Chemical Age

AIR POLLUTION
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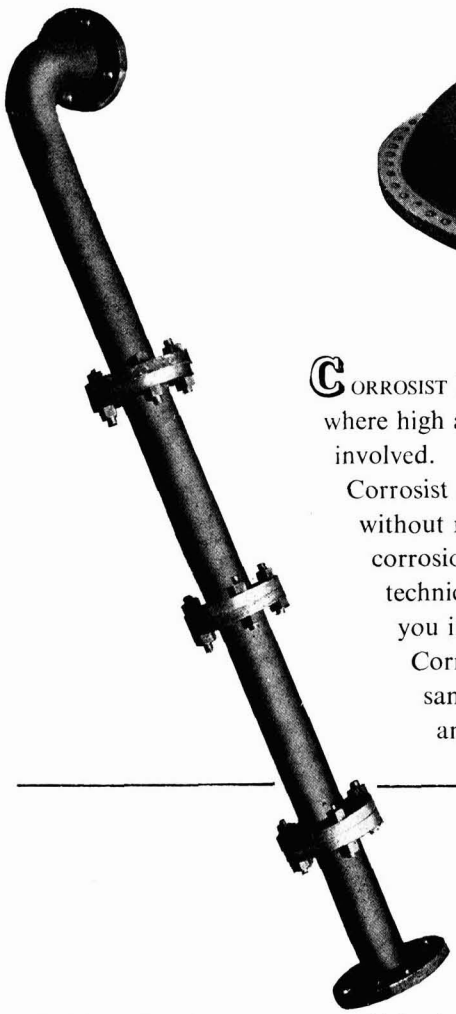

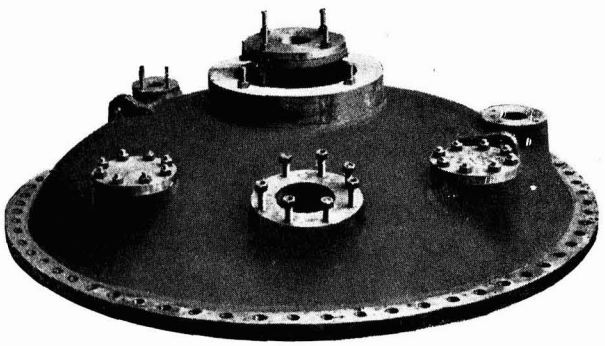

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CHEMICAL AGE

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FERTILISERS IN EUROPE

THE LATEST OEEC Report on fertilisers for 1954-57 (see CHEMICAL AGE, 23 February, page 334) might be said to strike a slight note of gloom that is far from justified. The 1955-56 figures show that the rate of expansion has slowed down. This is said to be 'not unforeseen' but 'rather greater than had been expected.' But expectations are purely personal opinions whether expressed by individuals or in the collective anonymity of an OEEC Report.

Much more important is the fact that expansion has nevertheless continued. Year-to-year variations in rate of expansion are relatively unimportant, particularly when calculated over a wide area that includes several West European countries whose average rates of fertiliser use are consistently the highest in the world. It is only in countries where usage rates are low and grossly inadequate that dramatic expansion year after year should be expected, e.g., Spain in 1955-56 used 30 per cent more nitrogen and 12 per cent more phosphate, compared with the overall OEEC expansion of 5 per cent for nitrogen and 3 per cent for phosphate.

Demand for fertilisers is closely related to demand for food. At a time when in most of Europe market prices for farm produce are not rising, or are even falling, it is a heartening fact, and certainly not a depressing one, that fertiliser use is still expanding. During a similar period after World War I, the immediate effect of declining crop prices was a sharp fall in fertiliser consumption. What is now happening in Europe shows clearly that many more farmers realise that cutting fertiliser rates is a false economy since high crop yields based on fertilisers bring the lowest production costs.

Expansion in use has been slightly greater than expansion in production, thus:

	Nitrogen	Phosphate	Potash
Usage rise, 1955-56:	5%	3%	6%
Production rise, 1955-56:	3%	3%	2%

This minor difference probably reflects manufacturing caution more than any other influence. When reports on agricultural market prospects can be punctuated with question-marks, it is hardly imprudent for manufacturers to adopt a wait-and-see policy over plans to expand production facilities. Any such caution is amply justified today when the high investment costs of plant erections or extension are considered. Those who would like to see fertiliser prices lower might hope for over-production and heavy unsold stocks at the ends of farming seasons, but this would be a retrograde development for producers and consumers alike. The fertiliser industry must be reasonably profitable if technical progress is to be maintained. Research and plant costs of modern developments are high. However, the benefits farmers have derived by technical progress since the 1940s—granulation and higher analyses per ton to mention only two examples—are bigger than is generally appreciated. Nothing could be more disastrous for agriculture than a return to the situation when the fertiliser industry was the chemical industry's Cinderella.

It is scarcely irrelevant to consider this report from the point of view of

British participation in a European common market. As a whole the chemical industry here seems to welcome that development. But its fertiliser manufacturing section may reasonably be less enthusiastic. The OEEC Report states that less than three-quarters of total capacity for phosphatic fertilisers (other than basic slag and phosphate for complex fertilisers) is being used in the OEEC countries.

Broadly, this applies to the superphosphate class of fertilisers, UK imports of which are at present subject to a protective duty. The catastrophic effects of superphosphate dumping in the 1930s are still within memory. The British fertiliser industry suffered grievous losses during that period. With a free trade area in being and with European superphosphate capacity still in under-operation by 25 per cent or more, the anti-dumping regulations of such an arrangement will need to be highly effective if the risk of unfair competition is to be eliminated. The British industry, largely re-equipped since the war and supplying a home market that has trebled in tonnage, can confidently face all the challenge of fair competition, but exposure to trading warfare like that of the 1930s with superphosphate must not be one of the *quid pro quo* concessions of this country's entry into a common market.

RUBBER SYNTHESIS

ISOLATION of cell-free plant enzymes capable of forming isoprenoids, precursors of the 'building blocks' for rubber, by two US scientists may assist in the synthesis of certain products chemically akin to rubber, improve breeding and selection of rubber trees and enable rubber tree growth to be explored and also to discover more about latex formation. In an investigation into the synthesis of rubber by Hevea rubber trees, Howard J. Tear and later, R. S. Bandurski, discovered that certain co-factors are necessary for making the enzyme-reaction take place. Enzymes were separated from rubber plants, acetic acid was added, also a sequestering agent (ethylenediamine tetra-acetate), a buffer (potassium phosphate, sucrose, and four co-factors, coenzyme A, diphosphopyridine nucleotide, adenosine triphosphate and magnesium fructose diphosphate). This reaction produced natural rubber.

By means of tagged acetic acid, using carbon-14, the investigators found radioactive carbon in the synthesised rubber, indicating that acetate had become part of the rubber's molecular structure.

While it would be prohibitive commercially to make rubber from enzymes, this finding should assist in improving natural rubber production. As the enzyme which controls the rubber yield is now known, it is possible to predict when a rubber plant is two years old whether it will produce an economic yield when it is 12 years old, thus saving 12 years of expense and care. It is also thought that separation of these enzymes may assist further research with regard to the production of chemically related compounds of economic importance, such as vitamin A, essential oils of food flavours and perfumes, and turpentine.

AUTOMATION FOR CHEMICALS

CHEMICAL engineers have been in the forefront in assessing the contribution that automation equipment can make to improve productivity in chemical processing and production. In fact, in the chemical industry automation can be considered an extension of the trend to complete instrumentation which has long been the industry's plan.

Automation is already making a growing contribution to the production of chemicals; potentially its uses are almost unlimited, restricted only by limitations imposed by the industry's need to make full use of existing plant and buildings. The present credit squeeze and dear money policy, combined with the high cost of new constructional work, make it certain that in the immediate years ahead, automation will develop by a gradual integration of automatic devices into existing systems of mechanisation, rather than the building of completely new automatic factories.

Generally, the industry's need is for basic units of automation equipment which have applications to a variety of processes. In that way the necessity for specially designed equipment and the high costs which inevitably accompany it will be greatly reduced.

Although considerable progress in automation took place in 1956, it is evident that failure of engineers to understand process dynamics is slowing down the arrival of fully automatic processes. Reliability of equipment is another important factor. End-point analysis has become more common, but it is suggested that faster, more complete analyses are required.

Chemical engineers will, of course, be able to review progress made in the development of automotive and control equipment at the Instruments, Electronics and Automation exhibition to be held at Olympia from 7 to 17 May. In addition to the exhibits of 200 British manufacturers, there will be a conference on related problems with papers to be presented by experts on each day of the exhibition; this will doubtless also arouse much interest.

Another event of interest to the chemical engineer is the lecture by Mr. J. A. Sargrove on 'Automation in the smaller business,' to be presented in Charing Cross Hotel, London, on 16 April at 7 p.m. This talk will be accompanied by two 25-minute films.

There is no doubt that 1957 will see a great extension in the use of automatic control in the chemical industry, assisting all sections of the industry to keep abreast of developments in America and West Germany.

HIGH DENSITY POLYTHENE TUBES

IN CHEMICAL AGE (19 January, page 123) it was noted that certain standards have been laid down by German municipal authorities for plastics pipes used to distribute drinking water. Elsewhere on the Continent, plastics pipes, particularly of p.v.c. are in use for domestic water supplies. It is therefore of interest to note that the general extrusions technical committee of the British Plastics Federation has begun consideration of a specification for high density polythene tube for cold water services. The committee states, however, that there are certain problems associated with the use of polythene pipes which will take some time to resolve.

It will be recalled that there is already a British Standard for low density polythene tube (BS 1972: Polythene Tube for Cold Water Services), which is now in wide use.

The British Plastics Federation technical committee is also investigating the future possibilities of the use of special grades of nylon tube for hot water services although at the present time use of such pipes cannot be recommended. It would appear from the information released by the British Plastics Federation that the certain problems announced by the technical committee might well include ageing of polythene, penetrability of such piping and the difficulties attached to using polythene piping for hot water services.

Also, can any significance be attached to the statement concerning the use of special grades of nylon tube for hot water services? This suggests that while the technical committee cannot recommend its use at the moment, nylon pipe is being seriously considered for such use and in preference to polythene.

AIR POLLUTION IN THE CHEMICAL INDUSTRY

Special Report of Clean Air Conference

THE Institution of Chemical Engineers was one of 19 participating societies which supported the conference on the Mechanical Engineer's Contribution to Clean Air, organised on 19 to 21 February by the Institution of Mechanical Engineers.

Many well known chemists, chemical engineers and specialist research workers were present among the nearly 500 people who heard *Sir Ewart Smith*, a deputy chairman of Imperial Chemical Industries, say, in his opening lecture on 'Economic and Technical Aspects of Atmospheric Pollution Reduction,' that industrial managers should remember that the standards of cleanliness required by the public were continually rising, as were the standards of performance which would be achieved. Any equipment erected in the future must be designed to take into account the most up-to-date knowledge and experience, or become the subject of justified complaints by the public. In an industrial and crowded community we could not have all the amenities of a highly mechanised and highly cultured age, without some disadvantages. We could not have 'seaside air' in all our towns, but we could have conditions in most of our industrial centres which were as good as those in existing areas of light industry.

Difficult Task

This would be a long and difficult task in high fuel consumption areas, where concentration of large units of heavy industry resulted in discharge of great quantities of flue gases or process effluents from a few acres. Remedial measures not only cost money, but involved diversion of productive efforts which were also required for other purposes. The question was how much is the community prepared to pay, directly or indirectly.

Sir Ewart laid emphasis upon the need, in future, to treat the whole problem of effluent treatment with the seriousness it deserves.

'If the same care and thought were given to the design of effluent treatment plant and to means of preventing the creation of noxious effluents, as is given to the main parts of process equipment, many of the complaints now made would be avoided.'

We needed engineers with special knowledge of 'clean air engineering.' Whatever the type of pollution to be dealt with the mechanical engineer would be primarily responsible for translating the ideas and knowledge produced by research and development in a large number of fields, into reliable working plant having minimum operating and capital costs. Chemists, chemical engineers, electrical engineers, physicists, instrument engineers and fuel technologists and metallurgists too, had important roles in this work. The main objective must be to make any discharge to atmosphere sufficiently innocuous, having regard to local conditions, topography and climate, for the inhabitants of the area to suffer no significant or avoidable discomfort from dirt, corrosion, loss of sunlight or injury to health.

Four main lines of attack should be followed or at least fully explored: (1) The method of operating particular processes should be improved to reduce creation of noxious effluent; (2) Subsidiary equipment should be installed (or improved) for removing, as far as possible, the pollutants at the end of the process; (3) If need be, the process itself should be changed; (4) The height of effluent discharge units should be increased.

A good deal of Sir Ewart's speech dealt directly with pollution due to chemical processes. When discussing the scope of the dust pollution problem, as shown by tables published in the Beaver Report and *Ministry of Fuel and Power Statistical Digests*, he pointed out, for example, that in addition to some 800,000 tons of grit and dust due to fuel burnt in 1955, one would have to take into account 500,000 tons of process dust.

Then again, when discussing high chimneys, after reviewing considerations governing chimney height he showed the conference a slide of a drawing which hangs upon his office wall of a 455 ft. high chimney, built in Glasgow in 1841 and standing until 1922. It was constructed in a year and designed to carry away sulphurous fumes from a chemical process.

A Challenge To-day

'Which of us, if asked to build such a chimney today, would not run to the National Physical Laboratory for wind tunnel tests? This chimney worked, it didn't blow over, it didn't fall down! It is a challenge to us to-day!'

Perhaps most dramatic of all, however, was his slide of a large blackened disc with a pin-hole of light in the centre. This represented the obscuration of the sky resulting from dispersion of one ml. of one micron particles.

It should perhaps be pointed out that although the Clean Air Act applies to smoke and grit and dust and does not attempt to extend the regulations concerning the emission of sulphur dioxide and other undesirable gases, it may well be that the Chief Alkali Inspector will have more to say, in the future, about the prevention of chemical pollutants.

One of the nineteen papers given was by E. A. Damon, C.B.E., F.R.I.C., M.I Chem.E., a member of the Chief Alkali Inspector's staff. This dealt with 'Air Pollution Prevention in the Chemical Industry' and laid stress upon present-day legislation, methods of dealing with noxious gases and offensive odours, relations between industry and the general public and similar matters.

Mr. Damon is in New Zealand, on loan to the authorities there, and his paper was introduced and briefly discussed by Dr. J. G. Carter, the Chief Alkali Inspector. He pointed out that an important difference between air pollution problems in the chemical industry, now and in the early days of the industry, was that very much greater volumes of air were now to be cleaned of very much smaller percentages of impurities. The total quantity of impurities was very much greater than it once had been.

Speaking, now on his own behalf, he said that his most intractable problem was that of emission from cement works.

Beaver Report

Mr. Damon's paper outlined the evolution of the chemical industry and the legislation evolved to deal with air pollution from that industry. It pointed out that the Beaver Report recommended that certain processes in which smoke prevention presented special technical problems should be registered and dealt with under the Alkali Act, and that additional provisions actually made by the 1956 Clean Air Act ensured that the Alkali Act would in future cover smoke, grit and dust emissions from scheduled premises 'as it has effect in regard to noxious or offensive gases,' and that the provisions of the Clean Air Act relating to dark smoke, grit, dust and other smokes which constituted a nuisance should apply to scheduled processes; and furthermore, under certain circumstances the responsibility for controlling discharge of smoke, grit and dust from scheduled processes might be transferred to a local authority.

Discussing the investigation of air pollution problems Mr. Damon stated that when dealing with new processes from which a noxious or offensive gas might be evolved, the Alkali Inspector should first consider whether evolution of the gas in question can be suppressed by alterations in technique or raw materials. He should then seek a means of controlling the discharge.

When the final escape had been reduced to a practicable minimum consideration should be given to the conditions under which it might be discharged to atmosphere. The more common gases arising in chemical processes were listed as sulphur dioxide, hydrogen chloride, hydrogen sulphide, chlorine, and oxides of nitrogen and fluorine.

Methods of dealing with these noxious gases were described and in particular reference was made, in the case of sulphur dioxide, to the fact that in waste gas a minimum content of 0.5 per cent was necessary for economic recovery of sulphur. However, the national average was only 0.1 per cent.

Total discharge to the atmosphere of sulphur dioxide from all sulphuric acid

plants in England and Wales was about 25,000 tons per year, which was equivalent to that in the waste gases from some 850,000 tons of coal. At certain contact plants scrubbing of exit gas with either soda or ammonia was practised.

Reference was also made to a scheme for recovery in the form of liquid sulphur dioxide by scrubbing waste gases with a basic sulphate solution or a suitable organic solvent.

In the case of hydrogen sulphide it was pointed out that where the amount justified the capital outlay, as at large petroleum refineries, it became practicable to strip it out by means of a solvent such as diethanolamine and to regenerate it in concentrated form for treatment in a Claus kiln, with the production of pure elemental sulphur.

Total absorption of nitrogen oxides was not possible because beyond a certain point the size of plant required was excessive. However, it was possible to denude gases from ammonia oxidation plants of their oxides of nitrogen to about 98 per cent. Gases from the dissolution of metals in nitric acid could be dealt with in a similar way and efficiency increased by addition of oxygen. Small quantities of oxides of nitrogen could be destroyed by admixture with coal gas and burning.

Fluorine Treatment

Regarding fluorine it was possible to scrub hydrogen fluoride out of waste gases and experiments had been made in this connection but the large volume of gas to be treated would make such an undertaking a formidable one. Moreover, the advantages gained would be to some extent offset by cooling of the waste gases.

In the production of superphosphate, a process scheduled under the Alkali Act, up to half the fluorine contained in the raw rock was evolved as silicon tetrafluoride. Fans were provided to draught the mixers and dens into a series of void towers, in which the gases were washed by liberal spraying with water. The tetrafluoride was decomposed, with release of silica and hydrofluosilicic acid which was removed in the waste water. With care and the provision of adequate tower space, the removal of over 99 per cent of the acid constituents could be effected. It seemed that outbreaks of fluorosis were not connected in any way with these works.

Methods of dealing with offensive odours were reviewed. One method of destroying offensive odours was to pass the gases concerned through a furnace or to bring them into contact with an oxidising agent such as chlorine. Alternatively, the principle of catalytic combustion could sometimes be profitably employed. By making use of a suitable catalyst, organic constituents could be completely oxidised at relatively low temperatures. If the heat generated justified provision of heat exchangers, the process could be economically attractive.

Mention was also made of the principle of masking or neutralising odours, as employed to a certain extent in the US. During discussion of this matter Dr. Carter made a point of referring to the masking of offensive but *harmless* smells and said that successful methods had been employed.

The point, presumably, was that one should be certain that an offensive smell was indeed harmless and some members of the conference were heard to say, privately it is true, that this could be a dangerous practice if it got out of control. One speaker did say that an effective method of masking odours had been developed for use in refining crude petroleum and this method was now available in Britain.

Mr. Damon's paper concluded with recommendations regarding relations between the chemical industry and the public. In the case of a newly established industry it would be false economy, he said, to delay installation of air pollution control plant. This policy might lose confidence in the good will of the manufacturers. It took a long time for restoration of confidence, once it had been lost.

When planning a works, provision of adequate control measures should be regarded as a first essential to be used from the outset. It would be a mistake to regard such plant, if installed, merely as a standby, which was to be brought into operation if and when complaints were made.

It paid to install good equipment of ample capacity. Plant which would just suffice might be inadequate to meet more stringent requirements in a year or two, or to cope with increased throughput. Replacement of inferior equipment was likely to prove more expensive than installation of better equipment in the first place.

Good Public Relations

Sincerity, he said, was the keynote to good public relations. Let the manufacturer's problems be explained and let it be seen that solutions were being energetically sought. Let the manufacturer also show that he appreciated his neighbours' viewpoints. Sometimes it was worth enlisting the aid of neighbouring residents, e.g. by asking them to keep records of dates, times and weather conditions when excessive pollution was apparent, or to permit installation of gauges and recording instruments on their premises. In this way useful information might be gained and this would help to pinpoint offending plant or operations.

The problem of dust collection was dealt with in a number of papers and deserves more space than can be spared in the present report. Perhaps most thought-provoking of all the statements were some made by Dr. Foxwell, who summarised the entire conference at the conclusion of the final session. He suggested that if it were possible to improve very much more thoroughly dust collecting efficiency in mechanical grit and dust collectors, electrostatic precipitators, and other devices, that this might help to overcome a problem which appears to be, at present, well nigh insoluble—the problem of doing something about sulphur dioxide emissions from power station and industrial furnace chimneys. Although directing his fire mainly at the electrical (and possibly the gas) industries, much of what he was putting forward is of direct interest to the chemical industry.

Observer's Impressions

It seems that there is medical evidence to suggest that SO_2 penetrates very deeply into the most sensitive tissues of the lungs where gas exchange occurs, if carried on solid particles. The smaller the particles of dust dispersed in the air and inhaled by men, women and children, the greater the health hazard. From the papers, the discussions and other available information, it was known that dust collecting equipment was often not very efficient with regard to the smaller particles of dust. Even where high efficiencies had been shown under test, often, in practice, due to overloading and non-too-effective maintenance, collecting efficiencies sharply declined, particularly for particles of, say, 10 microns down to half a micron.

These were the most dangerous of all. They adsorbed SO_2 and the smaller the particles the larger the surface area in proportion to size and volume of containing air. Now, discussion showed that little progress is being made in finding a solution to the problem of ridding power station chimney gases of SO_2, despite the 10 or more years of flue gas washing in London power stations and the studies in the dry removal of sulphur dioxide now being carried out by the Central Electricity Authority.

It would seem, therefore, that by getting rid of industrial furnace and boiler dust, especially the very finest dust, the problem of coping with SO_2 would become less urgent. In view of the fact that the chemical industry is responsible for a considerable proportion of the 500,000 tons of dust emitted by processing industries, the obvious conclusion is that this industry would be well advised to make a very special effort in this connection.

Impact of Atomic Energy on Chemical Engineering

IMPACT OF ATOMIC ENERGY on chemical engineering is the subject of a symposium to be held by the graduates and students section, Institution of Chemical Engineers, at the Cora Hotel, Upper Woburn Place, London WC1, on Friday 26 April.

Papers will be presented by J. M. Fletcher, head of AERE chemical processing group on 'Solvent extraction'; B. F. Warner, research manager UKAEA, Windscale Works on 'Chemical processing of nuclear fuels'; L. D. Roland, senior chemical engineer, Permutit Co. Ltd. on 'Ion-exchange applications to in atomic energy'; and R. Roberts, AERE technological irradiation group on 'Industrial utilisation of irradiation'.

Discussion will be led by P. V. Danckwerts, professor of chemical engineering science, Imperial College.

Soviet Union Symposium on Metal Wear and Friction

Papers on Corrosion and Metal Plating

ON THE SUBJECT of metal wear and friction several papers were published last year in the Soviet Union in a symposium under the general editorship of Professor M. M. Krushchov. The subjects included wear of metals and alloys by abrasive friction in aggressive media, wear of parts of sludge pumps and of water-economiser tubes, porosity of chrome plating, etc. Several papers on various aspects of corrosion, metal-plating, painting, have also appeared lately in *Zh. prikl. Khim.*, and some are summarised below.

An application of the rod method of protection against corrosion is given in a paper by O. N. Muravkin and A. V. Rabchenkovon on the corrosive-abrasive wear of steel used in boiler water-economiser tubes at a hydro-electric power station. The tubes are exposed to the combined abrasion and corrosion effect of dust-laden flue gases, resulting from the high-ash coal used. Laboratory tests were made with a special set-up in which the rate of gas flow could be varied and also the content and kind of dust or particles. This was followed subsequently by actual observation of plant operation. Gas flow speeds ranged from 18.3 to 64.3 metres per second. Angle of attack or impingement, an important factor, could also be varied.

Sub-Moscow Ash Fuel

The high ash fuel was of the so-called sub-Moscow type. In actual use temperatures up to 250°C are encountered, the gas flow averages 12-15 metres per second, and ash concentration 20-26 g. per cu. metre.

A direct result of the conditions is a change in the physico-mechanical properties of a thin surface layer of the metal attacked, resulting from oxidation. The formation of a thin oxide layer or film facilitates abrasive wear. Partial or complete wear of these oxide films by the abrasive particles aids the further advance of the corrosive process.

Intensity of metal wear depends on the physico-chemical properties and concentration of the corrosive agent in the abrasive medium. For each case of wear there should be apparently a maximum concentration beyond which rate of wear does not change.

In the present case a fairly thorough study was made of the dynamics of wear, with microscopic observation of surface layers and contours, with a view to explaining the breakdown of a cylindrical surface (tube) as a complex form of metal breakdown under abrasive gas flow. It is emphasised that the angle of attack when this effect is maximum is about 45°. The hardening of the metal surface which takes place under the conditions (and which may be intermittent) is also a material and positive factor, i.e., it increases wear; and the hardening is accompanied by cracks, scaling, etc.

The method has been successfully introduced in one of Moscow's power stations, in place of the so-called mantle method or semi-circular jacket.

First of recent papers on anti-corrosion work that seems of worthwhile interest relates to the effect of water vapour on the corrosion of metals by chlorine (Kh. L. Tseitlin, *Zh. prikl. Khim.* 1956, **29** [18] 1182-1191, 20 refs.). Some of the literature is reviewed, including the experimental methods used. The temperature range was up to about 550°C. and in some cases higher.

Test Metals

It was found that, under the action of chlorine containing considerable amounts of water vapour at relatively high temperatures, the test metals could be divided into two groups: (a) those of which the surface becomes coated with a protective oxide film; these include cast iron and alloys, stainless steels, aluminium, tantalum, where corrosion is markedly reduced; and (b) those where there is little change, such as copper, lead and nickel. In the case of nickel, attack may be somewhat greater in the temperature range 420° to 540°C. Comparative tests were made with chlorine alone and chlorine plus air.

With air there was little or no difference for iron and its alloys. For aluminium, however, in both cases (chlorine with water vapour or air) corrosion was reduced in about equal measure. Owing to the strongly oxidative effect of wet chlorine, even at 150° to 160°C, metals exhibit different degrees of stability. The usually easily passivated aluminium and stainless alloys, and nickel, corrode only slightly; tantalum is practically unaffected; lead, iron and steel suffer to a greater degree; and with copper corrosion reaches 8 g. per sq.m. per hr.

Maximum temperatures for satisfactory resistance are as follows with figures for dry chlorine in brackets: aluminium 425°C (130°C), Armco iron 375°C (285°C), carbon steel 375°C (260°C), cast iron 375°C (220°C), two Soviet steels 475°C (400°-418°C), nickel 375°C (500°C), lead 225°C (250°C) and tantalum 400°C (250°C).

Minimum temperature for satisfactory resistance in wet chlorine, in the case of aluminium, nickel, stainless steels, and two Soviet steels is 150°C. for lead 160°C, iron and steel 170°C. Above 150°C copper is strongly corroded. Tantalum is completely resistant below 150°C, with condensation of the vapour-gas mixture. Other metals under these conditions are strongly corroded.

V. V. Romanov (*ibid.* 1191-6) reports some experiments on the effect of cathodic and anodic polarisation on the sensitivity of the MA-Z alloy to corrosive attack in a solution of 35 g. per litre NaCl plus 20 g. per litre K_2CrO_4. This is a magnesium alloy containing (as percentages): Al 6.5, Zn 1.03, Mn 0.36, Fe 0.007, Si 0.07, Ni 0.0005, Cu 0.03, remainder Mg. Test apparatus is shown together with diagrams and graphs of results. Briefly, it was found that anodic polarisation from 0 to 5 mA per sq. cm. continuously increases the sensitivity of the alloy to corrosive breakdown; while cathodic polarisation, on the contrary, produces a marked lowering thereof, with current densities of 1.5 to 2 mA sq. cm.

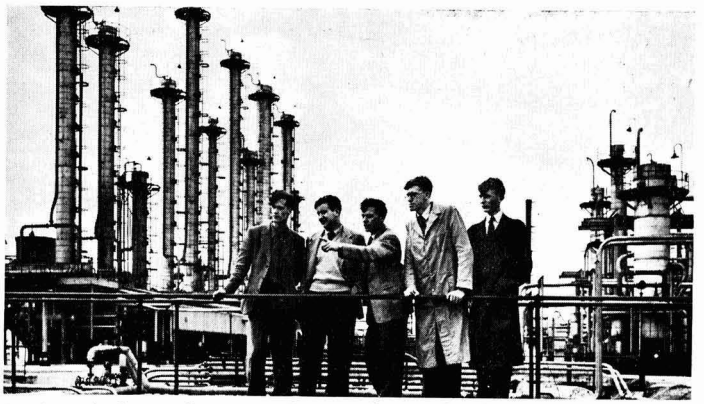
A short paper by A. F. Bogoyavlenskii *et al.* (*ibid.* 1295-7) describes the effect of the anodic passivation method and of electrolyte concentration on the porosity of aluminium oxide film, using the mineral oil test for porosity (weight absorbed). The electrolytes used were sulphuric acid, oxalic acid, chromic acid and carbonate. Effect on porosity was most marked with the first and last; it had little effect with the chromic acid bath; and was somewhat anomalous with oxalic acid.

A contribution by R. I. Agladze *et al.* on the anodic solution of ferro-chrome in solutions of sodium carbonate and caustic soda, based on work at the Institute of Metals and Mining, Georgian Academy of Science appears in *Zh. prikl. Khim*, 1956, **29** (9), 1365-71. This appears to be more concerned with the production of chromic salts by solution of chromium and ferro-chromium, than with corrosion strictly speaking. Such solution is possible in both acid and alkaline media, but several reasons are given for preferring the latter. The main object was to study the effect of various factors: concentration of electrolyte, temperature, current density etc.

Caustic Soda Preferred

Generally it may be concluded that the use of caustic soda is to be preferred to carbonate because the consumption of electric energy is lower, a more easily filtered deposit is obtained, loss of chromium is reduced to a minimum and no soluble compounds of iron are formed, thus eliminating the need for heating the electrolyte before filtering. With low concentrations of alkali of the order of 10-50 g. per litre and high current densities a flaky deposit is formed; the higher the alkaline concentration the wider are the limits of anodic current density within which the iron dissolving from the anode forms a cork-like deposit.

Another paper on alkaline solutions deals with the effect of inhibitors on the solution of iron therein (*ibid.* 1353-8), including silica gel, di-substituted sodium phosphate, and tannin. The most suitable additives are those capable of forming surface compounds with the iron or its oxides. Among those tested here tannin seemed to be the most effective, though not markedly superior to the others. With the right concentration they mainly act by slowing up solution of iron without lowering its electro-chemical activity, and this is closely associated with increased hydrogen over-voltage.



A senior technologist with science students attending a technical training course at Stanlow chemical plant, Cheshire

VACATION COURSES AT SHELL PLANTS

NEARLY 900 university students have attended vacation courses at Shell oil refineries, chemical plants, research centres and laboratories in the UK since the scheme started in 1946.

Six-week courses will again be available this year during the long vacation from 1 July to 9 August and from 12 August to 20 September. They are open to students of chemistry, physics, chemical and mechanical engineering, metallurgy and biology. Arrangements have also been made for a limited number of arts students.

New Process for Recovering Chlorine and Hydrogen Developed by Milan Firm

TWO developments are announced by Oronzio de Nora, of Milan. Mercury cells with a rated capacity of 120,000 amp., which can be operated at even higher currents, are being constructed by the company. The first series of these cells is being supplied to the Diamond Alkali Co. of Cleveland, Ohio, and will be installed near Houston, Texas.

Diamond Alkali is shortly embarking on a multi-million dollar expansion programme. Electrolytic production of chlorine at the Deer Park chemical plant near Houston, Texas, will be increased by some 40 per cent, or by 200 tons of chlorine daily. Production of caustic soda will be raised by approximately 30 per cent or by 220 tons, and that of hydrogen by two million cu. ft. per day. The new capacity is expected to be put into operation early in 1958 and to be completed by 1960.

De Nora cells have been installed and operated by Diamond at Muscle Shoals, Alabama, over a number of years. At Houston, 52 de Nora mercury cells of the 18 SGL type will be installed. With a rated capacity of 120,000 amp. they are believed to be the largest of their kind in the world.

A new process for recovering chlorine and hydrogen from hydrogen chloride has been devised by de Nora to exploit a hitherto largely unused by-product and at the same time to overcome a difficult disposal problem.

The recovery of chlorine from hydrogen chloride can be carried out in two ways either by the oxidation of the hydrogen chloride by means of oxygen in the presence of a catalyst or by the electrolysis of hydrochloric acid. Of these two methods, the latter is recommended owing to the simplicity of the equipment and to the relatively low cost of installation and operation. The electrolysis process is characterised by remarkable flexibility.

For this process a cell has been specially constructed from materials highly resistant to the chemical attack of hydrochloric acid and chlorine. The most significant feature of this cell is a new type of high conductivity diaphragm. Although permanently in contact with hydrochloric acid and chlorine at high temperatures a long life for the diaphragm as for the cell itself is claimed.

The de Nora process can be used on a large or small scale. Floor space and manpower requirements are modest. The standard cell unit operating at 1,000 amp. will, it is claimed, produce one metric ton of chlorine per day. The chlorine produced, together with the by-production of hydrogen, are said to be of the highest purity.

Fison's New Building

Fisons Chemicals (Export) Ltd., Fisons Pest Control Ltd. (Overseas Department), and Whiffen and Sons Ltd. (Sales and Technical Development) moved into their new building, Fison House, 95 Wigmore Street, London W1 (telephone: WELbeck 5500, on Monday 25 February. The new building will be officially opened in May.

Electroplating by Dalic Process

ELECTROPLATING with tin-zinc and other metals using the Dalic process is carried out by Metachemicals Ltd., Crawley, Sussex. In this process the metal to be plated is made the cathode. The anode consists of a porous 'brush' dipped in the plating solution. This brush is moved over the surface to be plated, forming a firmly-adherent, smooth grained coating.

A French invention, the Dalic process was adopted recently by Metachemical Processes who have agents in many parts of the world. Advantages for the process are that the plant can be taken to the job and intricate surfaces, not suitable for orthodox plating methods, can be tackled.

Welcoming the press to the Crawley factory on 25 February, Mr. H. D. Hughes, founder of the company, spoke of the difficulties in interesting British manufacturers in his company's processes. In Canada and the US, he said, there was a greater willingness to try new procedures even at considerable expense.

Some British companies seemed afraid of anything new. They were willing to carry on with old established methods which were not always the best.

Metachemical Processes is a comparatively new company, having been founded by Mr. Hughes some 10 years ago at Acton, London W3. The rapid expansion of the business compelled them to move to Crawley a few months ago.

Licences Needed for Export of Boron Minerals

EXPORT LICENCES will from 4 March be required for the export to all destinations, other than those specified in paragraph (a) of Article 5 of the principal Order of the following: boron minerals alloys and compounds, polymethyl alpha-chloroacrylate in specified forms, specified crystals and certain internal grinding machines. Regulations governing gift parcels will be amended to prohibit further specified scientific instruments and apparatus being sent as gifts.

In future the export of any goods to North Korea will be prohibited except under licence.

The Orders making these changes are: Export of Goods (North Korea) (Revocation) Order, SI 1959/246, price 2d, by post 4d.; Export of Goods (Control) (Amendment No. 3) Order, SI 1957/247, price 4d., by post 6d. They can be obtained from HM Stationery Office and branches.

Plastics Institute Meeting

An extraordinary general meeting of the Plastics Institute Ltd. will be held on 18 March. Objects of the meeting will be to alter the objects of the Institute as set out in the Memorandum of Association.

The present Memorandum of Association was drawn up in 1931 and has remained substantially unaltered since then.

CORROSION PROBLEMS IN CHEMICAL FACTORIES—3

Non-Metallic Materials : Atmospheric Corrosion

By
F. R. Himsworth, Ph.D., B.Sc.,
and
J. G. Hines, Ph.D., M.A.

IN general the chemical resistance of ceramic materials is much higher than that of even the most resistant of structural metals. But ceramics are invariably relatively fragile, very brittle, susceptible to thermal shock, and difficult to fabricate. The materials are quite cheap, but because of manufacturing difficulties the cost of the finished article may be quite high, unless it is a simple standard shape. Certain ceramics have long been used for handling acids, where condition of temperature and pressure permit. They have to some extent been replaced by special alloys and by plastics, but are still used in large quantities. An engineer accustomed to working only with metals regards ceramics as a last resort, but one accustomed to glass or stoneware plant will have no such inhibitions; these materials can be installed and used on quite a large scale without suffering undue damage.

Chemical Stoneware

Chemical stoneware is used for pipes, pumps, small tanks etc., for severe acid duties, and gives excellent service if correctly designed, installed and maintained. Glass is being increasingly used for handling hydrochloric acid, pharmaceutical products etc. Quite large units are in use, and many items such as pipes and flanges, cocks, condensers, are available in standard sizes, which greatly facilitates assembly. Joints give rise to some difficulty with both stoneware and glass; it is not easy to find materials with the required physical properties and also the high chemical resistance for the duties involved. An interesting new type of joint ring consists of a resilient material enclosed in an envelope of a chemically resistant, but physically unsuitable plastic such as polytetrafluoroethylene (p.t.f.e.).

Acid-resisting brick construction is widely used for plant floors, effluent ducts and vessel linings. The main difficulty is to find a jointing cement which is sufficiently resistant to the chemical conditions, and is otherwise satisfactory. Cements based on sodium silicate are cheap, and suitable for acid conditions. For alternately acid and alkaline conditions modern synthetic resin cements are very effective, though expensive. Some extreme conditions, for example, concentrated nitric acid alternating with caustic alkali, are beyond the scope of any cement.

For components which are not too large, vitreous enamel (glass) linings on mild steel or cast iron plant afford a high degree of acid resistance, but are attacked by caustic alkalis. They are thin, and somewhat brittle, so that the shell must be rigid, and great care must be used to ensure that they are not damaged during erection or in service. One tiny fault in a vessel containing acid will lead to complete failure of the vessel in a very short time. Small faults can be repaired using tantalum plugs, but a damaged area of any size entails complete re-lining of the vessel. The lining must therefore be tested by a searching method, preferably using a high frequency electric spark, and every fault in a vulnerable part of the vessel made good.

Plastics and Rubbers: Natural rubber compounds have been used for many years as tank and pipe linings, since they are resistant to many materials which are corrosive to the cheaper metals, hydrochloric acid being a notable example. A wide variety of other materials is now available, and is being used to an increasing extent as constructional and lining materials. A major disadvantage of rubbers and plastics is that they can be used over only a limited temperature range. Many are usable only up to about 60°C; others can be used up to about 150°C. Only the fluorine-containing polymers (p.t.f.e. and p.t.f.c.e.) and the silicones are suitable for higher temperatures—up to 250-300°C—but these are very expensive.

Common Polymers

The polymers most commonly used in chemical plants are natural rubber, Neoprene and butyl rubber; polythene and p.v.c.; and phenol formaldehyde plastics. The rubbers are used almost exclusively as linings for mild steel plant. They can be firmly bonded to the steel and give excellent service when the chemical conditions are suitable, for example, with acids (if not strongly oxidising), alkalis and salts, and with some classes of organic solvents.

Polythene and p.v.c. are widely used in the form of pipes, ducts, and small tanks, unsupported. They have also been used as linings for mild steel, but with varying success. They have very good all-round corrosion resistance. Polythene is quite flexible, and while this is sometimes a disadvantage, it is a distinct advantage for small bore piping, which can be coiled, and laid very easily in continuous lengths. It is cheap enough to displace lead and copper for cold water services, and in a factory it has the advantage over steel that no external protection is required.

P.v.c. being more rigid, is more suitable for larger bore pipes and for vessels, fans, pumps etc. Both of these plastics have the great advantage that they can readily be welded, so that fabrication of any plant item from sheets, pipes and rods is possible. This feature, together with their excellent corrosion resistance, makes them the most popular of plastics for chemical plant application. Great care is required in design, since the principles used are entirely different from those applicable to design of metal components. The breaking strength is quite irrevelant, since creep becomes excessive at loads far below the breaking stress. The working stress is, therefore, a small fraction of the ultimate tensile strength, and it would be wrong to adopt the ultimate stress divided by a factor of safety as is done for metals. Since creep tests are so difficult to carry out, estimates of safe working stresses are rather uncertain and liable to change as fresh data appear. Manufacturers' data should be adhered to, even though they seem conservative when compared with ultimate strength.

Phenol formaldehyde plastics, which are the commonest of all plastics in everyday life, are used to some extent in chemical plants, but they have severe limitations. They cannot be welded or shaped (some modern types can be shaped to a limited extent) and fabrication is awkward, except for very simple shapes. Although the material is relatively cheap, a fabricated article is quite expensive, and, if complicated, very expensive. It resists much higher temperatures than polythene or p.v.c., up to about 150°C, and is therefore used for hot dilute acids etc. The corrosion resistance is more limited than that of polythene or p.v.c.

Fluorine Compounds

The fluorine-containing plastics, polymerised tetrafluoroethylene (p.t.f.e.) and trifluoromonochlorethylene (p.t.f.c.e.), have quite remarkable properties. They resist attack by virtually all chemicals, at temperatures up to 200-250°C. They are, however, very expensive and thus suitable only for small critical items or as thin linings. P.t.f.e. is commonly used as a gland packing, since it has exceptionally good frictional properties, needs no lubrication, and is unaffected by any chemical. Steel can be successfully lined with either p.t.f.e. or p.t.f.c.e., but stoving at 300-350°C is necessary and this limits the application at present to quite small items. An interesting application is the coating of bursting discs for hot corrosive gases; the disc is completely protected internally, and the mechanically most suitable metal, for example aluminium, can be used.

Atmospheric Corrosion: Although corrosion caused by the atmosphere is an important problem in the chemical industry it is not proposed to consider it in detail here, as the problem is little different from that in many other industries, except for locations where particularly corrosive vapours escape to the atmosphere or where spillage of aggressive liquors may occur.

Painted mild steel is often satisfactory so long as the steel is carefully cleaned before painting, but in large factories

economy may be shown over a long period by shot-blasting and metal spraying structural steelwork before painting. The paint coating then has a much longer life than on even phosphate pickled steel, but repainting is, of course, necessary at intervals. In milder conditions the expense of metal spraying cannot be justified. The best metal for sprayed coatings appears to vary with the precise conditions, zinc being superior to aluminium in most atmospheres but inferior in some.

Aluminium and certain aluminium alloys—Al/Mn, Al/Mg and Al/Mg/Si—have good resistance to atmospheric attack under quite severe conditions, but as paint lasts very well on aluminium it is often wise to pretreat and paint the surface. Austenitic steel surfaces are, of course, extremely resistant, and although they may become coated with rust in some locations it is never necessary to give protection. Copper and lead, on the other hand, suffer severely in some atmospheres.

In some locations where corrosion is severe and painting is inadequate, protection of steelwork by casing in concrete has been valuable. This protection is permanent, but is difficult to apply to bracing, pipe hangers etc., and a properly designed reinforced concrete structure is better. However, it is very difficult to make alterations to a reinforced concrete structure, should modifications to the plant become necessary. Steelwork may also be protected by a loose fabric tape bearing a thick coat of a heavy petroleum grease, which can be wrapped round or pasted on to the structure at points where the conditions are severe. This provides an excellent protection, but constitutes a fire risk and is unsafe to walk on; on the other hand it is inexpensive, flexible and readily renewed.

Paints should be very carefully chosen at all times but even more so in known corrosive areas, as the escape of vapours from plants handling or making solvents can cause softening and stripping of paints which are otherwise completely suitable.

MARYLAND FIRM PUBLISHES WORK ON ELECTROLYTIC TITANIUM

SINCE 1948 the Chicago Development Corp., Riverdale, Maryland, US, has been studying processes for the production of titanium metal. Dr. Ben B. Raney, of Linton, Indiana, proposed to the Corporation entirely chemical processes and processes in which one or both of the reactants were produced in an electrolytic cell.

Electrolytic Titanium, published by the corporation, describes work to date on the production of titanium metal by electrolytic processes.

On 5 June 1951 Dr. Raney filed a patent (No. 230,336) disclosing 'a soluble crude titanium anode in a fused alkalinous chloride bath in a single compartment cell in which solution took place only as titanium chloride and particulate titanium was formed by cathodic action.' Chicago Development Corp. used this process from January 1951 to January 1953 to produce refined titanium for the US Army Chemical Corp.

Raw material for the process was iron-titanium scrap and rejected Kroll sponge.

As a result of work carried out in the last few years the electrolytic process has been developed considerably. Cells which produce from a few grams up to several pounds of titanium per day have been built and tested.

A typical cell consists of two eight in. stainless steel pots 36 in. long which are connected together at the bottom by a one in. stainless steel pipe. A water-cooled lid is fitted, from which the anode is suspended. A steel cathode is fitted inside the anode. An inert gas atmosphere is provided.

After a run is completed in the first pot the connecting pipe is heated to 900°C. Argon pressure is applied and the electrolyte is forced over into the second pot. The connecting pot is then cooled with water to prevent flow-back of the salt, and the next run is ready to begin in the second pot. The first pot is cooled and the lid removed for recovery of the cathode product.

Currents up to 500 amps. have been used in this cell and yields up to five pounds per run have been obtained.

To be of practical value the cathode product must consist of at least 90 per cent very large crystals from which the salt of the bath can be drained to a content of a few per cent. Production of a suitable deposit was described in 'The Structure of Titanium Deposits Formed in Electrolytic Cell Using Fused Alkali Chloride Baths' presented to the US Electrochemical Society on 1 October 1956.

Suitable operating conditions are:

(1) Temperature: In general, a temperature from 850 to 865°C. is desirable.

(2) Atmosphere: A high purity, inert atmosphere is necessary. Argon is preferable because of its higher density.

(3) Electromotive force: Closed circuit voltages are dictated by the geometry of the cell and the nature of the electrolyte. The open circuit voltage should not exceed a few millivolts for proper refining conditions.

Scale Prevention

Micromet, a slowly soluble form of sodium metaphosphate made from food grade raw materials, has been introduced by Albright and Wilson Ltd., Oldbury, Worcs, for the prevention of scale in domestic boilers. Medical authorities and water engineers are said to be satisfied that threshold concentrations of sodium metaphosphate in drinking water are harmless to taste.

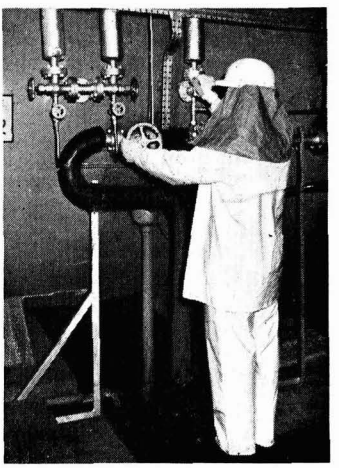
Oil Firing Courses

Following the success of the NIFES oil firing courses last year, a further series of courses has been arranged at Reading. Details are obtainable from NIFES Head Office, 71 Grosvenor Street, London W1.

Terylene Clothing for Handling HTP

EIGHT different articles made from Terylene polyester fibre are used in HMS *Excalibur,* a new type of submarine propelled by high test peroxide; similar articles manufactured from Terylene are used to handle the fuel for rockets propelled by HTP.

A range of Terylene hoses, lined and coated with a special plastics material formulated by the Admiralty materials



A Terylene protective suit being worn by an operator refuelling an HTP submarine

laboratory, has been developed by Compoflex Co. Ltd., London. This company has also developed a range of Terylene gaskets for use with HTP.

Overalls and hoods, in a silicone-proofed, vapour-permeable Terylene by Fine Spinners and Doublers Ltd. are made up to Admiralty specifications by M. Barr and Co. Ltd. of Glasgow.

For handling and pumping HTP on shore, both for submarine and rocket use, special protective clothing has been developed in Terylene by such firms as RFD Co. Ltd., Godalming, Siebe Gorman Co. Ltd., Surbiton, and M. Barr & Co. Ltd. In addition, Glove Industrial Ltd. manufactures Terylene protective gloves for handling HTP. All the protective clothing is sewn with Terylene thread.

Chemical Engineers' Annual Dinner

Thirty-fifth annual corporate meeting and annual dinner of the Institution of Chemical Engineers will be held at the May Fair Hotel, London W1, on Tuesday 30 April. The meeting will start at 11 a.m. and will be followed at noon by the address of Mr. John A. Oriel, president, whose subject will be 'Petroleum and the Chemical Engineer.'

Principal guest at the annual dinner will be Viscount Chandos. Applications for tickets, price 40s, should reach the Institution at 16 Belgrave Square, London SW1, by 17 April.

TOXIC HAZARDS IN INDUSTRY—7

Food Additives and Contaminants

By Peter Cooper, F.P.S.

DURING the handling of foodstuffs the vessels used, lubricants applied to them, and packaging materials, all of which must come into close and perhaps prolonged contact with the food, tend to yield trace compounds to be ingested by the consumer. Apart from these unintentional additions to diet, there must be deliberate additives intended to preserve food during its distant transport or prolonged storage for emergency purposes. Colour and artificial flavouring may be necessary to make the diet more appetising. In some instances uniformity of the raw foodstuff is required to adapt its preparation to large-scale processes, and here its natural ageing must be accelerated by chemical means. All these factors make for toxic risks which must be assessed and, if possible, eliminated before public safety is assured.

The original hazards of contamination of plant foods by foreign poisonous plants or toxic elements derived from local soil are now rarely encountered, and then only in primitive conditions by isolated peasant communities. Ergot scleratia in rye have caused convulsive seizures or gangrene of the extremities, for which vasoconstrictor drugs are useful. Hemp tops harvested with cereals have been suspected of causing disorientation with hallucinations. This intoxication is not dangerous and treatment is unnecessary as a rule.

Acute food-poisoning in warm weather usually results from the growth of *Salmonella* species in meat, fish or milk products, and can only be avoided be scrupulous hygiene in handing, and the maximal use of refrigeration and washing facilities. Botulism, caused by the anaerobic production of the exotoxin of *Clostridium botulinum* in canned meat or vegetables which have been imperfectly heat-sterilised, carries a mortality of 60 per cent. It is essentially associated with home-canning, and is rare with commercial products. The symptoms are of extreme gastrointestinal irritation followed by muscular paralysis. A botulinus antitoxin is available for treatment, and should be injected into all suspected of sharing the infected food.

Aluminium: Non-toxic

Most unintentional contamination of food derives from the cooking and storing vessels. Aluminium is unique in being non-toxic even when ingested in considerable amounts over many years. Rats fed on alum baking powders in twice the normal dosage over two generations have shown no deterioration of growth-rate or reproduction. Copper is a necessary trace element, and it seems probable that poisoning attributed to copper vessels may be due to foreign toxic metals. The human body handles about 2 mg. of copper daily, and the dangerous titre in food is probably 30 mg. per kilo or more. Copper treatment of peas and beans to improve the colour is not permissible, though copper chlorophyllin seems to be a harmless compound in small quantities. Nickel, apart from its sensitising property in some individuals, is a harmless trace-element. Inorganic tin also shows little toxic propensity, though traces occur in canned foods.

Zinc occurs in milk (about 3 mg. per litre) and eggs (1 mg. each) and in many fruits, especially tomatoes, where it is concentrated in the seeds. Poisoning has been reported in people who ate apples stewed in a galvanised-iron kettle; the titre was about 800 mg. per kilo, but cadmium also may have been present. Although 30 to 40 mg. per litre in drinking water has been claimed to be innocuous, a sub-committee of the Ministry of Food's Food Standards Committee (1954) has recommended an upper limit of 5 p.p.m. of zinc in ready-to-drink beverages and 50 p.p.m. in other foods except those where the natural zinc content is higher; edible gelatine may contain 100 p.p.m. Zinc containers are definitely unsuitable for storing or processing foodstuffs on account of their ease of corrosion.

Toxicity of Cadmium

Cadmium must carefully be avoided; sufficient is soluble in acid fruit juices to produce violent gastric irritation and diarrhoea, resembling a serious attack of bacterial food poisoning. Gastric lavage with sodium bicarbonate solution is effective in treatment, and the attack is short-lived. Antimony, once widely used in cheap glazes, is a dangerous contaminant leached out by fruit drinks and acid foodstuffs. It is a violent gastrointestinal irritant lacking the properties of conferring tolerance or exerting a central nervous effect (unlike arsenic).

Quantities of arsentic up to 1 p.p.m. are common in natural foodstuffs. Higher concentrations of arsenic are dangerous, and are probably the result of crop-spraying with arsenical pesticides. The limiting concentration in ready-to-drink beverages is 0.1 p.p.m. Arsenic in small quantities confers a relative immunity to poisoning by further doses, which probably makes it rather less chronically toxic than lead, which is dangerously cumulative. Lead is naturally present in concentrations up to 1 p.p.m.; contamination from plant, machinery, sprays, paints or wrappers may raise the level greatly. The permitted level (Food Standards Committee, 1954) in foodstuffs is 2 p.p.m., in ready-to-drink beverages 0.2 p.p.m. In food-adjuncts more lead is permitted; for instance, up to 20 p.p.m. in food-colours, and 50 p.p.m. in solid pectin. It is noteworthy that at one time childen's sweets were coloured with so toxic a compound as lead chromate.

Addition of chemicals to foodstuffs as preservatives or improvers needs careful consideration. Only necessary additions can be justified at all, since the cumulative effect of a chemical over a lifetime, or over several generations, is rarely known.

Two general criteria are recognised in making a judgement; if there is a known acutely toxic level it must never be approached, and there must be no impairment of growth or reproduction in experimental animals fed with the compound in exceptional doses during three successive generations. Chemical carcinogenesis, in particular, is a spectre which haunts all who try to improve the quality and keeping properties of food. It is necessary to eliminate from the diet all such substances as butter-yellow, which was found to cause liver tumours in rats although it had been in common use for colouring food for years. It is possible to control food-colours either by publishing a permitted list or a prohibited list; the first method seems preferable since it narrows the choice to known compounds. Prohibited compounds are those of antimony, arsenic, cadmium, chromium, copper, mercury, lead or zinc, together with gamboge, picric acid, dinitrocresol, naphthol yellow, aurantia and aurine.

Permitted Compounds

Nineteen permitted compounds are listed in the US, and a similar list has been recommended (Food Standards Committee, 1955) in Britain. It includes the natural pigments alkannet, annatto, bole or iron oxide, caramel, carbon black, carotene, chlorophyll, cochineal, flavine, orchil, Persian berry, saffron, turmeric, titanium dioxide and ultramarine, and thirty-two synthetic dyes. The calcium or aluminium lakes of these dyes are permitted for external colouring only.

Mineral oil, present as a lubricant during processing, and not added as a constituent, is permitted up to 0.2 per cent; dried fruits may contain 0.5 per cent, citrus fruits up to 0.1 per cent. There is reason to suppose that mineral oil may be deposited in certain body sites after ingestion; certainly it prevents or retards the absorption of the B-complex vitamins and so brings about malnutrition. The silicone products used now as lubricants appear to be non-toxic, though they probably have the same retarding effect as mineral oils on vitamin-absorption. The ethylene oxide derivatives sometimes used as anti-staling additions to bread are generally regarded with mild suspicion since insufficient is known about their long-term effects on the body.

Little or no exception can be taken to the natural products (lecithin, ascorbic acid and tocopherols) which act as anti-oxidants in fats and similar foodstuffs. Additional antioxidants are not permitted in Britain, but specified substances have been recommended to the Food Standards Committee by its subcommittee as being suitable if and when their use can be legalised. Propyl, octyl and dodecyl gallates or their admixtures (up to 0.01 per cent) and butylated hydroxyanisole

(up to 0.02 per cent) are included. Butylated hydroxytoluene is flavoured in the US. It should be noted that phenolic compounds which act as antioxidants are incorporated into food during smoking (bacon and fish), and there is no evidence that the century-long habit of consuming smoked foods has caused any toxic reactions.

Metal-chelating agents have a place in preventing oxidative spoiling of food, but their toxic propensities are varied and largely unexplored. Simple preservatives in food are not to be encouraged. Formaldehyde, formerly use in milk, is toxic, and borates, though they occur widely in natural foods, appear to have a definite chronic toxicity above a certain unknown level. A variant on the formaldehyde theme, hexamine, still appears sometimes in imported food. Nitrates used in bacon and ham may give rise to mild reactions, including a fall of blood pressure and cyanosis. The esters of p-hydroxybenzoic acid, said to be popular on the Continent, are non-toxic for most purposes, but their long-term capabilities are not definitely known. Sulphur dioxide, a versatile preservative effective at 20 to 40 p.p.m., is removed effectively during the cooking of food, and is unlikely to cause trouble; it may remain up to a concentration of 40 p.p.m. in jams. Antibiotics used to preserve frozen meat and fish present a new problem, since it cannot definitely be said that they will not produce resistant strains of organisms nor sensitise the consumer eventually. Aureomycin ice, with 3 to 7 p.p.m., extends by 50 per cent the keeping time of fresh fish. After cooking, the residual concentration of aureomycin is about 0.1 p.p.m.

The improving of flour may be accomplished with acid calcium phosphate, dicalcium phosphate, potassium or ammonium persulphate or potassium bromate. The oxidising agents used for bleaching offer no evidence of chronic toxicity, though they have an acute toxicity for those handling them. Chlorine dioxide not exceeding 30 p.p.m. is probably the safest bleacher and improver. Nitrogen peroxide and benzoyl peroxide have no chronic, though they have an acute, toxicity. The agene process, using nitrogen trichloride, has been condemned on the evidence of Mellanby's dogs and rabbits, which developed running fits, though no clinical evidence has even proved conclusively that agenised flour would produce fits in human consumers. In studying the toxicity of food additives and processing agents, potential toxicity must be assumed unless convincing evidence to the contrary can be brought forward to justify their widespread use.

Factory Inspectorate Change

A new division of the Factory Inspectorate, Ministry of Labour has been created. Known as the Northern Division it covers Cumberland, Durham, Northumberland, Westmorland and the North Riding of Yorkshire; head office is at Prudhoe House, Prudhoe Street, Newcastle-on-Tyne 1.

Detergents Discussed at RSA Meetings

DETERGENTS were the subject of two papers presented recently before the Royal Society of Arts.

On 20 February, under the title 'Modern Detergents', F. Courtney Harwood, late director, British Launderers' Research Association, discussed the present situation in the detergent industry and surveyed the history of detergents. He quoted some figures for the UK market in 1955 showing that alkyl aryl sulphonates formed by far the largest proportion of synthetic detergents produced. Dodecyl benzene accounts for over 90 per cent of this class.

'Synthetic Detergents—a New Pollution Problem' was the title of a paper presented by Dr. B. A. Southgate, director, Water Pollution Research, DSIR, on 27 February. Dr. Southgate spoke of the dangers of detergents interfering with normal sewage treatment resulting in river pollution and possible contamination of drinking water as has already occurred in the US.

Difficulties arise in sewage works because of foaming which is not easily overcome and is a danger to workers and the public. Addition of an anti-foaming agent appears to be the best solution. At one works where it was tried the cost of equipment was £5,000 and the annual cost of the anti-foaming agent about £15,000.

Change of Address

WEINREB & RANDALL LTD., tower packing and distillation specialists, have moved from 70 New Oxford Street, London WC1, to new premises at Watchtower Works, Greenside Road, Croydon, Surrey (Tel. THOrnton Heath 8696), on 1 February. This will bring the company's office, production and warehousing facilities under one roof.

CHEMICAL PRICES RISE 8% SINCE 1953

BOARD OF TRADE'S wholesale price index for 1956 shows that between 1953 and the end of last year the wholesale prices of all chemical and allied products rose from 130.4 to 138.8 (30 June 1949 = 100). The following are the annual average prices from 1953 to 1956 of a range of chemicals.

BOARD OF TRADE WHOLESALE PRICE INDEX

	Annual Averages			
	1953	1954	1955	1956
Hard coke	136.8	150.4	174.3	194.9
Dyes and dyestuffs	128.9	129.1	132.0	140.9
Disinfectants	108.8	110.9	117.1	124.9
Insecticides, weedkillers and fungicides	125.0	123.4	129.0	136.8
Synthetic resins and plastics materials	125.0	121.6	120.9	123.2
Cellulose acetate moulding powder (opaque)	107.9	102.7	90.0	85.9
Cellulose acetate sheet, comm. clear transparent	121.4	121.4	122.0	127.4
Laminated materials, fabric grade	140.3	136.9	137.3	136.9
Laminated materials, paper grade	134.4	131.5	131.3	131.8
Phenol-formaldehyde moulding powder	145.3	137.3	136.3	147.7
Polystyrene thermoplastic moulding powder	174.9	174.9	163.4	160.0
P.v.c., Geon polymer 101	116.2	116.2	116.2	112.4
P.v.c. Corvic 'HO'	109.5	112.5	113.7	109.6
Urea-formaldehyde moulding powder	111.9	109.6	100.4	109.4
General chemicals	142.7	147.3	151.4	156.7
Acetic acid, BSS 576–1950	138.1	134.0	130.0	135.4
Acetone, BS 509—1950	153.0	137.1	127.2	126.9
Aluminium sulphate (14 per cent Al_2O_3)	134.5	137.0	146.4	152.2
Barium carbonate, precipitated 98/99 per cent in powder form	137.6	154.5	157.1	162.4
Barium chloride, fine crystal	120.7	120.7	120.7	120.7
Benzole, pure, BSS 135—1950	173.2	179.1	182.9	185.4
Butanol, BSS 508—1950	112.6	110.6	102.6	101.2
Calcium carbide, BSS 642—1951	108.3	110.8	115.6	122.0
Caustic soda liquor, 100° TW.	137.3	145.0	148.2	156.2
Dichromate of potash	118.9	120.8	128.0	133.8
Hydrogen peroxide, 130 vol.	103.5	101.9	103.0	105.4
Liquid chlorine, pure	142.9	152.0	152.6	158.4
Methanol, refined	127.2	127.2	129.3	135.1
Nitric acid, concentrated, 95/96 per cent	129.1	136.7	140.7	147.0
Phenol	164.3	156.4	157.1	157.1
Phosphorus, 99.9 per cent pure, specific gravity, 1.82, melting point 44.1°	128.8	137.0	141.9	148.5
Phthalic anhydride	153.1	139.0	146.8	155.8
Pigments and earth colours, inorganic	119.2	119.6	126.0	133.0
Salicylic acid, technical or commercial grade	139.4	137.0	135.4	133.0
Soda ash, light (d/d)	141.4	151.3	155.1	163.3
Soda ash, light, f.o.r. works	147.2	157.7	161.9	171.9
Sodium cyanide, 96/98 per cent standard quality	126.5	129.0	129.3	131.8
Sodium sulphide, solid, 60/62 per cent	135.5	138.8	141.7	144.8
Sulphuric acid, BOV	146.3	154.9	170.6	173.7
Sulphuric acid, ROV, 94/95 per cent	168.4	171.6	181.1	181.8
Titanium dioxide (Anatase)	127.9	132.0	138.6	149.7
Titanium dioxide (Rutile)	125.0	129.6	134.8	142.8
Trichlorethylene, metal degreasing	137.7	140.1	143.0	149.3
Tri-cresyl phosphate	115.3	114.5	119.3	119.3
Urea, tech. pure	131.9	134.8	137.1	140.3
Drugs and pharmaceutical preparations	102.5	102.2	102.8	103.9
Carbon black	136.3	136.0	133.6	129.5
Fertilisers	171.8	171.7	182.1	196.7
Phosphate rock	136.5	136.3	147.2	151.9
Pyrites, c.i.f. UK ports	172.3	170.5	180.0	178.5
Rubber, No. 1 RSS, one month future	199.1	198.1	329.9	284.2
Sulphur, crude (for acid making) c.i.f.	174.0	159.6	176.6	177.8

ANNUAL AVERAGE WHOLESALE PRICES FOR SELECTED COMMODITIES PRODUCED IN THE UNITED KINGDOM

	Unit of sale	1953	1954	1955	1956
Cellulose acetate moulding powder (opaque), min. ½-ton lot, d/d	s. per lb.	3.69	3.35	2.64	2.58
Phenol-formaldehyde moulding powder c/o in 56 lb. non-returnable bags	d. per lb.	19.25	17.72	17.50	19.00
Polystyrene thermoplastic moulding powder crystal, c/p UK	s. per lb.	2.83	2.83	2.66	2.58
Urea formaldeyhde moulding powder wood metal type, d/d user UK and f.o.b. export	s. per lb.	1.29	1.29	1.29	1.29
Calcium carbide (BSS 642—1951) High grade, 4 tons and over c/p	£ per ton	35.39	36.20	37.79	39.89
Pure benzole, BSS 135—1950 bulk min. lots of 200 gals d/d	s. per gal.	5.05	5.22	5.33	5.41
Sulphuric acid ROV 94/95 per cent f.o.r. works, in road and rail tanks for min. tank loads 5/6 tons	£ per ton	9.39	9.57	10.10	10.14

Overseas News

NEW 3-D MICROSCOPE AIDS STUDY OF CONTAMINATION IN CHEMICALS

A POWERFUL new X-ray microscope has been developed by the General Electric Company, US. This magnifies objects up to 1,500 times and penetrates their interior, giving a three-dimensional view of hitherto invisible details regarding the composition of many types of material. The instrument may be used for direct viewing or for recording images on film by means of a Polaroid camera. Specimens to be examined do not have to be sectioned, mounted in a vacuum or otherwise specially prepared.

In the field of metals, X-ray microscopy reveals corrosion, the effect of foreign materials in metals, the soundness of electro-plated coatings and the effect of different processes on the behaviour and structure of metals.

Its importance in the chemical field is that it enables to be studied contamination in chemicals, deterioration of fibres and textiles, penetration of dyes and adhesives, and distribution of particles in a mixture or suspension.

The new microscope can be used to study plastics and it is thought that it may prove valuable for controlling the quality of carbon black used in the rubber industry.

CIL to Build Explosives Research Laboratories

Explosives research laboratories are to be built at Beloeil, Quebec, this summer by Canadian Industries Ltd. Announcing this, Mr. M. J. Watson, general manager of the explosives division, said that the project would cost approximately $600,000 and was expected to take a year to complete. Applied explosives research facilities are maintained by the company at Beloeil. The company also carries out fundamental research on explosives in its central research laboratory.

Spanish Sulphur Output Up

Spanish production of sulphur in 1956 totalled 50,000 metric tons, an increase of 33 per cent compared with 1955. Potash output, at 230,000 metric tons, was up by 18 per cent, while production of pyrites, at 2,320,000 metric tons, was up 12 per cent.

US Titanium Company's Record Sales

Sales for 1956 of the Titanium Metals Corporation of America, jointly owned by Allegheny Ludlum Steel and National Lead, reached the record figure of $55.1 million. The net income was $11 million, also a record. In the joint companies' report the total estimated annual consumption of titanium mill products for 1958 is stated to be of the order of 30 million lb. compared with under 4 million lb. in 1955.

Kenya's Pyrethrum Production Up

Kenya's pyrethrum production from 1 to 22 January amounted to 213 tons compared with 194 tons for the corresponding period in 1956, bringing the total production from 1 April 1956 to 22 January 1957 to 3,064 tons against 2,594 tons in 1955/56. Production in February and March is expected to be slightly lower owing to the recent lack of rain.

Canada to Sell Uranium

It was announced in Ottawa last week by the Trade Minister, Mr. C. D. Howe, that Canada is prepared to sell uranium to friendly Governments for peaceful purposes. Any sales agreements Canada signs would come under the control regulations drawn up by the United Nations for an international atomic energy agency. The Canadian Government's designated purchasing agents, for all uranium produced in Canada, Eldorado Mining and Refining, will be responsible for negotiating the sales contracts.

NZ Tariff Rates

The New Zealand Customs Department has classified the following goods at a rate of 3 per cent both for British Preferential and General tariffs: dimethyl formamide; emulsifiers etc., polyoxyethylene sorbitan trioleate; chemicals for lacquers, ethylene glycol monomethyl ether.

Utilising Sicily's Potassium Salt Resources

At an early date the construction of a potassium salts factory will be started by Montecatini Company near the railway station of Campofranco, Sicily. The new factory will process the potassium ore beds recently discovered between San Cataldo and Serradifalco, near the Salito River. Its output will be partly exported and partly used at the fertiliser factory operated by Akragas-Montecatini Company at Porto Empedocle.

Two other companies, Trinacria and Edison, have also found potassium ore beds in Sicily which they intend to exploit. At present Italy imports considerable quantities of potassium fertilisers, but when all the plants planned by the above three companies start operating, such imports will stop and there will be a sufficient margin for exports.

£350,500 Canadian Sewage Plant Contract to Brush Group

A modern sewage plant is now being built at Humber Valley for Toronto City. The sewage will be treated to a high standard by the activated sludge process with stages of settlement, aeration and digestion. The effluent will be discharged into the Humber river. The rotary blower engines to the aeration tanks are driven by gas produced during the digestion process but the plant has the unique feature of being able to use natural gas if the sludge gas is insufficient. The plant will drain an area of 5½ square miles with a dry weather flow of 28,750,000 gallons a day.

The machinery contract for the power plant is valued at over £350,000 and has been awarded to Brush ABOE (Canada) Ltd., a subsidiary company of the Brush Group of Great Britain.

Calcium Chloride Output Up

Latest figures announced by the US Bureau of Mines show that 1954 shipments by producers of flake and solid calcium chloride (77-80 per cent $CaCl_2$) totalled 437,705 short tons, 6 per cent more than in 1953.

Proportioning Pump for Corrosive Liquids

Exact quantities of corrosive liquids can be measured by means of a proportioning pump, type HD, made by Höganas-Billesholms AB, Sweden.

Claimed to be of simple and robust construction, the pump is made of acid-proof stoneware and is fitted with Teflon p.t.f.e. valves. The stuffing box lining is of Teflon-impregnated asbestos. Stoneware parts are mechanically protected by a cast iron shell.

Atomic-Vulcanised Tyre by Goodrich

Research Investigations of B. F. Goodrich Company, US, have succeeded in vulcanising a tyre by atomic energy, the company announces. The process represents the first change in the curing of rubber products for over 100 years. However, the process may not be commercially feasible for another 10 years, because the cost of atomic vulcanisation is at present too high, and will continue to be, until cheap sources of radiation are available.

In charge of the experiments is Dr. Charles Stockman. He reports that the laboratory experiments indicate that the atomic-cured tyre has from eight to 10 per cent more resistance to abrasion than the conventional tyre and twice as much resistance to ageing and deterioration.

Vulcanisation of the tyre was carried out at the US Atomic Energy Commission's National Reactor Testing Station

in Idaho. The tyre was placed in a steel mould and rotated slowly over radioactive fuel elements from the reactor.

The Goodrich Company recently opened a nuclear research laboratory at Akron, Ohio, to test the possibility of improving rubber products by radiation.

New Process for Low-grade Manganese Ore

Now undergoing a trial run is a new method of processing low-grade manganese ores. A prototype plant has been put up by Strategic-Udy Metallurgical and Chemical Processes, of Canada, a subsidiary of Strategic Materials Corporation at Niagara Falls, Ontario. Simulating full-scale operating conditions and costing so far $1\frac{1}{2}$ million, the present objective is development of design and gathering of cost data relative to the new Udy process, which is directed at development of low-grade manganese ores in New Brunswick.

Successful operation of the Udy pilot plant could have far reaching results, it is understood, for it would enable large low-grade manganese deposits in the US to be worked economically, and could make the North American Continent completely independent as to the sources of manganese.

Pakistan Increases Fertiliser Subsidy

Pakistan Central Government has increased the fertiliser import programme from a 1956 ceiling of Rs 4.55 crores to Rs 6.30 crores this year, when a further Rs 2.3 crores will be spent on purchases of fertilisers produced at Daud Khel and Lyallpur factories. To popularise the use of fertilisers, the Central Government is bearing the cost of the subsidy, at present 66 per cent in East Pakistan and 58 per cent in West Pakistan.

A total of 85 fertiliser stores are to be built in West Pakistan and a further 50 stores in East Pakistan.

Newfoundland Asbestos Find

Extensive drilling by Advocate Mines in Newfoundland last year is reported to have indicated a major asbestos deposit which is considered to be ideal for cheap open-pit mining. The company is of the opinion that so far 13.5 million tons of ore have been established, with a grade of more than $8.50 a ton. The average Canadian grade is $5.74.

French Tariff Rates on Chemicals Revised

The French Government has announced a long list of modifications in the customs tariff relating to chemicals and allied products. Now on the 'free list' are: Carbon and other blacks obtained from petrol, acetylene blacks and anthracene blacks; sodium nitrate (natural) with a nitrogen content of more than 16 per cent by weight in the dry anhydrous product; anhydrous tetraborate; artificial radioactive isotopes (radio-cobalt etc); crude calcium citrate; nitroglycerol, hexanitro mannite; tetranitropentaerythrite (penthrite) nitroglycol—imported for the explosives monopoly; disintegrated organic fertilisers; certain essential oils other than terpeneless; refractory cements, mortars, pisé grouting and mastics.

Temporary duty has been suspended on ammonium chloride; certain sodium and calcium nitrates; calcium cyanamide; and urea.

French text of the relevant orders may be seen at the Export Services Branch, Board of Trade, Room 625, Lacon House, Theobalds Road, London WC1.

Increased Boron-10 Supplies for Industry

The United States Atomic Energy Commission are now making increased quantities of isotope boron-10 available to private companies engaged in peaceful atomic energy projects.

As boron-10 can absorb neutrons easily without becoming radioactive, it is particularly useful in radiation-measurement instruments and in nuclear reactor and shielding control mechanisms. Previously only gram quantities have been available to civilian and industrial users under AEC's isotope distribution programme. Now kilogram quantities will be available. Natural boron is a mixture of two isotopes—boron-10, which makes up 20 per cent of the whole, and boron-11, which does not readily absorb neutrons. Boron-10 is separated from boron-11 and then processed into metal at an AEC-controlled plant situated near Niagara Falls, New York, US.

Support for Noratom

Forty Norwegian firms have already given their support to the proposed Norwegian atom company, Noratom (see CHEMICAL AGE, 16 February, page 292). Industries represented are iron and steel, wood processing, shipowners and banks. Two inquiries for delivery of nuclear reactors have already been received from abroad and it is understood that a number of countries are interested in an improved version of the reactor at Kjeller.

Canada's Titanium Plant Nearly Completed

According to Canadian Titanium Pigments Canada's first titanium pigment plant at Varennes, Quebec, is now more than halfway to completion. This plant, which is costing $15 million, should be in production by the third quarter of this year. Canadian industry will take the plant's entire output of titanium dioxide.

Radioactive Isotopes Detect Contaminated Water

It is reported that a team of scientists working at Georgetown University, Washington, DC, has shown that radioactive isotopes may provide a simple and rapid method of measuring bacterial contamination of water in reservoirs etc. Coliform organisms in a radioactive C-14-labelled lactose medium can usually be detected in less than half an hour.

The coli react with the lactose to form readily-detectable radioactive carbon dioxide after about 10 minutes of incubation. Conventional methods require up to 20 hours.

More US Oil for Europe

Mobil Oil Co. announced last week that its parent, Socony Mobil, had made 17,500 barrels a day of crude oil available for export to Europe from the Gulf of Mexico by cutting back its refinery operations. Three of the company's US refineries are, in addition, producing 1,750,000 barrels of heavy fuel oil in excess of normal production in the four months to the end of March. This is also for export to Europe.

The Texas Railroad Commission has decided to increase the permitted rate of oil output for March by 210,901 barrels a day to 3.73 million barrels a day—an increase of almost six per cent. This increase, which is the largest authorised by the Commission since the Middle East emergency began, should bring actual production in the state to 380,000 barrels a day greater than the flow before the Suez Canal was closed.

Pakistan's Chemical Imports

Pakistan's main imports on private account during December included: Chemicals and drugs Rs 7 million; mineral oils Rs 6.3 million; dyes and colours Rs 2.6 million. Central Government expenditure on the import of chemicals and equipment for plant protection during 1956/57 amounted to Rs 60 lakhs; the figure has been increased to Rs 85 lakhs during 1957/58.

Belgium International Fair

The 12th International Fair of Ghent, Belgium, will be held this year from 7 to 22 September. Many British firms intending to show at the Brussels world Fair 1958 have taken space to see how their goods sell in Belgium. Last year there were 1,350 exhibitors and half a million visitors. This year the fair buildings have been enlarged. Bookings can be made at the fair's London office at 178 Fleet Street, London EC4; telephone City 5889.

'Welding' Concrete

For 'welding' concrete, brick and cement blocks, a tough new plastic has been developed by the Permagile Corporation of America, Long Island City, New York, US. The resulting bond is said to be stronger than the concrete, brick or cement blocks themselves.

It is understood that this plastic has undergone two years of field testing. Reports claim that it is permanently waterproof, non-shrinking, non-expanding and unaffected by ageing or atmospheric conditions.

BRITISH GEON INTRODUCE A NEW UNPLASTICISED PVC COMPOUND

RIGID p.v.c. is being increasingly used as a constructional material in chemical plant. An unplasticised p.v.c. which has been found to have high impact strength, excellent chemical resistance, is light weight and yet has a high tensile strength should therefore be of considerable interest to the chemical industry. This new unplasticised p.v.c. has been introduced by British Geon Ltd. under the name Geon RA 170 (or Breon RA170 outside the UK). It differs from normal grades of unplasticised p.v.c. by its impact strength being some 15 times greater.

Use of Geon RA170 is stated to enable considerable saving to be made in labour costs and maintenance.

A great deal of chemical immersion data on Geon RA170 is provided by the company. Thus, in 30 per cent hydrochloric acid the tensile strength (originally 5,800 p.s.i.) after 30-day immersion at room temperature was 5,300 with percentage weight change of 0.22 and after a similar period at 60°C was 4,700 p.s.i. with 1.48 per cent weight change.

After immersion in 80 per cent sulphuric acid for 30 days at room temperature, the tensile strength was 5,400 p.s.i. (weight change = −0.01 per cent) and at 60°C, 5,700 p.s.i., with weight change of 12.78 per cent.

In 50 per cent sodium hydroxide for 30 days at room temperature, the tensile strength was 5,600 p.s.i. with −0.02 per cent weight change. At 60°C the tensile strength was 5,400 p.s.i. with −0.11 per cent weight change. With acetic acid the tensile strength was 3,600 p.s.i. and weight change was 4.48 per cent at room temperature and at 60°C, tensile strength was only 1,450 p.s.i., while the weight change was 15.39 per cent.

In chlorinated hydrocarbons, carbon tetrachloride and trichloroethylene, the tensile strength of Geon RA170 at room temperature was 1,850 p.s.i. and 1,550 p.s.i. respectively with weight changes of 59.14 per cent and 103.21 per cent. At 60°C there was excessive swelling.

With benzene, the tensile strength at room temperature was 5,000 p.s.i. with a weight change of 73.11 per cent. At the high temperature, excessive swelling occurred.

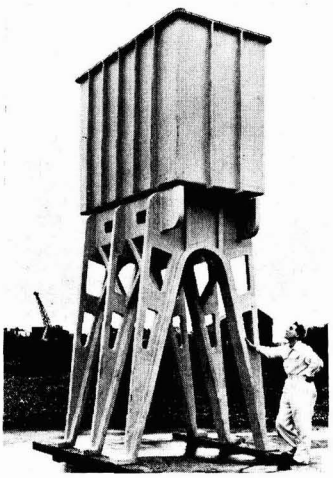
Tensile strength of this plastic in distilled water at room temperature is recorded as 5,200 p.s.i. with 0.61 per cent weight change and at the higher temperature, 60°C, 5,100 p.s.i. with 0.94 per cent weight change.

Specific gravity of Geon RA170 is 1.35 ± .02, hardness (Durometer D) is 78 ± 3, flexural strength (p.s.i.) is 8,600, light transmission is opaque and the coefficient of linear expansion per °C is reported as 10×10^{-5}.

Plastics-made Storage Tank and Stand

CONSTRUCTION from compound laminates of a tank to hold zinc chloride solution has been achieved by Mendip (Chemical Engineering) Ltd., Ashford, Middlesex.

Measuring eight ft. by four ft. by six ft., the tank is made from Bakelite



Large storage tank and stand

epoxide and polyester resins, reinforced with glass fibre materials. When full it weighs about 10 tons.

The stand is 10 ft. high and is a properly stressed engineering structure, the inherent rigidity of the main supports being further enhanced by cross members.

This tank and stand are part of a new chemical-proof unit being made for the Ever Ready Co. (Great Britain) Ltd.

FOR YOUR DIARY

MONDAY 4 MARCH

SCI (London Section)—London: 14 Belgrave Square SW1, 6.30 p.m. 'Documentation' by Dr. H. J. Barber, Dr. R. E. Fairbairn, and Dr. J. H. Hamence.

SCI (Plastics & Polymer Group & Yorkshire Section)—Sheffield: Chemistry Lecture Theatre, University, 6.45 p.m. 'Plastics in Relation to other Engineering Materials' by A. J. Warner.

CS—Cardiff: Department of Chemistry, University College, 5.30 p.m. 'The Chemical Significance of Vibrational Band Intensities' by Dr. H. W. Thompson.

CS—Swansea: Chemistry Department, University College, 6 p.m. 'Aromatic Compounds with a Nitrogen Atom Common to Two Rings' by Dr. B. R. Brown.

TUESDAY 5 MARCH

British Nuclear Energy Conference—London: Institution of Civil Engineers, Great George Street SW1, 5.30 p.m. 'Behaviour of Radio-isotopes in Sewage Treatment and the Disposal of Radioactive Wastes to Sewers' by A. W. Kenney.

Society for Analytical Chemistry—Birmingham: Main Chemistry Theatre, University, Edgbaston, 7 p.m. 'Thermogravimetric Analysis' by Professor C. Duval.

Institute of Metal Finishing—Birmingham: James Watt Memorial Institute, Great Charles Street, 6.30 p.m. 'Chemical Polishing of Metals' by F. H. Wells.

ASLIB—London: Royal Society of Arts, 8 John Adam Street, Adelphi WC2, 6 p.m. 'The Royal Society's Interest in Scientific Publications and the Dissemination of Information' by Dr. D. C. Martin.

WEDNESDAY 6 MARCH

Institution of Chemical Engineers—Birmingham: Midlands Institute, Paradise Street, 6.30 p.m. 'Project Costing in the Chemical Industry' by B. M. Robbins and H. C. Hollands.

Royal Society of Arts—London: John Adam Street, Adelphi WC2, 2.30 p.m. 'Trace Elements in Plant Nutrition with Special Reference to Crops' by Professor T. Wallace.

THURSDAY 7 MARCH

Royal Society—London: Burlington House W1, 4.30 p.m. 'Electron and Lattice Conduction in Metals' by I. I. Hanna and E. H. Sondheimer; 'The Dynamics of Twinning and the Interrelation of Slip and Twinning in Zinc Crystals' by R. L. Bell and R. W. Cahn.

Royal Institute of Chemistry—London: West Ham College of Technology, Romford Road E15, 6.30 p.m. Film display.

CS—Aberdeen: Marischal College, 7.30 p.m. 'Intermolecular Compounds' by H. M. Powell.

SCI, CS & RIC—Bristol: Chemistry Department, University, 7 p.m. SCI Jubilee Memorial Lecture, 'The Combustion of Coal' by Dr. A. C. Monkhouse.

CS—Edinburgh: Research Laboratories and Pilot Plant, Scottish Agricultural Industries Ltd., 7.30 p.m. Visit. Joint meeting with RIC and SCI.

FRIDAY 8 MARCH

Royal Institution—London: 21 Albemarle Street W1, 9 p.m. 'European Organisation for Nuclear Research' by Sir Ben Lockspeiser.

CS—Dublin: University Chemical Laboratory, Trinity College, 7.45 p.m. 'Some Recent Studies in Relation to the Biosynthesis of Aromatic Rings' by Professor A. J. Birch.

OCCA—Liverpool: Liverpool Engineering Society's Rooms, The Temple, Dale Street, 6.30 p.m 'The Preparation, Properties and Rheological Investigation of Thixotropic Paint Systems' by D. J. Doherty and R. Hurd.

UK Chemical Exports & Imports in January

EXPORTS

		QUANTITY		VALUE	
		January 1956	January 1957	January 1956	January 1957
INORGANIC					
Acids	Cwt.	17,231	22,609	47,607	52,145
Copper sulphate	Tons	3,007	2,639	323,928	246,257
Sodium hydroxide	Cwt.	467,274	440,754	608,576	446,638
Sodium carbonate	,,	370,269	314,605	240,850	207,235
Aluminium oxide	Tons	1,346	2,537	44,657	81,647
Aluminium sulphate	,,	2,844	3,254	45,769	49,039
Other aluminium cpds.	,,	486	239	17,859	12,727
Ammonia	Cwt.	8,662	6,405	30,813	21,707
Ammonium cpds. (not fertilisers or bromide)	Tons	1,424	2,091	59,841	74,459
Arsenical compounds	,,	168	417	14,801	31,115
Bismuth compounds	Lb.	34,787	30,112	30,832	25,065
Bleaching powder	Cwt.	52,943	12,583	80,619	21,130
Hydrosulphite	,,	3,949	8,448	30,770	65,737
Other bleaching materials	,,	9,209	10,041	36,769	40,082
Calcium compounds	,,	31,191	23,207	63,572	49,406
Carbon blacks	,,	30,008	56,763	105,080	197,041
Cobalt compounds	,,	980	1,026	49,492	48,897
Iron oxides (chemically manufactured)	,,	9,138	8,975	26,286	26,812
Lead compounds	,,	2,951	3,498	19,210	23,063
Magnesium cpds. (nes)	Tons	1,087	1,832	59,304	72,093
Nickel salts	Cwt.	4,750	6,520	50,038	62,138
Potassium cpds. (not fertilisers or bromides)	,,	3,858	3,692	40,562	38,410
Sodium bicarbonate	,,	60,848	50,075	55,299	43,439
Sodium phosphates	,,	5,491	18,800	26,980	75,688
Sodium silicate	,,	32,187	28,130	27,974	24,890
Other sodium cpds.	,,	128,288	101,325	264,936	256,120
Tin oxide	,,	498	962	19,244	36,003
Zinc oxide	Tons	549	650	46,685	44,702
Other inorganics (nes)		—	—	369,855	412,436
ORGANIC					
Acids, anhydrides & salts & esters		—	—	106,682	121,260
Glycerine	Cwt.	10,790	12,151	117,591	108,983
Ethyl, methyl, etc., alcohols & mixtures (nes)		—	—	87,349	163,234
Acetone	Cwt.	18,941	15,877	43,525	49,859
Citric acid	,,	2,714	4,259	27,206	40,575
Gases, compressed, liquid or solid		—	—	91,723	63,291
Phenol	Cwt.	8,991	12,264	54,530	79,952
Salicylates	Lb.	72,842	112,898	21,126	27,513
Sodium compounds	Cwt.	3,241	1,892	33,163	30,314
Sulphonamides, not prepared	Lb.	79,746	126,234	64,220	86,437
Dyestuffs intermediates	Cwt.	5,142	10,521	80,899	148,086
Organic compounds (nes)		—	—	1,037,000	1,343,732
Total elements & cpds.		—	—	**4,602,282**	**5,049,357**
Coal tar	Tons	4,897	4,979	47,353	46,407
Cresylic acid	Gall.	266,259	251,115	76,526	93,587
Benzol	,,	3,294	783	1,283	234
Creosote oil	,,	1,281,517	2,064,022	69,217	139,105
Other mineral tar & crude chems. from coal, petroleum & nat. gas	Cwt.	23,887	19,025	54,581	46,752
Pigment dyestuffs	,,	2,347	2,088	106,073	81,216
Other syn. dyestuffs & compounds	,,	13,767	17,226	538,766	753,964
Synthetic pigments	,,	2,136	2,001	66,850	86,329
Veg. & animal dyeing extracts	,,	275	257	10,504	11,965
Tanning extracts	,,	8,416	12,779	40,609	56,957
Pigments, paints, & varnishes		—	—	1,827,808	1,843,622
Drugs, medicines, etc.		—	—	3,269,874	2,848,263
Ammonium nitrate fertilisers	Tons	548	67	18,512	2,430
Ammonium sulphate	,,	8,689	1,146	171,002	21,883
Phosphatic & potassium		—	—	5,738	2,698
Other manufactured fertilisers		—	—	92,577	40,635
Explosives		—	—	987,487	821,175
PLASTICS MATERIALS					
Phenol & cresol formaldehyde resins	Cwt.	6,218	5,400	38,662	39,546
Urea formaldehyde resins	,,	24,344	18,101	114,781	91,972
Vinyl resins, unplasticised	,,	13,796	14,456	145,902	124,417
Vinyl resins, plasticised	,,	10,619	7,805	143,542	96,026
Other vinyl resins	,,	12,502	15,203	139,065	220,232
Moulding powders	,,	57,576	72,677	737,166	932,982
Sheet, rod, tube, film & foil	,,	22,839	23,599	703,915	683,113
Insecticides, fungicides & weedkillers	,,	56,873	38,229	574,109	477,227
Carbons, decolorising or activated	,,	4,360	4,460	17,992	17,934
Tetraethyl lead anti-knock cpd.	Gall.	406,883	430,079	857,843	932,809
Other chemicals (nes)		—	—	1,187,607	1,396,361

IMPORTS

		QUANTITY		VALUE	
		January 1955	January 1956	January 1955	January 1956
INORGANIC					
Acids	Cwt.	8,300	7,300	19,054	21,138
Al. oxide abrasives	Tons	1,627	1,011	98,363	70,728
Silicon carbide abrasives	,,	1,116	512	107,292	43,260
Arsenic trioxide	,,	1,319	463	50,301	15,587
Borax refined	Cwt.	21,400	69,300	37,733	131,549
Calcium carbide	,,	47,722	64,971	85,632	119,908
Carbon black (channel)	,,	15,987	17,189	88,838	93,463
Other carbon black (not acetylene black)	,,	14,907	10,296	63,164	38,171
Cobalt oxides	,,	4	591	322	36,941
Iodine	Lb.	37,480	221,521	19,039	85,322
Mercury	,,	208,856	268,162	234,763	299,667
Sodium, calcium, potassium, lithium	Cwt.	8,328	4,674	161,478	37,606
Carbonate	,,	8,232	15,956	26,891	48,596
Other potassium cpds. (not fertilisers)	,,	6,869	9,892	29,760	42,228
Selenium	Lb.	13,970	18,959	51,283	117,769
Silicon	Tons	712	499	99,371	77,706
Chlorate	Cwt.	5,923	11,790	19,476	38,851
Phosphate	,,	290	714	3,682	4,054
Other sodium cpds.	,,	24,699	16,013	115,788	76,260
Inorganic chemicals (nes)		—	—	220,568	260,234
ORGANIC					
Acids, anhydrides & their salts & esters		—	—	201,311	149,626
Glycerine	Cwt.	10,760	2,650	84,589	15,425
Menthol	Lb.	9,036	37,209	20,819	80,338
Naptha, methyl & alcohols & alcohol mixtures		—	—	163,143	168,446
Turpentine	Gall.	61,824	22,773	17,538	6,992
Glycol ethers & esters	Lb.	736,491	746,865	61,181	70,643
Sodium cpds.	Cwt.	10,577	13,735	133,008	132,152
Styrene (monomeric)	Gall.	406,741	145,737	227,275	79,130
Vinyl acetate (monomeric)	Tons	879	608	128,718	72,156
Dyestuffs intermediates	Cwt.	676	1,452	37,997	152,010
Organic cpds. (nes)		—	—	1,036,557	837,192
Syn. dyestuffs & cpds.	Cwt.	2,586	3,983	202,551	324,442
Dyeing extracts	,,	1,175	3,156	8,969	24,415
Tanning extracts	,,	77,852	73,820	300,481	274,638
Pigments (inc. tit dioxide)	,,	22,335	44,232	143,241	128,057
Other pigments, paints, etc.		—	—	41,524	84,360
Vitamins, salts & esters		—	—	108,773	104,698
Antibiotics		—	—	40,965	146,812
Alkaloids		—	—	143,634	57,395
Basic slag	Tons	16,113	15,243	128,413	127,819
Potassium chloride	Cwt.	1,168,424	1,072,785	957,354	926,685
Potassium sulphate	,,	28,380	35,320	29,042	36,428
Other fertilisers		—	—	84,854	148,772
PLASTICS MATERIALS					
Vinyl resins	Cwt.	14,050	12,154	207,846	173,243
Other syn. resins	,,	12,196	22,422	151,542	309,060
Moulding powders	,,	5,043	6,127	81,841	78,533
Sheet, rod, tube, film & foil	,,	44,102	52,544	1,031,438	1,105,548
Disinfectants, insecticides, weedkillers, cattle dressings	,,	1,906	4,899	45,693	193,728

EXPORTS OF CHEMICAL ELEMENTS AND COMPONENTS TO PRINCIPAL MARKETS

	January 1955	January 1956	January 1957
	£	£	£
Nigeria	124,323	44,457	37,272
Union of South Africa	298,419	286,049	246,347
Rhodesia and Nyasaland	17,851	32,068	30,957
India	354,225	416,805	381,952
Pakistan	131,902	56,323	13,327
Singapore	51,399	40,152	68,596
Malaya	72,321	64,348	88,319
Hong Kong	50,033	44,098	75,693
Australia	206,988	344,112	323,817
New Zealand	119,731	80,286	70,049
Canada	126,204	109,577	145,854
Jamaica	27,358	60,661	83,192
Other Commonwealth	97,172	113,326	109,974
Irish Republic	150,257	164,414	143,874
Finland	112,618	53,102	78,335
Sweden	145,118	147,702	178,946
Norway	134,354	101,488	127,127
Denmark	129,964	77,198	103,950
Poland	30,030	21,969	29,914
Western Germany	75,309	74,552	146,345
Netherlands	156,728	187,804	193,064
Belgium	86,917	91,846	126,135
France	126,080	133,063	297,662
Switzerland	46,233	72,716	103,910
Portugal	17,801	63,595	141,504
Spain	28,440	15,567	67,538
Italy	98,999	180,290	217,717
Greece	124,874	226,425	11,945
Turkey	12,916	104,584	2,100
Netherlands Antilles	61,316	188	56,562
Egypt	65,332	66,030	—
Israel	2,152	26,932	41,080
Iraq	20,299	56,773	22,017
Indonesia	58,545	123,800	196,298
China	68,394	13,301	58,038
Japan	17,539	27,964	100,687
Philippine Republic	24,806	30,358	26,138
United States of America	295,349	273,481	333,154
Mexico	56,790	84,162	38,528
Argentine Republic	269,330	14,217	92,635

LINEAR POLYMER SYMPOSIUM—2

Swelling and Solution Properties of Natural Fibres—I

IN his lecture, Dr. F. O. Howitt dealt particularly with protein fibres, so far as they aroused the interest of the chemist.

He began by describing the effect of water on gelatin. He referred to the absorption of water by wool, where it is considered that three distinct molecular species exist—(a) localised water bound irrotationally to localised sites in the fibre, (b) mobile water with properties identical to bulk water, and (c) an intermediate form of water with potential energy of sorption between those of localised and mobile water.

Cotton cellulose exemplified the comparatively ready penetration of a swelling agent into amorphous regions of a fibre. For swelling to be produced in crystalline regions, strong alkaline or acid solutions or solutions of high salt concentration were necessary. There was evidence, he said, that a base combination between cellulose and alkali occurs and concentration of sodium ions in the cellulose phase results in osmotic passage of water into both amorphous and crystalline regions of cellulose fibre. Various factors such as temperature, acidity etc., on swelling of cellulose were also mentioned.

Swelling in Acceleration

Reference was made to the importance of swelling in acceleration of a reaction such as xanthation, dyeing, weighting etc. Among swelling agents, aliphatic amines have been used recently, which effect a considerable lowering of the degree of crystalfinity.

It was pointed out that under certain conditions, a reverse of swelling may take place which is known as syneresis and is characterised by no change in volume.

Dr. Howitt felt it was perhaps an interesting speculation as to whether supercontraction of wool fibres might be considered as a process akin to a reversal of the swelling process.

The lecturer then considered swelling and dissolution in relation to wool, cotton and fibroin and discussed the various linkages which affect dissolution. Thus, cross-linking in protein fibres conferred the special properties such as increased resistance to moth and microbiological attack, as demonstrated by Zahn by the use of difunctional reagents such as 1:5-difluoro-2:4-dinitrobenzene. Bifunctional maleimides as cross-linking agents for wool reduced by 2-mercaptoethanol increased resistance of wool to supercontraction and to dissolution in acids and alkalis.

Intermolecular forces in cotton cellulose, silk fibroin and in protein fibres were then discussed.

It was of interest to note that, for a state of complete crystallinity and maximum group correlation, density of hydrogen bonding in nylon is only about one-third of that of fibroin. Therefore, bearing in mind the relative orders of crystallinity it is possibly in the weaker Van der Waals forces that an explanation of the little difference in their tensile strengths should be sought. Courlene, obtained from polythene, offered a guide in this matter.

DR. F. O. HOWITT,
author of this paper

Chain alignment would be of importance and with the factor stereostructural arrangement, was evident in the isotactic polymers. In these latter close-locking arrangement of side-chains leads to high melting point, high crystallinity, and decreased solubility. Dr. Howitt felt that possibly isotactic arrangement entered into the structure of proteins and polypeptides. For example, when fibroin was degraded by tryptic action, a product of molecular weight 7,000 consisting almost entirely of glycine, alanine, and serine, was obtained. Acid hydrolysis of this product, and suitable fractionation yielded, among other products, a fraction with an average peptide length of six residues, which was remarkably insoluble in common aqueous solvents. Insolubility was due to aggregation of the short straight chains unimpeded by side groups and it was the nature of this aggregation that could be explained by isotactic linking.

Solubility behaviour of natural fibrous proteins was extremely complex, Dr. Howitt pointed out.

There was some evidence that most keratin was formed from a soluble precursor, in a manner similar to formation of collagen from pre-collagen. Silk fibroin existed in the silk-gland as a water soluble protein and conversion of fibrous into spherical or water-soluble form had been achieved in the laboratory. The normal soluble form of insulin had been converted into the fibrous form which had been reconverted into the crystalline physiologically active form. The lecturer felt that these conversions might shed some light on the form of sulphur linkages in wool keratin, where 15 per cent of the total sulphur is not accounted for as cystine or methionine-sulphur. Note should be taken also of the claim (by Woodin) that feather keratin molecule appears to be cyclic in structure.

Wool keratin, according to Dr. Howitt, merited special attention owing to its inherent insolubility. To date, dissolution of keratin could not be effected without first splitting all or most of the dithio bonds by reducing or oxidising agent. When this was carried out, there was little doubt that some degradation, with perhaps even chain fission, of the molecule occurred.

Investigation on this in Australia had yielded Kerateine2, containing less cystine and more aspartic and glutamic acids than does parent wool. Preparation of an electrophoretically homogeneous form of kerateine could be performed. It was to be noted also, that some of the preparations were rendered partly or completely insoluble by pressure (e.g. by centrifuging) or freeze-drying.

Solubility studies of wool in water had shown that seven successive extractions of clean wool with cold and then hot water removed 2.35 per cent of the wool substance. The dissolved material consisted of glutamic and aspartic acids, glycine, alanine, serine and leucine.

Briefly mentioned were investigations on solvents for proteins. Proteins studied, including keratin, have been shown to dissolve in ethylenediamine and almost all in hydrazine. It was considered probable that proton-accepting powers of hydrazine, ethylenediamine, and propylenediamine and perhaps their ability to form hydrogen bonds were mainly responsible for their solvent action.

Extensive Range

For wool, the most extensive range of solvents were the metal complexes of nitrogenous bases. Generally of strong alkalinity, these complexes were rapidly absorbed by wool and produce swelling and ultimate dissolution.

Reference was then made to the work of Varsiliadis of Leeds University regarding uptake of complex by wool. Two points of interest, the lecturer stressed, were that (a) solubility of wool in cuprammonium does not fit into the absorption order for copper previously noted and (b) while solubilities in caustic soda and an amine (e.g.-propylamine) separately are nil, a mixture of the two bases had a pronounced dissolving action.

Finally, Dr. Howitt pointed out that wool fibre which is dissolved by concentrated hydrazine, was not significantly affected by a 2 per cent solution of hydrazine in butanol at 100°C for one hour or by a 10 per cent solution for five minutes. Under these conditions, however, Terylene was completely dissolved. This was the basis of a method proposed by Speakman *et al.* for the removal of Terylene from Terylene-wool blends.

Bradford Symposium

SWELLING AND SOLUTION PROPERTIES OF NATURAL FIBRES–2, by MR. G. KING

MR. KING began his lecture by pointing out that absorption of water and other chemical reagents was one of the outstanding characteristics of most naturally occurring polymers. This problem had first been examined by Katz who advanced a hypothesis based on simple solution on the grounds of the similarity between the water absorption isotherm of wool and those for glycerine and sulphuric acid. This concept had been applied to the swelling of textiles.

Mixing of two simple liquids whose molecules are similar and do not interact chemically was then considered.

The relation of the law of mass action to the absorption of water by textiles has been applied by considering the equilibrium

Water + polymer $\rightleftharpoons$ Polymer Hydrate

i.e., $n_{pH}/n_p.n_w = K_1$ and equating absorbed water activity with the external water vapour $n_w 2K_2 h/100$. From these two simple relations an isotherm can be derived.

$$\frac{Mr}{100} = \frac{k_2 h}{100 - K_2 h} + \frac{K_1 K_2 h}{100 + K_1 K_2 h}$$

where r is the regain of the polymer and M is its effective molecular weight.

Crystalline amorphous ratio in polymers, Mr. King said, had been investigated recently by introducing heavy water and determining the amount of hydrogen deuterium exchange which took place. Lower values had been obtained for the crystalline fraction of keratin fibres.

Theory Criticised

The solution theory had been criticised on the grounds that the polymer-water solution cannot be considered ideal having regard to the marked difference in size between the molecular species.

An essential feature of the solution theory was that interchange of solvent and polymer molecules takes place but the lecturer felt that it was difficult to visualise such an interchange in the case of water and many textiles. Alternative absorption theories had, therefore, been developed in which the polymer merely provided absorption sites. In these theories the absorption of water had to be justified in addition to that chemically bound to the polymer.

The theory of multimolecular absorption of Cassie and later developed by Hill was then quoted and the lecturer showed how the isotherm relation:

$$\frac{A}{B} = \frac{p}{(p_o - p)\ \beta + (1-\beta)\, p/p_o}$$

is obtained, which is essentially the BET isotherm.

It was noted that Cassie considered that the polymer imposed a constraint on the absorption. According to Cassie's findings with wool the number of absorption sites obtained was equal to the number of repeat patterns along the polypeptide chain which led Cassie to suggest that the absorption sites were CO groups in the main chain. A similar theory of constraint, Mr. King said, had been put forward by Newns.

If constraint due to the polymer was not introduced then infinite absorption was possible for saturation vapour pressure. The lecturer then showed how for a wool-water system, the maximum of nine molecules per site was obtained. The cluster of nine molecules, it was pointed out, must occur very infrequently and on the average there would be about five per site at saturation.

It was reported by Mr. King that recently an alternative absorption theory had been proposed in an attempt to explain some data obtained for water absorption by viscose rayon and cotton. Two types of absorption sites have been assumed. The first type of site is saturated by a single water molecule thus giving a Langmuir type absorption. The second type of site on absorbing a water molecule provides a site for further absorption and so gives rise to a linear form of absorption isotherm.

While experimental isotherms generally represented a true equilibrium and were true for water absorption by textiles, the lecturer pointed out that it was not necessarily true when dealing with a solid mass of polymer.

Summing up, Mr. King said that although there were many theories of swelling, there were no critical data on which to test them. It was not understood how the swelling agent was associated with the polymer and why the latter underwent such considerable change in physical properties. Breaking of only a small fraction of the hydrogen bonds in a polymer might profoundly modify its properties.

Infra-red absorption studies of the reaction between various reagents and secondary amides in carbon tetrachloride solution might throw some light on the interaction between swelling agents and peptide groups.

Under these conditions, Mr. King reported, one investigator had shown that phenol reacted with the carboxyl rather than the NH group thus confirming Cassie's original suggestion that water was absorbed on these groups in keratin.

US Standards Bureau Develops a Method for High Purity Barium Titanate

BECAUSE of its desirable dielectric and piezoelectric properties, barium titanate is being used extensively in electronic devices. Important applications of this ceramic include high-capacity miniature condensers, ultrasonic transmitters and transducers for sensing devices. In spite of its wide uses, however, the relationship between compensation and electrical characteristics of barium titanate has not been fully worked out.

Recently, the US National Bureau of Standards developed a method for preparing a highly pure barium titanate in which the mole ratio of barium to titanium is exactly unity.

The method of preparation using barium titanyl oxalate tetrahydrate as starting material was described by Clabaugh *et al., J. Research* NBS 1956, **56**, 289. This double oxalate tetrahydrate, $BaTiO(C_2O_4)_2.4H_2O$ is ignited, to yield a pure barium titanate containing equal molar proportions of barium and titanium.

The oxalate is prepared by slow addition of aqueous solution of titanium tetrachloride and barium chloride to a hot solution of oxalic acid. Titanium tetrachloride and barium chloride are in nearly equimolar proportion but with barium in slight excess, while the amount of oxalic acid is about 10 per cent more than the reaction requires. Excess barium and oxalate is required to minimise competing reactions that might result in formation of insoluble partially hydrolysed compounds of titanium.

While the solutions are being added the oxalic acid solution is continuously heated at 80°C. A dense crystalline precipitate of $BaTiO(C_2O_4)_2.4H_2O$ is formed which is converted to barium titanate by heating in a furnace at 900°C

Titanium tetrachloride solution is prepared by adding highly purified tetrachloride, drop by drop, to rapidly stirred distilled water cooled in an ice bath to prevent formation of hydrolysed titanium compounds. The exact titanium content of the solution must be determined so that the quantities of barium chloride and oxalic acid to be used can be based on this value.

International Organic Chemistry Journal

TETRAHEDRON, the new international journal of organic chemistry will be published early this year. Chairman of the editorial board is Sir Robert Robinson, O.M., F.R.S. There are 41 members of the editorial and editorial advisory boards and the executive editor is Professor H. Stephen, of London.

This new journal is envisaged as a forum for the publication of all aspects of organic chemical research from all parts of the world. In keeping with its international character, contributions will be printed in one of the three languages, English, French or German. Original memoirs of an experimental or theoretical nature will be accepted and also preliminary communications and short presentations of stimulating ideas.

A special feature will be the publication in English, French or German of outstanding research work already published in Russian, Czech, Hungarian, Chinese or Japanese.

Chemist's Bookshelf

FOR THE INORGANIC CHEMIST

MOLECULES AND CRYSTALS IN INORGANIC CHEMISTRY. By *A. E. van Arkel*. 2nd edition revised. Butterworth Scientific Publications, London. 1956. Pp. 270. 30s.

To explain the interplay of attractive and repulsive forces between atoms and so to account for the formation, stability properties, or non-existence of inorganic compounds is the aim of this work. In the present state of theories of the chemical bond it is not easy to do this for first year science students. Making all united atoms into ions provides readily comprehensible means of attraction or repulsion, but the difficulties apparent in 1930, when *Chemische Binding* appeared, have not diminished.

The homopolar bond gets a mention at the beginning but is deliberately kept to the later parts of the present volume. A good deal can be said in favour of the electrostatic approximation but putting it first creates a difficulty in expression that might be avoided if the two types of bonds and their gradations were used from the start. Thus the statement that there is 'little point in considering the HCl molecule as a combination of two ions' is followed by another that hydrogen compounds 'obey the stability rules of heteropolar compounds,' and again by 'a very good picture of some of the properties of hydrogen compounds can be obtained with the aid of an electrostatic model, but we must be careful not to conclude that all hydrogen compounds are therefore ionic in character.'

On other topics balancing statements or ideas seem to be too far apart. Ionic radii which are used a great deal are, with reservations, taken as constant, but the variation with co-ordination number appears only in an appendix. The confusion between p. 206 where 'a molecule $PCl_4^+Cl^-$ consists in fact of ... PCl_4^+ and Cl^- ion' and p. 223 where crystalline phophorus pentachloride is given the constitution $PCl_4^+PCl_6^-$ is of a different kind, unresolved for the reader by the previous exclusion of ionic formulae for PCl_5 in the vapour.

The book, which is well written, contains much sound material on many topics that concern the inorganic chemist, and when read as a whole should prove stimulating to the student who might be advised to ponder whether he could construct a mirror image form with homopolar on his left.

H. M. POWELL.

Analytical Survey of Polymer Breakdown

THE CHEMISTRY OF HIGH POLYMER DEGRADATION PROCESSES. By *N. Grassie*. Butterworth Scientific Publications, London. 1956. Pp. 335. 42s.

The study of polymer degradation processes has advanced so rapidly from the days of accelerated 'weathering' tests upon manufacturers' products that, paradoxically, it is now more precise in some cases than the corresponding study of processes operating in the reverse direction, i.e. those of polymer synthesis.

The book is an analytical survey of all types of polymer breakdown, including thermal, oxidative, mechanical and irradiation processes, and is in many ways to be preferred to the publication of the US Bureau of Standards dealing with the same subject, because of its wider scope and more rigidly theoretical approach. The author has not confined himself completely to material concerned directly with high polymers but instead has included such allied topics as the oxidation of olefines which contribute to the understanding of polymer breakdown.

On the other hand, phenomena of more immediate practical importance to the manufacturer, such as the tendering or sensitising to light of fibres by the organic compounds with which they are dyed, or the protection of plastics materials against deterioration are not considered, or are only mentioned briefly. Nor is the treatment extended beyond the thermoplastic materials to include many important commercial products.

The book opens with an introductory chapter in which the degradation reactions are classified and the experimental difficulties are discussed. While the effects of the viscosity, thermal conductivity and physical size of the sample are considered, one of the chief difficulties in the interpretation of results, the inhomogeneity of high polymers, is not stressed.

The second chapter is concerned mainly with the thermal depolymerisation of polystyrene, polymethylmethacrylate, polythene and polyisoprene. The mechanism of reaction is discussed and in the following chapter the relationship between such reaction schemes and those occurring in polymerisation is examined. The next three chapters deal with the various chemical processes involved in polymer breakdown such a sulphuration, ozonisation, oxidation, and hydrolysis and the final chapter with reactions which may modify polymer structure without breaking the molecular backbone and producing a gross change in molecular weight.

The book provides an excellent review of a new and rapidly developing field from the standpoint of the physical chemist. It would add considerably to its value in future editions if more material of an empirical nature were added and if the index, which is in outline only, were made more detailed.

J. R. MAJER.

A Good 'Bible' of Physical Constants

CHEMIKER-KALENDAR. Edited by *H. U. v. Vogel*. Springer Verlag, Berlin. 1956. Pp. vii + 560. DM 19.60.

Since the publication of the first edition of the *Chemiker-Kalendar* in 1880, this book must have saved chemists many arduous miles of walking, for a good 'bible' of physical constants obviates countless trips to the library. Its popularity can be ascribed to the fact that it provides a happy compromise between price and coverage; it is a rich mine of information, and yet careful pruning and the economical use of space have ensured that it remains small enough to fit into the average coat pocket.

The scope of this completely revised edition may be seen from the following abbreviated list of contents:
(1) Fundamental units, including a Fahrenheit-Centigrade table, a comparison of British, American and German standard sieves, and conversion factors for other units, (2) mathematical tables and formulae, (3) physical properties of elements, inorganic compounds (over 2,000 entries; the table includes crystallographic data as well as the more usual information) and organic compounds (about 3,000 entries; derivatives and reactions which can be used for identification are included in many cases), (4) density tables, including data on gases and on aqueous solutions, (5) solubilities of gases, inorganic compounds and organic compounds at various temperatures, (6) thermodynamic properties (heats of formation, fusion and evaporation, standard entropies etc.; also heats of combustion in the case of organic compounds), (7) vapour pressures.

The data are well chosen and clearly presented, and the reviewer has only two minor criticisms. The first is that certain tables which extend over two pages are not provided with reference numerals on each page; this increases the danger of losing the place when passing from one side of the table to the other. Secondly, the reviewer was disappointed to find that the trigonometric functions are only given for whole degrees.

The price is very modest and the book is strongly recommended. J.C.P.S.

VOLUMETRIC ANALYSIS

MASSANALYSE (Sammlung Göschen, Volume 221/221a). By *G. Jander* and *K. F. Jahr*. Walter de Gruyter, Berlin. 1956. Pp. 303. DM 4.80.

The little paper-covered volumes of the *Sammlung Göschen* are well known to every German student. Their titles range from theoretical physics to the technique of singing, and they dispense knowledge at a very moderate price.

The title under review is an elementary textbook of volumetric analysis, which deals with acid-base and oxidation-reduction titrations, complexometric techniques, and titrations depending on precipitation reactions. Conductometric and potentiometric analysis are also discussed. These subjects are presented with skill and clarity, but the book contains no special features which would justify its purchase in England. P.S.

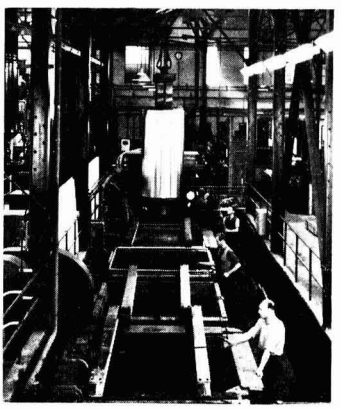
EXTENSION TO FESCOL'S PORT GLASGOW WORKS

NEW PLANT for the electro-chemical deposition of chromium which can accommodate components up to 15 ft. long, 5 ft. diameter, and weighing up to six tons, has now been completed at the Port Glasgow works of Fescol Ltd. The company operate chromium deposition plants at Port Glasgow and also in London, Huddersfield and Brownhills (Staffs).

As the London plant is capable of handling nickel deposition of articles of up to six tons, the new chromium plant has a similar capacity, for the company frequently carries out nickel deposition to build up heavily worn components before the final chromium is deposited.

A six-ton version of a Scandinavian low head-room hoist, the 'Munck' (supplied by Taylor Stoker Co. Ltd.) has been installed. The vats are housed in an asphalt-lined pit excavated from shale and rock with the tops level with the factory floor. Close control of the temperature of these vats is ensured by a specially-designed cooling system. A heat balance of plus or minus 1°F can be maintained. Current supplied to the plant is more than three times that provided for any one chromium deposition vat in the company's London works.

The Fescol process, which was started in 1920, is a method of applying certain non-ferrous metals—particularly nickel and chromium—to already fabricated metal components so that the superimposed metal becomes an integral part of the component. The process is a cold one, so that high-grade steels are not damaged.



Fescol's new heavy chromium deposition plant at Port Glasgow. The component being treated is a film drying drum used in the production of manganese sulphate monohydrates.

Privileges for Soviet Engineering Students

A 25,000-WORD report 'Engineering Education in the Soviet Union' was published on 25 February by the Institutions of Civil, Mechanical and Electrical Engineers. The report was produced by a team of nine British engineers led by Professor E. Giffen (Professor of Civil and Mechanical Engineering at London University) which visited the Soviet Union last September.

Main conclusion of the team is that since engineering teaching is the highest paid profession in the country, complete exemption is granted from National Service for engineering students, two shift working of a 6-day week in many of the training establishments is allowed, and the fact that Russian engineering is so highly rewarded and socially acceptable that there are 3.6 applicants for every vacancy on an engineering course, explains the mystery of how Russia is training three times as many engineers as Great Britain per head of population.

It is reported that Russia produces 65,000 trained engineers a year to Britain's 5,000 and the members of the delegation consider that there will be a strong challenge from the USSR to capture new markets abroad in the near future.

The educational system differs from that in Great Britain and practical work is incorporated in institutional courses in Russia, although there is little difference in the quality of the training.

London Discussions on Euratom

EURATOM'S 'three wise men'—Monsieur Louis Armand, France, Herr Franz Etzel, Germany, and Professor Francisco Giordani, Italy have been visiting the UK at the invitation of Her Majesty's Government this week. Professor Giordani and Herr Etzel arrived in London on 25 February. Monsieur Armand arrived on Tuesday morning, 26 February, and talks started later that day.

The 'three wise men' were nominated by the six governments now negotiating the Euratom Treaty—Belgium, France, the Federal Republic of Germany, Italy, Luxembourg and the Netherlands—to 'report on the amount of atomic energy that can be produced in the six countries in the near future and on the means whereby this can be achieved.'

During their visit they met Lord Salisbury, the Lord President of the Council, Lord Mills, Minister of Power, Sir Edwin Plowden, chairman of the UK Atomic Energy Authority, and senior officials of the UK Atomic Energy Authority and of the Central Electricity Authority. On 27 February they visited the Calder Hall nuclear power plant.

Patents Bill Passed

The Patents Bill, extending the time limits involved in applications for patents, gained an unopposed third reading in the Commons recently.

Correspondence

Methods for Detecting Toxic Gases

SIR, My committee has asked me to communicate with you in reference to the booklet 'Methods for the Detection of Toxic Gases in Industry', leaflet No. 4 Benzene Vapour (second edition 1955), issued by DSIR.

An error has been found in the standardisation of this test as published which necessitates alteration of the table of concentrations given on page 5 of this booklet. The revised table reads as follows:—

No. of inflations of aspirator bulb	Concentration of benzene (approx.)	
	p.p.m.	mgs./cm.
1	120	400
2	60	200
3	40	130
4	30	100
5	24	80
6	20	65

An amended table is to be issued by HM Stationery Office and copies will be circulated to all purchasers of the apparatus used in conjunction with this test.

It will be noted that the original table gave higher concentrations of benzene than those actually present so that the error has tended to safety. It is felt, however, by my committee that this revision should be brought to the notice of all persons who might be interested in this test.

Yours etc.,

J. NIXON,
Secretary,
Committee for Tests for Toxic Substances in Air,
Ministry of Labour,
Engineering and Chemical Branch,
Factory Department.

Limitations of PVP as thickening Agent

USE OF polyvinylpyrrolidone (p.v.p.) in cosmetics, its manufacture and properties, was the subject of a paper given by Mr. I. Greenfield at the February meeting of the Society of Cosmetic Chemists. He said that the final stage in the manufacture was one of polymerisation. It had been found possible to prepare polymers with molecular weights ranging from about 10,000 to 100,000. Although the more highly polymerised grades might find application as thickening agents, it was clear that the complicated synthesis would bring the cost to prohibitive limits for general purposes.

Chief use of p.v.p. in the past had been in hair lacquers and wave sets and reported sales of p.v.p. aerosol sprays in 1955 in the US accounted for some 70 per cent of hair-spray output. Formation of complexes with dyestuffs combined with substantive action, allowed temporary tinting. Effectiveness of p.v.p. as a pigment binder and dispersing agent had led to its use in make-up and mascara. It would be worth while examining its effect in shaving creams, hair creams, shampoos.

Mr. Greenfield said that p.v.p. was a foam builder and stabiliser. He stressed the importance of examining the compatibility of p.v.p. with any perfume it was proposed to include in formulation.

People in the NEWS

● MR. WILLIAM HUGH ROGERS has been appointed industrial sales manager of British Oxygen Gases Ltd. Mr. Rogers joined British Oxygen in 1935. In 1946, Mr. Rogers was appointed manager of Oxhycarbon Ltd., a subsidiary of British Oxygen, and in 1950 he became assistant sales manager at the Wembley depot of British Oxygen Gases Ltd. He subsequently became assistant to the chief buyer at the company's headquarters, supply officer for British Oxygen Engineering Ltd. at Edmonton, sales planning officer for British Oxygen Gases Ltd., and finally sales manager for the same company.

● MR. CHRISTOPHER BARROW, A.M.C.T., A.T.I., chief colourist, English Sewing Cotton Co. Ltd., Manchester, and MR. JOHN WHARTON, F.R.I.C., M.I.Chem.E., director of research, Courtaulds Inc., Alabama, US, have been awarded the Fellowship of the Textile Institute.

● MR. GRAHAM COOKE has been appointed advertising and publicity director of the Solartron Electronic Group Ltd., having been elected a director of Solartron Laboratory Instruments, Ltd.

Mr. I. Goodman, Imperial Chemical Industries Ltd., Fibres Division, who read a paper on 'Synthetic Fibre Forming Polymers' at the Bradford Polymer symposium on 15 February. (See CHEMICAL AGE, 23 February)

● LORD CLITHEROE has joined the board of Tube Investments. He is deputy chairman of Borax Consolidated and is on the boards of a number of other companies.

● MR. A. G. EVE, a graduate of Rhodes University and recently an assistant research officer at the Council for Scientific and Industrial Research, Pretoria, has been appointed an assistant lecturer in chemistry at the University College of Rhodesia and Nyasaland. Another new assistant chemistry lecturer is MR. E. R. SWART, who was also on the staff of the CSIR, Pretoria.

● MR. G. D. JONES has been appointed head of the material-control department of Quickfit & Quartz Ltd., manufacturers of interchangeable laboratory glassware, Stone, Staffs.

● The following changes in the board of directors of Griffin and George Ltd., laboratory furnishers, are announced: MR. RONALD MCKINNON WOOD, O.B.E., has asked to be relieved of his duties as chairman of the company, in view of the public duties he will assume in the near future as chairman of London County Council. MR. H. R. BETTINSON, M.C., hitherto vice-chairman, will, for the time being, act as chairman of the board. MR. NORMAN MCKINNON WOOD has been appointed vice-chairman and relinquishes his appointment as managing director. MR. NORMAN TREPTE has been appointed managing director.

● DR. FRANKLIN KIDD, C.B.E., F.R.S., will relinquish his post as Director of Food Investigations on 31 March 1957, after nearly 40 years' service with the DSIR's Food Investigation Organisation. No successor has yet been appointed. For the time being the functions of the Director of Food Investigation will be discharged by the secretary of the department.

● At the annual general meeting of the Biological Methods Group of the Society for Analytical Chemistry in London on 23 January, the following officers were elected for the forthcoming year: *chairman*: DR. S. K. KON; *vice-chairman*: DR. J. I. M. JONES; *hon. secretary and treasurer*: MR. K. L. SMITH, Standards Department, Boots Pure Drug Co. Ltd., Nottingham.

● MR. C. W. CLARK has resigned his directorship of Gas Purification and Chemical Co. Ltd., on medical advice.

● MR. R. W. KEAR, F.R.I.C., M.Inst.E., has received an award of 150 guineas from the Sir George Beilby Memorial Fund in recognition if his work on the behaviour of fuel impurities in combustion processes with special reference to the role of sulphur, chlorine and alkalis in corrosion and deposit formations by flue gases in combustion appliances. He is employed in the oil products development department of the Shell Petroleum Co. Ltd. The administrators of the fund represent the Institute of Metals, Royal Institute of Chemistry and the Society of Chemical Industry.

● MR. DAVID CONKLIN, director of sales of Du Pont's petroleum chemicals division has been appointed managing director of the Du Pont Co. (United Kingdom) Ltd.

Billingham Output Rises 17 per cent in Four Years

TOTAL TONNAGE of chemicals made for sale by the Billingham Division of ICI Ltd., has risen by 17 per cent in the past four years and now exceeds 2,500,000 tons a year. Total manpower employed has remained substantially the same. Expenditure on new plant and equipment has averaged about £750,000 a month.

Large production increases are expected this year from the second oil cracker on the Wilton site and from the new oil gasification process for the manufacturing of ammonia, due to be completed at Billingham in a few months.

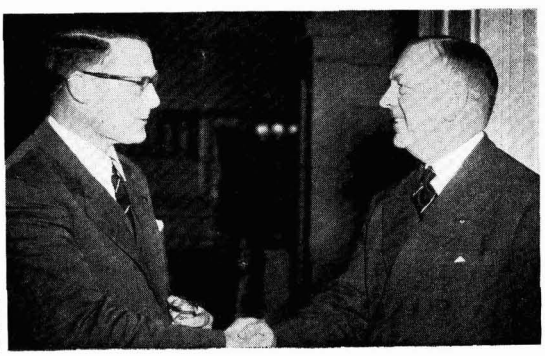
At Wilton, more than 7,000 adult workers have taken the training courses; more than 400 have taken supervisory courses and nearly 400 have trained in aspects of work study.

Five Lectures on Hydrazine

A series of five lectures on hydrazine will be given at Borough Polytechnic (Department of Chemistry) on Wednesday evenings 6.30 to 8.30 p.m. beginning 13 March. The lectures will deal with the manufacture of hydrazine, its chemical reactions and industrial uses. A detailed syllabus may be obtained on application to the Borough Polytechnic, Borough Road, London SE1.

Change of Address

Head office of the Incorporated Plant Engineers has been moved to 12 The Parade, Solilhull, Warwickshire (Solihull 1111).



E. L. Harrison (left), sales director of Quickfit and Quartz Ltd., laboratory glassware manufacturers, Stone, Staffs, is congratulated by Sir Graham Cunningham, Triplex Group chairman, on becoming a member of the Triplex 21 Club

NEW DIVISIONAL DIRECTORS APPOINTED BY ICI

THE board of ICI Ltd., as stated last week, has announced appointments to the boards of the Metals, Nobel and Paints Divisions and to the Wilton Council.

Dr. Maurice Cook, who has been appointed chairman of the Metals Division, was educated at Manchester and Cambridge Universities, obtaining the D.Sc. and Ph.D. degrees. He joined one of the constituent companies of ICI in 1926 as a research worker. In 1938 he was appointed research manager of the Metals Group of ICI, and became a director of the Metals Division in 1942. In 1951 he was appointed joint managing director of the Division.

Mr. Elstub, who has succeeded Dr. Cook as joint managing director, received his training at Manchester University and as a student apprentice with Vickers Armstrong Ltd. He joined the Billingham Division of ICI in 1936, becoming staff manger and plant engineer in 1938. After the war he spent two years with the Ministry of Supply before rejoining ICI as assistant chief engineer in the Metals Division. In 1951 he was appointed a director of the Division, and in 1954 was awarded the C.B.E. in the New Year's Honours List.

Mr. W. H. G. Lake, who has been appointed a director of the Metals Division, joined the Dyestuffs Division of ICI in 1940 and was transferred to the research department of the Metals Division in 1943. He became assistant research manager in 1953 and, in 1955, was appointed production manager of titanium production.

Mr. W. N. Ismay, who has also been appointed a director of the Metals Division, joined the Division in 1948 and, in 1952, was appointed production and development engineer at the Kirkby Works of the Division. In 1955 he became technical manager of the technical department at the Metals Division headquarters in Birmingham.

Dr. J. M. Holm has been appointed joint managing director of the Nobel Division as from 1 April. Educated at Glasgow University, he joined the Nobel Division in 1934. In 1938 he became superintendent of the propellents department at Ardeer and during the war served with the Ministry of Supply as Deputy Director General of Explosives. In 1948 he was appointed assistant research manager of the Nobel Division and, in 1952, became production director.

Dr. A. D. Lees has been appointed a director of the Nobel Division with effect from 1 April. Joining the company in 1935, he was appointed chief superintendent of the acids department at Ardeer in 1945, works manager of the St. Rollox and Maryhill factories in 1948, divisional staff manager in 1953, and divisional labour manager in 1955.

Dr. W. A. Caldwell, who has been appointed development director of the Nobel Division as from 14 February, joined the company in 1934. In 1947 he became assistant research manager of the Nobel Division and became manager of the development department in 1956.

Dr. J. S. Gourley, B.Sc., F.R.I.C., who has been appointed chairman of the Paints Division, joined the Nobel Division in 1919. He was transferred to the Paints Division in 1929 and became assistant development manager in 1938. In 1945 he was appointed research manager. He became a director of the division in 1947. In 1952 he was appointed joint managing director of the company's Plastics Division.

Mr. J. C. H. McEntee, who has been appointed chairman of the Wilton Council, joined the company's Alkali Division in 1929 and was appointed personal assistant to the production director of that division in 1937. In 1948 he became works manager of the Winnington Works, Alkali Division. He joined the Wilton Council as general manager in 1950 and was appointed managing director in 1956.

Mr. R. E. Newall, who has been appointed managing director of the Wilton Council, joined one of the constituent companies of ICI in 1929 and, in 1933, became personal assistant to the chief engineer of Billingham Division. He joined Wilton Council in 1946 as assistant chief engineer, becoming chief engineer in 1949 and engineering director in 1956.

Evans Medical Supplies Expand Tabletting Plant at Speke

Dr. Harold Davis, chief pharmacist, Ministry of Health, starts machinery in the new tablet department of Evans Medical Supplies Ltd., Speke. Others (l. to r.) Dr. F. S. Gorrill, deputy chairman, I. V. L. Fergusson, chairman, C. W. Robinson, pharmaceutical development director

Bahamas Freeport Offers Tax-free Opportunities for UK Industry

SUBSTANTIAL TAX-FREE concessions are offered to UK industrialists who establish manufacturing plants in a new development area in the Bahamas. The area of 50,000 acres is known as Freeport. This free enterprise venture—the land has been purchased from the Crown under a 99-year agreement—is being carried out by the Grand Bahama Port Authority Ltd., which has a London office at 1 Lygon Place, Grosvenor Gardens, SW1.

Construction of a deepwater harbour is well under way, and the building of roads, houses, offices etc., is also in hand. Among tax concessions offered to UK firms are a 30-year period in which firms and employees will pay no income tax, no capital gains tax, no real estate tax, no personal property tax, no excise tax, no customs duties (except on goods for personal consumption) and no taxes on bank remittances.

From the end of that 30-year period until the end of the agreement (99 years from 1955) there will be exemption from excise taxes, customs duties (except goods for personal consumption) and taxes on bank remittances.

Full details are contained in a booklet —'A Tax-free Opportunity for UK industry and Commerce'—available from from the Grand Bahama Port Authority Ltd.

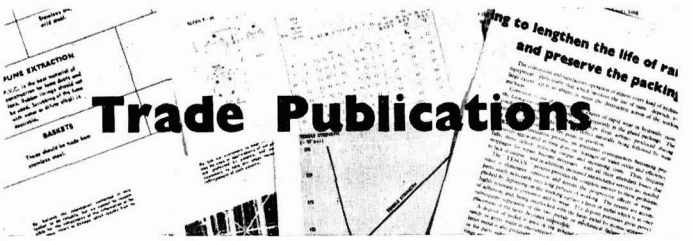
Electroluminescence in Chemical Engineering

IS A NEW FIELD of activity for the chemical engineer developing in electroluminesence? This question was asked at a meeting of Liverpool Centre, Illuminating Engineering Society on 19 February, when Mr. J. N. Bowtell, B.Sc., A.Inst.P., of the Research Laboratories, General Electric Co. Ltd., described and demonstrated the production of light from phosphor powder by subjecting it for direct action of an electric field. He said electroluminescent light sources are conveniently made by incorporating the phosphor in a suitable resin which is sandwiched in a thin layer between two conducting plates to form a simple capacitator, phosphor and resin mixture serving as the dielectric, replying to questions, Mr. Bowtell said chemical engineering inevitably was involved in the development of electroluminescence owing to the many processes involved in the preparation of the phosphor.

Glassware Prices Reduced

Price reductions have been made by H. J. Elliott Ltd., E-Mil Works, Treforest, Glamorgan, for some of their range of laboratory glassware and thermometers. Slight increases have however been made for a few items because of extra labour and material costs.

Details of the price changes are contained in a new retail nett price list for E-Mil laboratory glassware, thermometer catalogue No. 7 and catalogue supplement No. 1.



Four Laboratory Items

Four small items from the Griffin and George range are described in a leaflet, available from Ealing Road, Alperton, Wembley, Middlesex. The Nivoc filter pump has a precision moulded plastics body, a nickel plated removable jet and nickel plated brass water tap and side connections. Vacuum obtainable is claimed to be 12 to 10 mm. Hg at water pressure of 15 lb. per sq. in. Overall length is 14 cm. A finger operated non-corrosive pinch valve for the control of fluid flow, vacua and pressure in laboratory apparatus is also described together with a stopclip designed for retaining stopcock plugs. The advantages of both a seven inch spatula and two sizes of spoon are claimed to be combined in the Griffin Trulla made of heavy gauge, highly polished steel.

Unit Laboratory Furniture

A new publication on unit laboratory furniture has been issued by Charles Hearson and Co. Ltd., 68 Willow Walk, Bermondsey, London SE1. This company has evolved a range of unit furniture which is complete in itself apart from a bench top and can be used singly or arranged as considered appropriate by the customer.

Assembly of the units into a laboratory bench is a simple matter as all are completely standardised in the basic dimension of height, width and depth. Sufficient space is left behind the units to house the services.

Cupboard units, cupboard and drawer units, nest of drawers units, waste box units, apparatus cupboards, bench tops are available, normally ex-stock. Because of the large batch quantities made at one time, production costs are considerably cheapened and are reflected in the prices.

New Chemicals in BDH Range

Nine additions are announced to the range of chemicals supplied by British Drug Houses Ltd., Poole, Dorset. They are: Chloranilic acid, diaminoethane tetra-acetic acid tetrasodium salt, dipyrido-zinc thiocyanate, 3-ethyl 5-methyl phenol, fructose 1:6-diphosphoric acid calcium dihydrogen salt, glucose 6-phosphoric acid disodium salt, 3-hydroxy pyridine, nitrilo-triacetic acid, and Panacide brand dichlorophen.

Commander Class Instruments

George Kent Ltd., Luton, Beds, have given the name *Commander Class* to a new range of Kent Instruments engineered to meet modern needs for more practical and highly accurate tools of process measurement and control. Among the advantages claimed for this new range are rationalised design, compliance with British Standard recommendations, and simplification of servicing.

One of the eight basic models in the KU group is the KU flow instrument which offers: permutations of recording, integrating crescent-scale indicating and automatic-control functions; six maximum-flow differential pressures of 25 in., 50 in., 100 in., 200 in., 400 in., and 600 in. w.g. on an air-on-mercury basis and alternatives of automatic-control functions.

Other instrument groups related to the KU instruments in the Kent *Commander Class* include: pneumatic flow recorder-transmitters, combined flow and pressure recorders, combined flow and temperature recorders, pressure and temperature recorders, combined flow and pressure recorders with pneumatic transmissions of flow value, and flow pneumatic receiver-records etc.

In addition the *Commander Class* range embraces flow instruments which are basically indicators. *Commander Class* spare parts are also available.

Electrical Trades Directory

Now ready for distribution *The Electrical Trades Directory, The Electrical Journal Blue Book* (Benn Brothers, Ltd., 154 Fleet Street, London EC4, 63s. carriage paid) contains some 65,000 references under the headings of manufacturing and other companies; merchants, exporters, importers agents, patent agents, electrical installation contractors, wholesalers and distributors; twenty-seven different categories of engineers, information, respecting electricity supply and transport.

Booklet on Glass Containers

The importance of glass containers to packers of chemicals, pharmaceutical products, cosmetics and oils is illustrated by Mr. Dennis Rider, director of the Glass Manufacturers' Federation, in a booklet, *Glass Bottles and Jars,* published by the Glass Container Publicity Committee. It deals with raw materials, production, standardisation, packing of glassware and its uses. Copies may be obtained, free of charge, from the Federation at 19 Portland Place, London W1.

Index to Quarterly Bulletin

Consolidated index, June 1953 to September 1956, to the *Quarterly Bulletins published by the British Sulphur Corporation* Ltd., 4 Grafton Street, London W1, has recently been issued.

Blowing Agents for Rubber and Plastics

Genitron blowing agents are the subject of a new brochure issued by Whiffen and Sons Ltd., Fison House, 95 Wigmore Street, London W1. Agents described are Genitron AC (azodicarbonamide), Genitron azon (azo-diisobutyronitrile), Genitron BSH (benzene sulphonyl hydrazide), and Genitron OB (P,P'-oxy-bis (benzene sulphonyl hydrazide)).

A typical usage described for expanded shoe soles, is as follows (parts by weight): pale crepe 70; styrene-butadiene copolymer (master batch) 30; zinc oxide 5; sulphur 2.5; filler 40; stearic acid 3; paraffin wax 2; anti-oxidant 0.75; accelerator 1.5; Genitron BSH 5-6.

DSIR Revised Sectional List

Now available from HM Stationery Office or through any bookseller is the Department of Scientific & Industrial Research, Sectional List No. 3 revised to October 1956. *This list contains those* publications which are issued by HM Stationery Office or the Department that are still in print or in the press. It should be of use to research workers and to all types of libraries.

Included in this revised list are sections on chemical research, pest infestation research, water pollution research.

Dust Collector

Holmes-Rothemuhle multi-cell cyclone dust collector, now being made and marketed in the UK by the gas cleaning division of W. C. Holmes and Co. Ltd., Turnbridge, Huddersfield, is the subject of the company's latest leaflet, No. 68.

Paint Trade Manual

Details of about 3,000 items are included in *Paint Trade Manual of Raw Materials and Plant,* compiled by Dr. H. W. Chatfield and distributed by Scott Greenwood and Son Ltd., 83-86 Farringdon Street, London EC4. Information on raw materials, plant etc. is arranged in groups in alphabetical order and there is a comprehensive index. Research and development associations are included and there is a section devoted to specifications. Price is 24s (postage 1s 1d).

Deoxygenation of Boiler Feed Water

Two new leaflets dealing with Zerox (35 per cent hydrazine solution) for the deoxygenation of boiler feed water, have been issued by Whiffen and Sons Ltd., Fison House, 95 Wigmore Street, London W1. One illustrates the typical boiler. It is stated that hydrazine is one of the newest chemicals to be used in water treatment and describes its properties and recommended uses. This chemical removes dissolved oxygen throughout the steam/water cycle and does not affect the dissolved solids. It cannot produce any acidic substances and is said to keep the water alkaline.

Commercial News

Monsanto Increase Capital to Finance Fawley Plant

THE directors of Monsanto Chemical Company have announced that it is proposed to raise over £5 millions of new capital. Of this sum £2,025,000 will be raised by way of a 'rights' issue of 5.4 million shares of 5s each at 7s 6d share to the ordinary shareholders. Holders will be able to subscribe in cash for one new share for every two now held. The American parent company which holds two-thirds of the issued ordinary capital of the British company, intends to subscribe for its proportion of the new shares.

When this rights issue is out of the way the directors propose to capitalise £1,350,000 of reserves to issue one free share for every three then held. The issued capital will thus be doubled and it is expected that a dividend of 13½ per cent will be paid for 1957 on the doubled capital, compared with 22½ per cent paid on the old capital for each of the past three years.

It is also proposed to increase the capital to £10 million by the creation of 14.8 million additional 5s Ordinary, but at present no further shares other than those of the two issues proposed will be issued.

With regard to the results for 1956, the directors state that sales were up by 4 per cent but increased costs and growing competition reduced consolidated trading profit from £2,878,568 to £2,596,773 and consolidated net profit from £1,097,311 to £919,315. It is to be noted that the further expansion of export sales, which at £5,821,357 were 15 per cent higher, represented 41 per cent of total sales against 37 per cent previously.

The company is paying 22½ per cent for the third successive year. A second interim dividend of 15 5/6ths per cent is declared for 1956. No further distribution will be recommended.

Anchor Chemical Co.

Anchor Chemical Co. Ltd., Manchester, is repeating the 17½ per cent payment on the £270,000 ordinary with a final for 1955-56 of 12½ per cent. Group trading profit was £126,405 (against £144,532).

British Industrial Plastics

Turnover for the British Industrial Plastics group for the year ended 30 September 1956 was a record, showing an increase of approximately 6½ per cent over the previous year. The decline of £53,115 earned by the group occurred mainly in BIP Chemicals and was attributable to the policy of holding prices says Mr. E. R. Crammond, chairman.

Group trading profit was £962,162 (£1,003,814) before charges. Taxed net profit was £296,495 (£331,940) and the dividend was repeated at 20 per cent.

British Oxygen Co.

Increases in costs, and resultant lowering of profit margins, have again largely offset the benefit of continued sales growth at home and overseas, states British Oxygen Co. Ltd.

The trading profit of £5,198,464 for the year to 30 September 1956 is comparable with £4,845,639 if 12 months' trading of the parent company is included for 1954/55. (The published profit for 1954/55 of £4,277,152 included parent company trading for nine months only.)

The directors recommend a final dividend of six per cent on the £17,047,166 ordinary stock (nine per cent on £11,364,777) which with the interim dividend of four per cent on £17,047,166 ordinary stock (six per cent on £8,117,698) makes a total dividend for the year of ten per cent (15 per cent).

Anglo-French Phosphates

Net profit of the Anglo-French Phosphate Co. Ltd. for 1956 was £45,793 (against £47,445). Dividend of 25 per cent (same) is proposed.

Milton Antiseptic Ltd.

An increase in their trading profit of £14,150 is announced by Milton Antiseptic for the year ended 30 September 1956. Profit before taxation shows an increase of £11,466. Net profit of the parent company, after allowing for taxation and profits retained in the accounts of the subsidiary companies, was £46,477. A dividend of 13½ per cent is proposed on Ordinary.

Speaking at the 33rd annual general meeting in London on 19 February, Mr. E. J. Tucker, chairman, said that progress continued in the production and marketing of fine chemicals for both home and export trade.

NEW COMPANIES

DURHAM AND BONNY LTD. Capital £20,000. Manufacturers, agents, distributors, importers and exporters of plastics and elastomers, chemicals and metals, oils, resins etc. Directors: Robert N. Bonnett, Elizabeth R. Bonnett, Joseph F. E. Ruffell, and Frank L. Gilbert. Registered Office: Birtley, Co. Durham.

R. HECKSHER AND CO. LTD. Capital £250. Merchants of and dealers in chemicals and chemical products of all kinds etc. Directors: Rudolph Hecksher and Mrs. Erna S. Hecksher. Registered office: 'Heathbank' Woodhead Road, Glossop, Derbys.

LONDON GAZETTE

Intended Payment to Preferential Creditors

ACIDWARE AND REFRACTORIES LTD., registered office, Heather Works, Heather, near Leicester, manufacturers of bricks and refractories. Last day for receiving proofs, 5 March. Liquidator, E. C. Stimpson, official receiver and liquidator, 27 Regent Street, Park Row, Nottingham.

Notice of Dividend

WILSON AND WOODS LTD., registered office, 19 Village Way East, Rayners Lane, Harrow, Middx, manufacturers of chemical compounds. First and final dividend of 3s 9 1/16d per £, paid 19 February or any subsequent day between 11 a.m. and 2 p.m. at the office of the official receiver and liquidator, Inveresk House, 346 Strand, London WC2.

Release of Liquidator

KENFORD LTD., registered office, 231-6 Dashwood House, 69 Old Broad Street, London EC, chemical manufacturers. Liquidator, G. F. Morris, official receiver and liquidator, Inveresk House, 346 Strand, London WC2, released from 11 February.

Market Reports

Potash and Soda Products in Steady Demand

LONDON Buying interest has been sustained in nearly all sections of the market with home consumers calling for good quantities against contracts. With few exceptions the price basis remains firm. Most of the potash and soda products are in steady request, with chlorate of soda and yellow prussiate of soda moving well.

Fertiliser materials are again reported to be in active request while demand for bleaching powder and copper sulphate

(Continued at foot of facing page)

NEW PATENTS

By permission of the Controller, HM Stationery Office, the following extracts are reproduced from the 'Official Journal (Patents),' which is available from the Patent Office (Sale Branch), 25 Southampton Buildings, Chancery Lane, London, WC2, price 2s 6d including postage; annual subscription £6 6s.

Specifications filed in connection with the acceptances in the following list will be open to public inspection. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period. Dates on which these applications will be open to inspection are given in 'Official Journal (Patents)'.

ACCEPTANCES

772 354 Filters for removing fine particles from liquids. Auto-Klean Strainers Ltd.

772 243 Industrial products derived from monourethanes of glycols. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny et Cirey.

772 173 Copolymerisation of vinyl compounds. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny et Cirey.

772 109 Unsaturated polyfluorinated organic compounds. Haszeldine, R. N.

771 991 Production of aliphatic acids. Distillers Co. Ltd.

772 174 Trialkylaluminium compounds. Ziegler, K.

772 085 Analogue computer particularly for analysis of liquid-vapour phase equilibria. Compagnie Francaise de Raffinage.

772 046 Apparatus for determining interfaces in liquid bodies. National Research Development Corp.

771 992 Recovery of aliphatic acids from oxidation product of hydrocarbons. Distillers Co. Ltd.

772 440 Tanning process. Boehme Fettchemie Ges.

771 993 Treatment of organic acid mixtures by distillation. Distillers Co. Ltd.

772 289 Epoxide resin compositions. General Electric Co.

772 178 *Tris* (N-dimethyl) phosphoric acid amide. Southern Production Co. Inc.

772 443 Aralkyl carboxylic acid amides. British Petroleum Co. Ltd., Geach, C. J., and Habeshaw, J.

772 294 Radio-active materials. Isotope Developments Ltd., and Shaw, E. N.

772 179 Heterocyclic compounds. Chemische Fabrik Promonta Ges.

772 295 Amides. Rohm & Haas Co.

772 446 Piperidines. Celanese Corp. of America.

772 256 Preparing 2-methyl-4-amino-5-acetaminomethylpyrimidine. Shionogi Seiyaku Kabushiki Kaisha.

772 296 Reducing corrosive and other effects of combustion products in gas turbine plants attributable to vanadium compounds and to alkali metal or alkaline earth metal sulphates. Sulzer Freres Soc. Anon.

772 453 Steroid α-iodo-ketones. Djerassi, C., and Lenk, C. T.

772 088 Organopolysiloxanes. General Electric Co.

771 926 Graft copolymers. Distillers Co. Ltd.

772 017 Coating compositions and process for their manufacture. Deutsche Magnesit AG.

772 454 Dispersing agents from polyalkylene oxide waxes. Boehme Fettchemie Ges.

772 301 Alkali soluble synthetic resins and compositions containing same. Johnson & Son Inc., S. C.

772 019 Chromium- and cobalt-containing azo dyestuffs of the benzene-azo-2 - hydroxynaphthalene - 3 - carboxylic acid series. Sandoz Ltd.

772 184 Discharge mechanisms for liquid containers. Schlicksupp, T. F.

772 185 Herbicidal compositions. Monsanto Chemicals Ltd.

772 059 Method of and means for covering tubes with plastic. Burn, L., A.

772 189 Production of artificial filaments, threads, fibres etc. Imperial Chemical Industries Ltd.

772 060 Process and apparatus for contacting two partially miscible liquids. Esso Research & Engineering.

772 192 Thyrotropin preparations. Armour & Co.

772 193 Biocidal compositions. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij.

772 143 Process for treating a secondary alkyltoluene. Standard Oil Co.

772 306 Preparing quaternary ammonium salts. Abbott Laboratories.

772 373 Apparatus for separating liquid mists from gases. Metallges AG.

772 144 Aluminium alcoholate derivatives. Hardman & Holden Ltd., and Rinse, J.

772 196 Preparation of acrylamide. Rohm & Haas Co.

772 308 Pigmented artificial fibres. Farbenfabriken Bayer AG.

772 030 Anthraquinonoid dyestuffs. Imperial Chemical Industries Ltd.

772 197 Plasticisers. Goodyear Tire & Rubber Co.

772 145 Purifying ethylene oxide. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij.

772 273 Exothermic mixtures. Foundry Services Ltd.

771 938 Titanium-bearing slags. American Cyanamid Co.

772 147 1, 4-Unsymmetrically substituted piperazines. American Cyanamid Co.

772 094 Fuel-combustion apparatus and production of controlled gaseous effluents therefrom. Fraser, R. P.

772 034 Polymeric materials from polyvinyl compounds. Eastman Kodak Co.

772 199 α, β-Unsaturated carboxylic acids and esters thereof. Hoffmann-La Roche & Co. AG.

772 151 Epoxidation of fatty acids. Food Machinery & Chemical Corp.

772 159 Fluorinated N, N'-di-substituted thiourea compounds. Soc. de l'Institut de Serotherapie Hemopoietique.

771 942 Foamed natural and/or synthetic rubber latex coagulable at reduced temperatures. Goodyear Tire & Rubber Co.

772 160 Preparing filaments of polyamide and polyester substances. Soc. Rhodiatoce Soc. per Azioni.

772 206 Cellular compositions. Du Pont de Nemours, E. I., & Co.

771 943 Compositions for inhibiting corrosion of both cuprous and ferrous metals by aqueous solutions. Albright & Wilson Ltd.

772 212 Chlorinated cyclopentadiene adducts. Ruhrchemie AG.

772 041 Lubricant compositions for rolling light metals. Dow Chemical.

772 042 Vat dyestuffs produced from 1, 5-diamino-4,8-dihydroxyanthraquinone. Farbenfabriken Bayer AG.

772 322 Stabilised aqueous hyaluronidase solutions. [Addition to 730 929.] American Home Products Corp.

772 044 Reduction of carbon content of ferroalloys. Chromium Mining & Smelting Corporation Ltd.

772 213 Dithiophosphoric acid esters. Geigy, J. R., A.G.

772 166 Dehydrobromination of α-brominated ketosteroids. Laboratoires Française de Chimiotherapie.

772 215 Production of di-acylated tartaric acids. Cilag Ltd.

772 113 Method of and solution for coating steel and zinc surfaces. American Chemical Paint Co.

772 114 Hydrocarbon mixtures containing higher alkenes. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij.

772 391 Gases having high carbon monoxide content. Metallges AG.

772 119 Piperazine salts of glycolylarsanilic acid. Delmar Chemicals Ltd.

772 323 Devices for breaking friable aggregates. Shawinigan Chemical.

772 339 Titanium-base alloys. Titanium Metals Corp. of America.

772 327 Sweetening hydrocarbon oil distillates. Shell Research Ltd.

772 343 Modifying cellulose or cellulose derivatives. Farbenfabriken Bayer AG.

772 345 Polyvinylamine. Hercules Powder Co.

772 169 Salts of ascorbic acid. Soc. des Usines Chimiques Rhone-Poulenc.

772 347 Cyanine dyes, processes of preparing them and photographic emulsions containing them. Kodak Ltd.

772 404 Nuclear reactor. Varian Associates.

Market Reports

(*Continued from previous page*)

has been maintained. Export trade continues at a good level.

There has been an active call for most of the coal-tar products with supplies adequate for current needs. Home demand for pitch remains good, while a good business on home and export account is being done in creosote oil and cresylic acid.

MANCHESTER Firm price conditions continued in all sections of the Manchester chemical market during the past week. A wide range of heavy products is still finding a reasonably good outlet among the textile and allied industries of Lancashire and the West Riding. Other leading industrial consumers are mostly calling for steady contract deliveries. A fair number of fresh inquiries have been circulating. In the fertiliser section basic slag and compound and concentrated descriptions are meeting with a good demand, as are most of the light and heavy tar products.

GLASGOW Business has been reasonably brisk during most of the past week, and demands against contract requirements have been well maintained. This also applies to spot requirements. The fertiliser position continues to show an increase and as already stated some forward bookings have been placed.

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