON PIPES, 5000 ft. Each 6 in. and 8 in. **NEW VALVES** in Stainless, Gunmetal, Enamel Lined.
Free Catalogue. "Watkins Machinery Record," available

FRED WATKINS, (BOILERS) LTD.,
COLEFORD, GLOS.

FOR Sale, **FOUR MANESTY GAS-FIRED STILLS.** Capacity, 6 to 8 pints per hour. In working condition. Apply to **BOX No. C.A. 3245, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

ROTATING PAN MIXER by **ARTOFEX.** Two **PANS,** 47 in. diam. by 22 in. deep; 2-sack capacity. Human arm type blades. Fast and loose pulley drive. £100 ex-works.
One Ditto by **T. COLLINS, BRISTOL.** Two **PANS,** 47 in. diam. by 24 in. deep; 2-sack capacity, with automatic feed. Chain drive to 5 h.p. motor. £85 ex-works.

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

SERVICING

CONCENTRATION AND DRYING. Chemical Company in South East London will shortly have capacity available for Evaporating and/or Spray Drying. The units are in stainless steel and can produce about 500/1,000 lb. of dry powder per hour, depending upon product. Short or long contracts will be welcome. Inquiries invited and prices given on application to **BOX No. C.A. 3243, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

CRUSHING, GRINDING, MIXING and DRYING for the trade.
THE CRACK PULVERISING MILLS LTD.,
Plantation House,
Mincing Lane,
London E.C.2.

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

WET AND DRY GRINDING, Micronising, Grading and Mixing of Minerals and Chemicals for all trades. Also suppliers of ground zircon, sillimanite, fused silica, precision casting materials and a wide range of ground minerals.
W. PODMORE & SONS, LTD.,
SHELTON, STOKE-ON-TRENT,
Phones STOKE-ON-TRENT 2814 & 5475

WANTED

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

PATENTS & TRADE MARKS

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

HYDROGEN PEROXIDE
Concentrated Qualities Dyestuffs & Chemicals
COLE & WILSON, LTD.
24, Greenhead Road, HUDDERSFIELD
Phone: Huddersfield 1993. Grams: 'Colour' Huddersfield

THE WORLD'S GREATEST BOOKSHOP
FOYLES
FOR BOOKS
All new Books available on day of publication. Secondhand and rare Books on every subject. Stock of over three million volumes
Subscriptions taken for British, American and Continental Magazines
119-125 CHARING CROSS RD., LONDON, W.C.2
Gerrard 5660 (16 lines) ★ *Open 9-6 (inc. Sat.)*
Nearest Station: Tottenham Court Road

INDEX TO ADVERTISERS IN THIS ISSUE

Printed in Great Britain by THE PRESS AT COOMBELANDS Ltd., Addlestone, and published by BENN BROTHERS LTD., at Bouverie House, 154, Fleet Street, E.C.4, 8 August 1953. Registered at the General Post Office. Entered as Second Class Matter at the New York U.S.A., Post Office.