

VOL. LXXIV

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3 MARCH 1956

No. 1912

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Something to Say

ATER this month three professional institutes of British science are holding a joint meeting on the perennial theme, 'The Presentation of Science to the Public'. As this is only an evening meeting, a large amount of varied ground will have to be covered in a short time. In the broadest terms of reference, we feel bound to wonder whether this subject is even yet being given sufficient attention, whether it is not another 'weak spot' that we accept too readily. To make this critical point is not to belittle the efforts of those who strive to keep the subject ventilated, rather it is an expression of regret that these efforts are not allowed to be more substantial.

In last month's issue of the US Journal of Chemical Education (1956, 33, 54), a symposium of papers on technical writing, papers originally read at the 128th Meeting of the ACS, was printed. It is difficult to read these papers without concluding that more is being done about this problem of presentation and expression on the other side of the Atlantic. That the problem exists there no less starkly is evident enough—but it is no longer being accepted as an inherent and chronic ailment. A quotation from Barrie given in one of these papers deserves to be repeated: 'The man of science appears to be the only person who has something to say just now, and the only man who does not know how to This is an exaggeration for other say it.' professions besides those classifiable as scientific have been known to be incoherent but it is the exaggeration that drubs the point home. However, scientists can rarely use exaggeration as a device of emphasis—their thinking is objective and they reach few conclusions that are free from qualification or conditional interpretations.

It is undeniably important that as much of our science as possible should be 'understood' by the public. In an age when the 'couldn't-care-less' outlook seems to be growing dangerously, those who instead 'could care less' deserve the utmost encouragement. But in many ways this aspect of scientific expression or presentation is a task either for specialists or the naturally gifted, and possibly these two are one and the same. Throughout the history of science, some scientists have been outstanding for their public intelligibility. That they have also been among the greatest scientists of their time may not be entirely accidental —yet it cannot be made the basis of generalisation for there have also been great scientists who have regularly failed to be intelligible even to keen undergraduates. Taking science to the public without degrading it into some parody of half-truths and glittering mumbojumbo—seems to require a particular flair, and it remains to be seen whether that flair can be induced by courses of training.

What is surely more important at present is that science should be made more understandable to people who need the help of science in arriving at decisions of action-administrators of industry or government, and even scientists themselves where problems in their own fields of work cannot be solved without guidance from specialists in other branches. If what modern science has to say is to be said more clearly, the place of beginning is the scientific or technical report, the expression of science for the practical purpose of its application. The writing and structure of academic papers is frequently criticised. Many of these papers could be less cumbersomely written, could be liberated from needless jargon and lengthy circumlocutions, and some of them could be at least 20 per cent shorter. But on the whole progress has not been seriously impeded by this customary weakness-the difficult readability of papers can be compared to an infectious disease everybody endures. It is in the technical report that the price of bad writing and presentation is so much more costly, and this fact aligns itself with another-that it is not research efforts that lag behind our needs nearly as often as research application.

One of the papers in the US symposium referred to reveals that in 1954-55 41 out of 86 accredited schools of chemical engineering required courses of technical writing in their curricula, and 39 schools also required courses in speech. A similar survey in 1948 had shown attention to this aspect of education in 15 out of 53 schools. Data were not given for schools of chemistry though it was suggested that chemists, as opposed to

chemical engineers, enjoy a more 'cultural' education, and the need for special training in technical writing is therefore less pronounced. Nevertheless, as in this country, some professors of chemistry had recognized the need and had instituted their own courses for chemical writing and chemical 'literature'. This inevitably reminds us of Professor R. O. Kapp's book, 'The Presentation of Technical Information', in the preface of which when describing the circumstances in which such a course was begun at University College, London, he said : 'From the very beginning the students welcomed the opportunity . . . they were interested, appreciative, co-operative. But it took me a long time to find a suitable lecturer. . . .'

It is clear from the US symposium that many industrial companies are now regarding technical writing as a subject for staff-training—'these organizations believe that greater efficiency of their research effort can be realized if they can improve the quality of reporting.' The training may be indirect and subtle, the circulation of books and papers on report writing, the frequent discussion of the topic in internal bulletins etc., or it may be direct with formal and informal courses. The problem of finding suitable teachers is variably solved—a consultant is hired, a professional teacher of English from a school or college is invited, or, when possible (for this is regarded as the best method) an efficient reportwriter within the organization is used. This particular paper also mentions two graduate courses organized in the USone by the University of Pittsburgh and another by the National Bureau of Standards, and each is said to show 'what can be done when the problem of scientific writing is attacked with vigour'.

Is there as much vigorous attack upon the same problem here? The frankly journalistic approach shown in some of the major US scientific publications is apt to be deplored by some British readers. But is it in fact damaging? Does it not help, albeit indirectly, in breaking down some of the over-complex approach to writing in scientific papers and reports? Waste Oil Pollution

VEN those of us whose association

Notes & Comments

with the shores of this island is limited to an annual fortnight are by now keenly and perhaps bitterly aware of the oil-discharge pollution problem. However, its nuisance to those who look upon the beach as a place of leisure is trivial compared with its lethal attacks upon sea-birds. The oil pollution problem is especially severe on the coast of Jutland in Denmark. It is said that 3,000 birds were killed or had to be destroyed as the result of a single inflow of discharged oil quite recently. While at an international level committees try to frame regulations for oil-discharge practice at sea, Jutland coastal resorts have set up their own committee to carry out experiments for oil disposal. They claim to have found that mixing talc with the oil makes it sink to the sea-bed; also, that further experiments showed lignite dust to be a cheaper and even more effective oil-sinking additive. The committee has also designed and tested a small skimming machine, but so far this mechanical approach has met with success only on very flat beaches. Whether the experiments with additives like talc and lignite will lead to shipping companies agreeing to carry these materials for addition to oil before discharging it at sea seems somewhat problematic. Much would depend upon the amount required; and it seems hardly possible for talc or lignite dust to act as 'trace-additives'. But is there some chemical solution to be discovered? In these days of surface-active synthetics and silicones, is there some substance to be found which when added in minute quantities to oil would either make the oil-mass disperse widely or sink readily?

Chemical Feeds

ANY years ago the phrase 'chemical food' brought an enticing ring, and several medicinal products were thus described. It is doubtful if any new product would be designated in the same broad terms today for in foods the presence of 'chemicals' is suspect by a good many people if tolerated for specific functions by the majority. The idea of 'chemicals' as foods-despite the universality with which sugar is added to dishes-has lost caste. Nevertheless in America there are signs that chemical feeding for farm animals is no slender possibility. Urea is already being used, more often than not in mixtures with molasses. Kansas research work seems likely to add phosphoric acid to the chemical menu. Good results using this substance in place of bone or defluorinated mineral phosphates for beef cattle feeding have been reported. Other promising work along the same lines has been done with lambs. One or two firms are already offering animal feed formulations based upon urea and phosphoric acid; as these two chemicals are often the basis of liquid fertilizers, the commercial potentialities for making animal feeds and liquid fertilizers on the same plant seem particularly good, though this dual-market prospect may good. still be somewhat long-term. There are two obvious snags. It must take quite a long time to build a confident market for liquid chemical animal feeds, for even a first-class record of successful testing will not immediately overcome prejudice against foods that seem like medicine in bulk'. Secondly, the ultimate demand may require the use of high-purity phosphoric acid, a requirement that does not apply to fertilizer use; if this difference develops, some of the economy of overlap in production will be lost.

Oil Claim Appeal

Sir Hartley Shawcross, Q.C., appearing for three Dutch oil companies, subsidiaries of Shell and Standard Vacuum, in an appeal against a dismissal by the Singapore War Claims Commission Board of a claim for £700,000, the value of oil seized by the Japanese, said in the court at Singapore 'that crude oil only became a war material when it was refined. If it were seized, it must be returned to the owner and indemnity paid.'

Pullman-Phillips Move

New Type Polyolefine Plastics

PULLMAN Incorporated announced on 7 February that it has signed a licence agreement with Phillips Petroleum Company to produce new types of polyolefine plastics.

In announcing the agreement, Champ Carry, president, said that it was not possible to state accurately at this time when the new facilities required for production would be in operation but it would be at least 18 to 24 months.

'This move, which continues our general policy of diversification, broadens the present base in the plastics field of our subsidiary, The M. W. Kellogg Company,' said Mr. Carry. 'Kellogg was one of the pioneers in the development of the fluorocarbon resins and for the past seven years has been commercially producing various fluorocarbon products under its registered trademark—Kel-F.' These include plastics moulding materials, dispersions, oils, waxes, greases, inks, acids, and a speciality rubber.

The Phillips polyolefines process differed from those used commercially for the production of hydrocarbon resins in that it employed a new type of catalyst which produced a unique type of polythene. The process is the first one developed for converting ethylene mixed with other olefines into resin materials.

Advantages Claimed

The polythene produced by this new process is claimed to be tougher and more heat resistant than that prepared by the present commercial technique. This toughness is manifested by higher tensile strenth, greater rigidity and higher impact strength. An advantage of this new plastic is the fact that it can be heated to sterilization temperatures without deformation. This opens a wide variety of possibilities not available to conventional polythene.

During the last decade, 'conventional' polythene has shown the sharpest production rise of any of the plastics. In 1955 it attained an estimated consumption rate of over 300,000,000 pounds per year—the entire output of the plastics industry will top 3,000,000,000 pounds. The applications of conventional polythene which were commercialized during World War II to meet a military demand for high frequency cable insulation, have been extended by the ad-

vent of the new type polythene into countless industrial and consumer products.

Based on a study of properties, preliminary opinions of authorities in the plastics industry are that the newer polythene will not only compete with the 'old' in certain areas of application but will also invade the markets of other plastics such as the styrenes, acetates and vinyls; and it will permit the fabrication of improved plastic products not previously possible because of limits imposed by properties or economics.

Segas Plant for Kent

Power-Gas Corporation Ltd. THE of Stockton-on-Tees is to construct a Segas catalytic oil-gas plant for the South Eastern Gas Board to be constructed at the British Petroleum Company's Isle of Grain site in Kent. The plant will have a capacity of up to 20,000,000 cubic feet per day of town gas and will supplement the existing supplies distributed through the grid system of the South Eastern Gas Board from Sittingbourne in Kent to Guildford in Surrey. It will be the largest cyclic catalytic gas making installation relying solely on oil as its raw material.

This type of plant has previously manufactured gas from heavy oil at York and from heavy oil distillates at Sydenham. Other Segas plants are now being built in this country and in Europe. The Isle of Grain plant will make use of refinery residual products such as heavy and light fuel oils, gas oil, light distillate and liquefied petroleum gases for manufacturing town gas and is expected to be in production by the autumn of 1958.

Infra-Red Symposium

A TWO-DAY symposium on the applications of infra-red spectroscopy will be held in the William Beveridge Hall, Senate House, the University of London on 9 and 10 April.

On the evening of 9 April an informal dinner will be held at the Connaught Rooms at which the speakers will be entertained. Fee for the symposium is, members 10s; non-members £3. Registration forms can be obtained from the Assistant Secretary (Infra-Red Symposium), Society of Chemical Industry, 56 Victoria Street, London SW1.

Chemical Exports for January

Increase Over Previous Month

Singapore

Kenya

Finland

Burma

Irag . .

Iran . . Total value of chemical

Hong Kong

exports

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BRITISH chemical exports for January 1956 increased from £19,695,706 in December 1955, to £20,165,782. Australia still remained the biggest importer despite a slight reduction in the value of chemicals imported from Britain during January. Closely following Australia were India and South Africa, each of whom spent more than £1,000,000. The demand for most commodities remained more or less constant during the month, although sales of sodium hydroxide, bleaching powder and ammonium sulphate showed a marked increase.

EXPORTS : PRINCIPAL COMMODITIES

	Jan. 1956	Dec. 1955	Jan. 1955
Acids inorganic (owt)	17 231	15 883	12 379
Conner sulphate (tons)	3 007	2 472	4 478
Sodium hydroxide	5,007	2,172	1,170
(cwt.)	467.274	285,492	501.055
Sodium carbonate	140,000 - 1997 - 1997	1000000-00 - 0000-000	
(cwt.)	370,269	364,971	365,543
Aluminium oxide			
(tons)	1,346	1,500	1,964
Aluminium sulphate			
(tons)	2,844	2,645	3,782
Ammonia (cwt.)	8,662	7,800	11,684
Bismuth compounds			
(lb.)	34,787	25,631	30,500
Bleaching powder			
(cwt.)	52,943	23,993	33,672
Hydrosulphite (cwt.)	3,949	3,508	7,117
Calcium compounds	21 201	24 277	24 (47
inorganic (cwt.)	31,391	24,277	34,647
Lead compounds in-	2 051	9 670	6 1 1 9
organic (cwt.)	2,951	0,079	0,110
Magnesium com-	1 097	1 400	1 102
Niekel celte (out)	4 750	6 705	4 680
Potossium compounds	4,750	0,705	4,000
(aut)	3 858	4 269	5 1 1 5
Acide organic & deri-	5,050	4,207	5,115
vatives (value in fs)	106 682	92 940	69 079
Ethyl methyl etc.	100,001	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0,015
alcohols (value in £s)	87.349	81.001	130.879
Acetone (cwt)	18,941	12.749	12.572
Citric acid (cwt.)	2.714	2,728	2,810
Sulphonamides un-		1000 C	
prepared (lb.)	79,746	93,807	145,479
Dyestuffs inter-			
mediates (cwt.)	5,142	6,607	4,437
Total for elements			
& compounds in £s	4,602,282	4,416,729	4,694,717
Cool ton (tons)	4 807	6 776	25 368
Coartar (tons)	266 259	257 661	208 013
Cressile acid (gal.)	1 281 517	979 988	613 741
creosole oli (gal.)	1,201,517	779,988	015,741
Total for tar pro-			
ducts in £s	248,960	252,388	365,302
Total for multi-			
duostuffs (out)	16 144	18 044	18 906
uyestuns (Cwt.)	10,144	10,044	10,700

Total for paints, p ments & tanni in £s	ig- ins	1,827,808	1,860,432	1,769,164
Total for medicin	nal			
products in £s		3,269,874	3,364,351	3,295,517
Total for essent	ial			
oils, perfumes, e in £s	tc.	2,238,610	2,189,902	1,900,199
Ammonium nitra (tons)	ite	548	464	1,113
(tons)		8,689	6,409	29,899
Total for all fer lizers in £s	rti-	287,829	189,227	671,810
Total for plast	ics	156 160	155 960	142 725
materials (cwt.)	••-	150,109	155,800	145,755
Disinfectants etc. (cw *Insecticides, fun cides & rodentició	(t.) gi-	13,905	12,231	14,460
(cwt.)	103	43,997		41,503
*Weedkillers (cwt.)		12,876		7,830
Lead tetra-ethyl (ga	1.)	406,883	393,957	308,324
* Previous totals n	ot s	given in this	form.	
V	- C -	D	Deserver	Currante
VALUE OF EXPORTS IN	v ts	: PRINCIPAL	BUYERS OF	Lon
		Jan.	1055	1955
Amatualia		1 665 646	1 878 000	1 657 028
Australia	•••	1,005,040	1 511 016	1 088 078
South Africa		1 211 368	940 995	1 195 772
Netherlands	•••	762 712	727.024	680,396
Italy		688,145	626,809	498,793
United States		636.527	629,490	702,637
Eire		636,370	560,839	621,000
New Zealand		572,730	564,587	725,798
Sweden		557,423	587,803	503,451
Nigeria		536,512	376,046	455,364
France	• •	525,649	503,605	547,441
Western Germany	•••	463,503	555,771	403,698
Pakistan	•••	445,134	505,239	455,002
Canada	•••	421,700	301 795	269 020
Egypt	•••	373 878	312 423	119,409
Relgium	•••	342 473	408.821	427,073
Malava		320,349	295,708	341,233
Norway		314,118	236,260	356,524
Denmark		310,439	326,258	369,776
Gold Coast		293,761	452,130	389,814

Paint Agreement

284,070

272,090

266,663

259,094

257,937

256,979

247 280

367,841

259,916

197,914

291,202

259,394

109,687

90,586

.. 20,165,782 19,695,706 19,907,828

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Denton Edwards of Barking, Essex, have signed an agreement with Tip Top Paints (Australia) giving the Australian company the sole right to manufacture and sell Dentolite self-sterilizing paint in Australia.

206,512

148.234

93.007

344

299

176

282 328

Industrial Safety Trophy

To be Awarded Annually

A TROPHY for industrial safety was presented to the Industrial Safety Division of The Royal Society for the Prevention of Accidents by Sir George Earle, C.B.E., the chairman of the Associated Portland Cement Manufacturers, at a ceremony at the Charing Cross Hotel, London, on 22 February.

The trophy, a Georgian inkstand with a space to contain a vellum book to record the names of the holders, will be awarded in May each year for an outstanding contribution to accident prevention.

Sir Howard Roberts, C.B.E., L.L., the president, who received the trophy on behalf of the society, said that it was distressing to note that the industrial accident rate continued to increase each year. In 1954, he said, 185,167 accidents were reported, compared with 181,637 in 1953 and 177,510 in 1952.

Among those who attended the ceremony were: Sir George Barnett, chief inspector of factories, Mr. R. A. Banks, personnel director, ICI Ltd., Mr. H. R. Payne, O.B.E., chairman of the National Industrial Safety Committee and the National Executive Committee, and head of the safety department, ICI Ltd., and Mr. B. L. Lelliott, M.B.E., chief welfare officer, Associated Portland Cement Manufacturers Ltd.

Entry for the award is open to all industries. companies, local accident prevention groups, and branches of the Institution of Industrial Safety Officers. Entry forms are available from the Secretary, The Royal Society for the Prevention of Accidents, Terminal House, 52 Grosvenor Gardens. London SW1.

Nuclear Heat Project

TESTS to determine the feasibility of using nuclear heat to produce gas from coal have begun at the US Bureau of Mines' Appalachian Experiment Station, Morgantown, West Virginia, it was announced on 25 January. These tests, which do not actually involve the use of nuclear heat, resulted from discussions between the Bureau of Mines and the Atomic Energy Commission regarding the use of nuclear heat in high temperature chemical processes.

The Bureau's immediate interest is in the gasification of coal. Coal gasification is a

first step in processes for producing synthetic liquid fuels from coal, and also in making synthetic pipeline gas from coal.

It has been decided that two experimental stations should be built, and one of these has been completed.

The objects of this preliminary work are:—(1) To determine suitable materials for constructing such units. (2) To determine their heat transfer characteristics. (3) To study other process variables.

Further developments in this field will depend on the outcome of this study.

4th Management Course

THE University of Cambridge has arranged a fourth course for managers in industry at the Madingley Hall from 25 June to 21 July. The course is open to managers who have had some years of industrial experience and are under 40 years of age.

Three main topics for discussion have been proposed; management and the changing structure of the national economy, human problems in industry, and Britain's international position. Lecturers from industry, from the university, and from elsewhere will provide the background.

The object of the course is to enlarge the outlook of managers, so that they can see their work (production, technical, sales, accounting etc.) against the background of the firm as a whole, of the industry, the community, and the state, and is intended primarily for managers who appear likely to reach high levels. Details of the course can be obtained from Mr. G. F. Hickson, M.A., the secretary, at Stuart House, Cambridge. The course will be limited to 40.

ICI Fibres Division

Imperial Chemical Industries Ltd. is forming a Fibres Division responsible to the fibres director, Mr. P. C. Allen, as from 1 April. The new division takes over responsibility for the manufacture and business of Terylene polyester fibre from the Terylene Council, which is being dissolved, and of Ardil protein fibre from the Nobel Division. The Fibres Division will be responsible for all the company's research and development work on man-made fibres, excluding nylon. The division's board will be the same as the Terylene Council as at present constituted, and its headquarters will be at Harrogate.

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Friedel-Craft Catalysts in Polymerization Techniques

by E. G. CURPHEY

FRIEDEL-CRAFT catalysts have found considerable success in the polymerization of olefines and di-olefines. Their earlier classical applications were of course associated with alkylation processes, and it was not until later that their significance in polymerization processes became apparent. The interpretation of the Friedel-Craft reaction, and the role played by the catalyst was in effect an indication of its possible application in polymerization processes.

The ability of AlCl₃, for example, to behave as an acceptor molecule and form a tetrachloride anion during Friedel-Craft reactions, alkylation being effected through an active carbonium, indicated a possible use in ionic generated polymerization mechanisms. Later Morgan and Walls used Friedel-Craft catalysts in cyclization processes and prepared phenanthridine derivatives; thus the versatility of such catalysts appeared to be established. In such reactions the final stage was accomplished through an E_1 displacement mechanism, which in polymerization processes became an E₂ mechanism.

Aluminium Trialkyls

Olefines may be dimerized using the aluminium trialkyls as catalysts. These dimerizations have been accomplished by heating a given olefine between 60 and 250°C using such catalysts. Employing such techniques, pentene has yielded 2-propyl-•hept-1-ene, utilizing aluminium tripropyl as catalyst (1). 2-methyl-pent-1-ene has been synthesized by mixing liquid propylene (100 Kg.) and aluminium tripropyl (10 Kg.) in a pressure vessel, the contents being passed under pressure through a tubular coil, maintained between 200-210°C, the contents remaining in the heated zone for about two hours, the resultant hydrocarbons being separated by distillation. By the integration of simple monomers by dimerization the preparation of useful intermediates may be envisaged.

Products useful as ingredients for adhesives, resin-based varnishes, moulding compositions and paper treatment, may be obtained by copolymerizing suitable 3:4dihydropyrans with olefinic hydrocarbons. Aluminium compounds in most of their reactions as catalysts behave as acceptor molecules, whether they function in the classical Friedel-Craft reaction, or the lesser known Meerwein-Pondorff/Oppenhauer reaction involving ketone and secondary alcohol. The organo-aluminium catalysts in the latter reactions appear to behave as electron acceptors, appropriating the 2p electrons from the carbonyl oxygen, thereby affording a reactive carbonium. The rate determining reaction in such mechanisms would appear to be the chelation phase, the active carboniums constituting the faster phases of the reaction.

Bulk & Solution Applications

Friedel-Craft catalysts like other organometallic catalysts find applications in both bulk and solution polymerization techniques. The familiar fact that aluminium chloride can undergo dimerization, suggests that in aprotic solvents such as hydrocarbon solvents it may behave as an ion-aggregate, in this way resembling in its mode of operation the more complex alfin catalysts (2). The latter catalysts comprising sodio derivatives of olefines and a primary alcohol together with sodium chloride, were used by Morton for the polymerization of butadiene. This worker postulated the mechanism of the polymerization as due to the formation of an ion-aggregate by the catalyst in the nonionic media.

About 1939, free sodium or potassium were used in the polymerization of butadiene, the process being a type of bulk polymerization process (3). These techniques, however, suffered obvious disadvantages such as poor heat dissipation and a lethargic induction period, possibly accredited to the slow co-ordination of the π electrons by the sodium. Mechanical aids were later devised, such as worm agitation, to overcome such drawbacks.

In such reactions the sodium atom prompted electron pairing in its 3s orbital by acquiring a π electron. In this way it could initiate a free radical polymerization reaction. In 1946 Morton *et al* (4) as a result of studies on the Wurtz reaction, polymerized butadiene using amyl sodium.

In the latter system the sodium appeared capable of acquiring π electrons, thus affording active carboniums. Conditions of allylic polymerization ensued to produce both 1,2 and 1,4 polymerized products. Like the Friedel-Craft mechanisms, the polymerizations really constituted intermolecular alkylations, the terminating reaction comprising a possible electrophilic displacement of the sodium by a carbonium in a polybutadiene chain, the sodium reverting to its lower 3s² configuration.

Considerable Progress

The study of Friedel-Craft catalysts in polymerization processes during such a period, however, had progressed considerably and several years before the advent of the uses of organic complexes in the polymerization of butadiene as illustrated by the Alfin catalysts, organo-metallic complexes comprising aluminium chloride and titanium alcoholates had already been used in the polymerization of olefines in inert solvents (5).

Commercially useful commodities have been obtained by the cyclization of natural rubber. The mechanism of the cyclization of natural rubber using acceptor molecules has been essentially postulated from analogous studies of the simpler terpenic structures. Tiemann as far back as 1900 successfully cyclized geraniolene to cyclogeraniolene using sulphuric acid (6). Many years later Bloomfield, investigating the cyclization of dihydromyrcene, postulated a Whitmore type mechanism, involving active carboniums, as a conceptual basis for the nature of such reactions (7).

Natural rubber has now been cyclized using aluminium chloride, stannic chloride, boron trifluoride and ferric chloride. This cyclization, in consonance with the mechanism prevailing for other cyclizations, is one of alkylation through a transient carbonium. The alkylation is intra-molecular in nature, no gelation being observed during the process.

The cyclization is accomplished by reaction at adjacent isoprene moieties, so that six membered rings may be formed. The catalysts in the reaction behave as accepter molecules; thus boron trifluoride by virtue of its lone 2p orbital, the latter resulting after hybridization to the Sp² state after reaction with halogen, is capable of acquiring π electrons into this vacant orbital.

With isoprene fragments, boron trifluoride would react in the following way:—

$$\begin{array}{c} CH_{3} \\ -CH_{2} - C - CH - X = acceptor molecule. \\ \cdot \cdot \\ + X \end{array}$$

Cyclized rubbers containing accelerators etc. afford useful bonding agents. They may be dissolved in gasoline containing three to five per cent butyl alcohol and used as rubber-metal bonding agents, Cyclized rubber adhesives have also been used for bonds between polymethyl methacrylate and a rubber material.

The application of Friedel-Craft catalysts is not strictly limited to cyclization processes, and these catalysts have featured in condensation reactions involving natural rubber and saturated and unsaturated fattv acids. The products so obtained are claimed to be useful as plastics, dielectric materials and as ingredients in waterproofing.

Such rubber derivatives may be prepared by reacting unvulcanized rubber with stearic acid, using tetrachlorethane as solvent. The catalyst is slowly added to the agitated contents of rubber and acid, the whole then being refluxed at 140°C. Graft polymers may also be prepared on both natural and synthetic rubbers using the alkoxydiolefines (5), aluminium chloride etc. being used as catalyst.

Polymerization of Ethylene

Organic derivatives of aluminium feature in polymerization processes and ethylene has been polymerized using aluminium ethyl dihydride, the structure of the polymer prepared depending upon the conditions of polymerization and the type of activators, between 160 and 220°C using used: these type activators, mixtures of oleobtained. Aluminfines have been ium trialkyl is alkylated by ethylene, excess ethylene yielding a range of complex hydrocarbon radicals. The presence of a methyl group in the olefinic linkage tends to reduce the ionization potential of the π electrons, this being sponsored by the hyperconjugative characteristics of the methyl group, and supports the attractive concept that isoprene-type monomers would

readily polymerize in the presence of acceptor molecules,

Polymerizations performed at low temperatures are important because they tend to give the higher molecular weight polymers, which are more symmetrically polymerized than when the reaction is accomplished at the higher temperatures. It might be suggested that aluminium chloride behaves as an active ionic complex in inert solvents, in much the same way as the Alfin catalysts (*loc.cit*) behave in pentane.

Aluminium chloride polymerizations are successfully effected under cryoscopic conditions, and olefines and di-olefines have been polymerized or co-polymerized in inert freezing solvents. In performing such polymerizations, AlCl₃ (four parts) is dissolved in 100 parts of solvent at a temperature of 12° C. Equal parts of this solution and liquid propylene may then be mixed in the presence of carbon disulphide at a temperature of -78° C (8).

The polymerization is completed at the end of half an hour and plastic polymers having molecular weights between 2,000 and 4,000 are obtained. The concentration of catalyst is of some importance in the polymerization of such olefines, below 0.4 parts of aluminium chloride per 100 parts of solvent being unsatisfactory.

The reactivity of aluminium chloride at such low temperatures may possibly be related to the number of ionic centres exposed on the surface of the catalysts complex. On such an assumption a polymeric chloride complex would react with a monomer in the following way:—



It is the polypolar nature of the aggregate that would suggest polymerization at the lower temperatures, more regular products being obtained in systems of reduced entropy. In such low temperature techniques, internal refrigerants find application, these preferably vaporizing at the desired polymerization temperature. External refrigerants such as liquid ethylene have also been employed.

No reaction mechanism appears to have

been postulated for these polymerizations. A conceptual basis for such reactions may be that of the formation of active cations which extend outwardly from the axis of the catalyst chain, such chains ultimately ejecting a proton, the latter effecting an electrophilic displacement at, for example, the halogen to sponsor an E_2 mechanism.

High molecular weight polymers prepared at temperatures around -10° C from olefines and/or di-olefines are described in BP 611255 and BP 611256 respectively.

Styrene has been copolymerized with such monomers as 2-methyl pentadiene, myrcene and allo ocimene using Friedel-Craft catalysts. In this way polymers have been prepared having molecular weights varying from 2,000 to 30,000 (9). The copolymers produced can vary in their degree of unsaturation this depending upon the nature and amounts of polyene utilized.

Weather Resistant

Copolymers with iodine numbers above 100 oxidize and therefore harden with age, and so find use in weather resistant compositions. They may be applied in solutions of petrol naphtha. The copolymers have been recommended for use in electrical insulations.

The modulus of GRI rubber is improved by the inclusion of a 30 per cent styrene/ 70 per cent 2-methyl pentadiene resin.

Styrene and isobutylene have been copolymerized between -10° and $-80^{\circ}C$ in the presence of aluminium chloride. Copolymers from indene and other alkenes and isoalkenes have also been prepared by this method. Such copolymerizations may be carried out as bulk or solution processes, the reactants being cooled to the desired temperature, the catalyst being then added.

The copolymers formed from styrene and isobutylene monomers have been used as plasticizers for the tough GRN rubbers. The incorporation of stybutenes (50 to 60 per cent combined styrene content) in quantities around 20 per cent of the GRN being plasticized, permits not only of easy milling but of the facile compounding of the ingredients being incorporated. GRS can be similarly plasticized.

Even tough copolymers containing 35 per cent acrylonitrile can be made processable by the incorporation of the stybutenes. In GRS compounding operations, the time of incorporation of the ingredients may often be reduced by one third (10).

Such monomers as the methylene dioxolanes have again been polymerized in the presence of Friedel-Craft catalysts either in bulk or solution processes; the acrylonitrile copolymers may be used as plasticizers for other polymers in the production of filaments, films, and moulding products, such copolymers being the hardest products so far obtained.

The polymers produced can vary from sticky clear materials to brown rubbery products, the properties of the resulting polymers depending upon the catalyst employed in the polymerization. Thus CdCl₂ yields colourless sticky products, whilst SnCl₂ affords rubbery-type materials.

These new polymeric resins have manifold applications. Their use may include the production of non-transparent films for packaging, rainwear and draperies. Additional uses embody coatings for fabrics, paper and leather and their inclusion in adhesives (11).

Polymers having ether linkages have been obtained by the polymerization of suitable Friedel-Craft cyclo oxabutanes using catalysts. The polymerization is strongly exothermic and proceeds without the incipient aid of heat to yield polymers having fragments denoted by (I), X and Y being inert groups. The presence of hydroxyl groups in such positions, would lead to cross-linking and detract from the desirable characteristics of the resulting polymer.



These ether polymers are stable products, from which films and sheets can be made, the suitably crystalline ones being spun fibres. The nature of the substituents X and Y make important contributions to the properties of the resultant polymer. When the substituent is halogen the polymers exhibit a highly crystalline structure and are non-inflammable possessing good insulating properties. When X = Cl and Y is O.OC.CH_a, the resulting polymer is a hard clear resin (12).

Polyisobutylenes may be obtained under cryoscopic conditions using Friedel-Craft catalysts and methyl chloride as solvent (13) and waxy polymers have been obtained by solution polymerization using Friedel-Craft catalysts and isobutylene oxide (13). The integration of the simpler molecules by dimerization and ultimate polymerization appears fundamentally attractive as a facile, continuous, process for the production of elastomers.

Isoprene & Butadiene Homologues

Useful dimers obtained by the dimerization of acetylene and olefine monomers, under appropriate conditions, could yield isoprene and butadiene homologues. The latter monomers could then be integrated to appropriate polybutadiene derivatives. The synthesis of isoprene has in fact been achieved by the co-polymerization of acetylene and propylene in the gaseous phase using BF_3 in water maintained at temperatures between -20 to 40°C (14).

There is a tendency for HCl to be liberated in polymerizations involving AlCl₃ and this is known to be a retarding factor in such reactions as the polycondensations of isocyanates and glycols. In the production of polyurethanes, the addition of glycol across the -N:C: bond in Micheal addition fashion is apparently retarded by the presence of free acid. In polymerization processes involving aluminium chloride. lubricating oils prepared by such techniques have displayed irregular viscosity factors. and the higher molecular weight polymers suitable as possible elastomers, have displayed undesirable variations in tackiness and elasticity, so imparting to the elastomer. unpredictable physical characteristics.

Developments to surmount these difficulties have been made, whereby the harmful influence of free acid may be attenuated. In the polymerization of olefines or of their copolymerizations with such di-olefines as isoprene etc., improved products have been procured by the introduction of alkali metals (15).

Aluminium chlorides can be used as a catalyst in the synthesis of siloxanes (16). of examples reactants being the dialkyldichlorosilanes and the ethers. Dimethyl dichlorosilane with anisole gives PhOSi(Me)₂Cl (II). This reaction is probably based on the existence of a positive silicon atom, formed as a result of an aluminium chloride anion; reactions of the second order would yield (II) this involving

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an electrophilic displacement at the ether linkage, the existence of the active positive methyl being curtailed by immediate reaction with an AlCl₄- anion.

$Me_2(Cl)Si^+ + MeOPh \rightarrow Me_2(Cl)SiOPh + Me^+$ $Me^+ + AlCl_4^- \rightarrow MeCl + AlCl_3$

This type of reaction is of particular interest when the ether involved is cyclic in nature as for example, tetrahydrofurane. A by-product of the siloxane synthesis is then 1:4-dichlorobutane, which can be reacted with sodium cyanide to give adiponitrile. Assuming no steric hindrance, utilizing alkyl furane homologues would yield the corresponding substituted alkyl adiponitrile intermediates. Using such derivatives as starting materials, the polyamides may be prepared.

Carbon monoxide can be reacted with olefines in the presence of aluminium chloride to give resinous compounds, the resulting polymers having carbonyl groups. Polyaminopolyethylene polymers may then be obtained by means of the Leukart reaction, which involves reaction of the carbonyl with formamide or a formamide releasing substance. These polymers have found useful applications in textile operations, where, for example, the shrinkage of wool may be considerably reduced. Other applications embody their use as peptizing agents for rubber and in the treatment of leather to enhance the dye-susceptibility of the latter. Such properties are probably associated with the amino groups.

Waterproof Paper

The hydrophobic nature of the molecule renders these polymers useful also in the impregnation of paper, making the latter These materials have water repellent. therefore found important uses in fixing acid dye-stuffs to fabrics and paper. Other applications include their uses as anti-fogging agents for glass and also their important applications as anti-static agents for polythene.

The properties of the resultant polymer will to some extent depend upon the ratio of carbon monoxide used in the original polymerization. Assuming for example that the anti-static properties of a given polymer may be related to the number of polar groups extant, such properties being possibly related to the tendency of the nitrogens to increase their covalency with vicinal carbons, then increasing the carbon mon-

oxide content within practical limits would on the simplest of assumptions tend to improve the antistatic properties of the resulting polymer.

Finally research has been directed to the synthesis of polymers obtained fron benzyl chloride, with aluminium chloride as catalyst.

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Chemical Patents Figures

FIGURES issued by Information for Industry Inc. of the US reveal that in 1955 the number of chemical patents issued to 271 firms in 21 countries and their colonies, and in two US possessions, totalled 6,065, of which 636 were issued by the US Patent Office. Second to the US in the number of patents registered was England with 179, followed by Germany (172), Switzerland (86), and France (51).

Fields covered by the patents awarded to 1,168 companies included oil, petroleum, lubricants and fuel (1,662 patents); coatings paint, varnish, lacquer, enamel etc. (778); pharmaceuticals (615); metallurgy (540); textiles (475); agricultural chemicals (386); rubber (377); food (310); glass (269); paper (241); photography (209); and atomic energy (203).

Gas From Sewage Waste

THE LCC are planning to use gas produced from sewage sludge to drive gas turbines at the northern outfall sewer in Beckton, east London. About 7,000 tons of sludge are produced daily and this will be used to supply 2,500,000 cubic feet of gas, mainly methane, daily. The plant will be completed in 1958.

It is anticipated that 16,000 tons of Diesel oil fuel will be saved every year.

Active Mineral Products

Attapulgus Range Now Available in UK

THE range of active minerals processed by the 'Attapulgus Division of the Minerals & Chemicals Corporation of America, 210 W. Washington Square, Philadelphia 5, Pa., is now available in this country. Previously the dollar problem had prevented their ready purchase in Europe. The UK agents are Dominex Ltd., 29 Queen Street, London EC4, who are acting on behalf of Hermann Bensmann, Bremen.

It was Hermann Bensmann who, at the end of the last century, drew the attention of the oil industry to the possibility of using mineral decolorizers. He referred especially to a complex form of aluminium magnesium hydrosilicate known as attapulgite, of which large deposits had been found in the United States. At first the industry was slow to adopt this material, but eventually came to appreciate its worth. Bensmann registered the trade mark Floridin for this product.

Natural Fullers Earth

Floridin is a natural fullers earth and is available in a variety of mesh grades to suit different purposes. It is used in a large number of refining and processing operations, including lubricating oil, wax and petroleum decolorization.

Data sheets put out by the Attapulgus Division of Minerals & Chemicals Corp. describe some of the materials manufactured from attapulgite. Attapulgite is the principal mineral constituent of the fullers earth clay which is only mined in south west Georgia and north west Florida.

Caking and agglomeration of industrial and agricultural chemicals can be prevented by the use of Attasorb, it is claimed. Attasorb is a uniform, ultra-fine, highly sorptive and chemically inert product having an acicular (needle like) structure. It is also recommended as a grinding agent.

Caking of hygroscopic or waxy materials has been eliminated, says the data sheet, simply by tumbling the material with about 0.5 per cent Attasorb.

' Small percentages of Attasorb may be added to a large number of substances to prevent caking during transit. Some typical examples are as follows:---

Ammonium nitrate, metallic and other soaps, napalm, insecticides and fungicides, urea, resins and plastics, gums and waxes. barium salts, detergents and surface active agents, pharmaceuticals, dyes and sulphur.

A colloidal form of attapulgite is also produced, and is sold under the trade name of Attasol. Great stability is claimed for suspensions of this material in concentrated aqueous solutions of electrolytes.

Attasol is compatible with caustic soda, soda ash, silicates and phosphates which are used as adjuncts in washing severely soiled fabrics, and may be used in place of part or all of the soap customarily used. It is claimed to be especially efficient in the washing of fabrics heavily soiled with greases, oils, dyes or inks, and its substitution for a portion of the soap and alkalis results in longer fabric life and more brilliant appearance of the washed fabric.

Attaclay is another form of attapulgite made by the Attapulgus Division. As produced, the total volatile content of Attaclay does not exceed six per cent and consists of water of crystallization. In handling, small amounts of moisture may be picked up, but this does not appear to affect its properties in any way.

Carrier & Diluent

Attaclay is recommended as a carrier and diluent for the formulation of insecticides, fungicides and other agricultural chemicals. Its ability to accept and carry large amounts of liquid or low melting point solid toxicants would enable processors to make highly concentrated formulations which are dry and lump free more efficiently than with other known carriers or diluents.

Claimed to be the ideal bodying and thickening agent in organic or water systems is Permagel which is one of the newest products developed by the Attapulgus Division. Permagel is said to be capable of gelling a wide range of petroleum base oils and synthetic lubricants.

The Personal Factor in Accident Prevention

by A. G. THOMSON

 $\mathbf{A}_{ ext{ted}}^{ ext{N}}$ accident is essentially an unexpected and unpremeditated event; hence the circumstances contributing to it can only be investigated after it has occurred. Occasionally the cause is fairly well defined, but more often it is extremely complex. Analysis will usually reveal the existence of two main groups of causes, one being impersonal (relating to the building, machine or object) and the other personal (relating to one or more persons, who may or may not be the actual victims). At the one extreme are accidents caused by failure of material, such as the bursting of a pressure vessel, and on the other those due to carelessness.

It follows that accident prevention can be accomplished in two ways: by climinating or reducing the hazards presented by working conditions, machinery or equipment; or by eliminating the predisposing cause through study of the personal factor. Nowadays it is widely realized that for an industrial safety campaign to be fully successful, both approaches must be adopted. It has been stated by HM Factory Inspectorate that, no matter how well machines are guarded, we cannot look for a reduction of more than 10 per cent in the accident rate by the provision of safeguards alone.

Importance Overlooked

For many years, progress in accident prevention was made chiefly through the study of the impersonal factor. Such aspects as safety devices, guards for machinery and machine design were constantly under investigation. Yet the part played by the personal element in accident causation was apt to be overlooked.

The statistical study of the condition now widely known as accident proneness was initiated by Greenwood and Woods in 1919, when they investigated the frequency with which accidents occurred in groups of women engaged in various machine operations required in the manufacture of shells.

They found that, while many of the women suffered no accidents at all, others

suffered once or twice and a few of them more frequently. It was postulated that this might be due to one of three possible causes. The distribution of the accidents incurred might have been the result of simple chance. Alternatively, the workers might have started with an equal chance, but the worker suffering one accident by pure chance might then have had her probability of suffering further accidents increased or decreased. The pain and inconvenience might have made her more careful and so reduced her liability, or it might have increased her nervousness and thereby predisposed her to more accidents.

The third possibility was that the workers did not, in fact, start equal, some being more liable to suffer accidents than others.

Hypothesis Tested

The investigators tested their hypothesis by comparing observed accident frequency in a number of instances with the frequency calculated to occur according to the three distributions postulated. It was found that two-thirds of the women concerned suffered no accidents at all, about one-fifth suffered one accident, and one-fifteenth two accidents. Twenty six women suffered three to five accidents, whereas on a purely chance distribution it was calculated that only eight of them should have suffered these multiple accidents (1).

Another method employed by Greenwood and Woods to investigate accident proneness was to compare the accident rate of groups of women in two successive intervals. For instance, 136 women who had no accident in February 1917, had only 0.16 per month during the next five months, while 62 women who had one or more accidents in February suffered 0.35 accidents, or more than twice as many, in subsequent months.

Greenwood and Woods realized that the study of accident proneness might lead to a simple and practical method of reducing the accident rate. 'There are some instances,' they reported, 'such as branches of the explosives supply trade, in which accidents may lead to frightful disaster. Nine times out of ten, perhaps ninety-nine times out of a hundred, a trivial cut or scratch is the sole consequence; the tenth or hundredth time the consequence is appalling. The results here described point a moral. Trivial accidents are indications of unsafe people, whom the record of the ambulance room can be employed to discover'.

Detecting 'Unsafe People'

An important step forward would be taken if means could be found for detecting these 'unsafe people', so that they could be employed only on work which offered little opportunity of injuring themselves or others.

Unfortunately accident proneness is too complex a condition to be expressed in terms of carefulness or carelessness, of workers whose fingers are all thumbs while others are nimble, or of persons who are scatterbrained whole others are circumspect.

Fraser and Chambers applied 'aesthetokinetic' tests to six groups of workers, totalling 650 people, who were engaged in different occupations. The results of the tests, which involved the performance of simple movements, were compared with accident records of the subjects the examined. Subsequently this study was extended to 1,800 apprentices in the workshops of certain naval and RAF establishments. According to the investigators, there was reason to believe that the tests actually did measure some factor in accident proneness, a supposition which was supported by the fact that a significant degree of correlation was found among the figures recorded for the various groups. The accident rate of the worst 25 per cent was about $2\frac{1}{2}$ times as great as that for the remaining 75 per cent.

Although much progress has since been made in the identification of accident-prone persons by means of psychological and other tests, we have not yet reached the stage where even the most highly skilled psychologists can identify persons who are accident-prone, or likely to be so, with any degree of certainty. The most reliable method of identification is still by keeping accurate records of all accidents incurred, however trivial.

It has also to be remembered that accident proneness is not a characteristic which a particular individual possesses to an unvarying degree. The condition is one which is liable to be affected by changes in bodily condition. It is influenced by external changes of environment and also by internal changes of physical and mental health.

Newbolt in her study of accident causation (2) collected sickness records at a number of factories where accident data were available and investigated the relationship between the two sets of figures. She found that accidents were probably even more an indication of an inclination to report sick and a disinclination to work than of actual sickness. They are a measure of lower general health and vitality.

It has long been recognized that a relationship exists between accident incidence and both output and fatigue. The faster one works the greater the number of accidents, and the more weary one becomes when working at the same rate, the greater the rate of misadventure.

In 1920, the US Public Health Service published a report embodying the result of an investigation into 46,000 accidents in two engineering plants. The main conclusions were that although, in the absence of fatigue, accidents might vary directly with the speed of production, owing to increased exposure to risk, the regular variation was broken up by fatigue, which played an important part in accident causation.

Qualitative Resemblance

investigation into more than In an 50,000 accidents incurred in munition factories in the United Kingdom, Vernon found a strong qualitative resemblance between the rate of output curve and the accident incidence curve during the day He concluded that the varying shift. speed of production was largely responsible for the day shift variations of accidents. and not fatigue. He recognized, however. that fatigue might nevertheless be an important contributory cause, as was indicated by the fact that during a period when a 12 hour day and 75 hour week were being worked, the accidents incurred by women workers were 2¹/₂ times more numerous than during a subsequent period when the daily hours were reduced to 10 (3).

Evidence that variations in the speed of production were conducive to accidents was afforded by laboratory experiments conducted in 1921, in which two tests of muscular precision involving eye-hand coordination were applied to workers, the speed at which they were performed being varied to a known extent by means of a metronome. These experiments tended to show that accuracy of movement, while constant throughout spells up to $2\frac{1}{2}$ hours when the speed of performance was constant, decreased rapidly when the speed of performance was increased.

By comparing the accident incidence on the day shift with that on the night shift at the same factory, it was found that such influences as alertness and attention had an important bearing on industrial safety (3). Whereas during the day shift the accident curve followed the output curve very closely, in the night shift it was at a maximum at the beginning, then fell sharply, and finally sank to less than half the original value. Furthermore, the total accident rate was lower by an average of 16 per cent with no decrease in output. These differences were ascribed to psychological influences, the assumption being that the night workers started work in a careless and excited condition and gradually settled down to a calmer mental state than the day workers.

Age & Experience

Age and experience also have a significant influence on the accident rate. Greenwood and Woods make the obvious point that youth and inexperience coincide to a large extent, since the majority of new entrants to industry are young people. Irrespective of this natural tendency, there are certain qualities of youth (such as bravado, failure to realize danger etc.), which tend to disappear with increasing age. The example was cited of an American young steelworks where men were employed with other men in occupations likely to produce many cases of short-term disability. In this works the accident frequency rate for workers under 20 was twice that for workers aged 20-29 and more than three times that for workers aged 30-39.

Information relating to 29,000 accidents incurred during the period of a year in the manufacture of motor cars, railway cars, coke and gas, showed that accidents were much more numerous during the summer months, while the number of new employees varied in a more or less corresponding fashion. It was concluded that if the labour turnover could have been

reduced to zero, the number of accidents would probably have diminished by 75 per cent.

These findings, which have been substantiated by the results of subsequent investigations, emphasize the importance of adequate training and supervision when new workers are enrolled.

Mental Attitude

Accident proneness is greatly influenced by mental attitude and predisposition. Recorded data indicate that accident-prone persons are often liable to be insubordinate and to disregard regulations such as reporting for duty. They may also be temperamentally too excitable with a tendency to be flustered and do the wrong thing in an emergency. Domestic worries and other pre-occupations may result in accidents.

Alcohol is a factor which cannot be wholly disregarded. Vernon showed that diminished neuro-muscular control followed the consumption of alcohol, except in moderate quantities, though there was a marked difference in this effect according to circumstances. As would be expected, a subject used to alcohol would be less affected than a total abstainer, while alcohol taken on an empty stomach has a much greater effect than when taken with food.

External conditions, such as environment, were early found to have a close relationship to the incidence of accidents. For example, self-protection from a potential danger depends on rapidity of view, which in turn is affected by the nature of the lighting at the time. Inadequate or unsuitable lighting is responsible for bad work and also leads to accidents. It has been said that the proportion of scrap produced in a factory is a direct measure of the efficiency of the lighting.

Statistics collected in the United States are reported to indicate that of 91,000 accidents tabulated, no fewer than 24 per cent were due to imperfect lighting. British workers have found that on an average there are 25 per cent more accidents during hours of artificial light. Accidents due to foreign bodies, such as metal particles and emery powder in the eye, appear to be specially influenced by lighting, apparently because workers tend to bend nearer to their work when the light is poor and so expose their eyes more freely. Temperature also has a considerable influence on the accident rate. A continuous record of temperature over a period of nine to 12 months was obtained at a projectile factory and a shell factory by means of thermocouples. The smallest number of accidents occurred at 67° F. With fall in temperature the number of accidents increased gradually and at 52° F accidents were 35 per cent more numerous. Above 72° F they increased very rapidly with men and slightly less rapidly with women.

It is evident in studies of accident causation account must be taken of a larger number of variables, and that the effects of individual factors cannot readily be determined. Industrial life is so closely integrated that it is impossible to examine by any direct method a single factor in complete isolation, although there are indirect methods by which certain variables can be controlled.

Correlation Techniques

The correlation techniques most frequently used in accident research to provide qualitative estimates of the accident behaviour of individuals from one period of time to another have recently been reviewed by Teel (4). After discussing their advantages and limitations. Teel refers to a less widely used technique which he describes as 'more adequate'. It involves the correlating individual's scores on theoretically related predictor variables (such as intelligence, physical condition etc.) with the accident rates. In actual practice this approach has yielded typically low correlations.

Teel emphasizes the need for a more sensitive criterion measure, such as could be provided by systematic information on 'new accidents' and the behaviours involved. A second refinement he considers to be greatly needed is better differentiation between 'personal' and 'situational' accidents. In theory situational accidents, such as those caused by material failure. occur independently of the personnel involved. They could not, therefore, be predicted from a knowledge of personnel factor variables only.

A third requisite for more meaningful studies of personal factors in accidents .s considered to be systematic collection of more complete information on exposure. Wherever possible, records of the time spent in performance of various aspects of the job should be maintained, for they provide a basis for determining relative hazards. If adequate data were available it would be possible to determine the risk per unit of time for each part of a job. An index of experience could then be drawn up for each person which would weigh his experience in the various phases of the job by the risks associated with each.

Analysis of accidents and interpretation of the data is a difficult task, particularly when dealing with the complexities of human behaviour. In the investigation of such complicated factors as accident proneness. the trained psychologist is making a contribution of growing importance to accident prevention. Organizations such as the National Institute of Industrial Psychology are also promoting industrial safety by their work on the location and elimination of sources of friction or discontent in factories, which are apt to be reflected by disgruntled workers, reduced efficiency and an accident rate which is higher than average for particular operations.

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Heat Exchangers Orders

AMONG recent orders received by Brown Fintube (GB) Ltd. a subsidiary of Birwelco Ltd. of Aston, Birmingham, was one from the Kellogg International Corp. for a quantity of multiple section heat exchangers to be used in the processing of hydrocarbon gases of relatively low molecular weight at the Wilton Works of Imperial Chemical Industries Ltd. Some of the exchangers were designed and constructed to withstand operating temperatures as low as minus 310°F.

Another order is for a number of heat exchangers to be supplied in collaboration with Etudes et Recherches Industrielles of Brussells, and the Lummus Co. Ltd. for a new petrochemicals plant at Antwerp to be operated by the Societe Chimique des Derives du Petrole (Petrochim), and which is scheduled to go on stream this year.

Safety Notebook

A NEW safety-type fluid is now being used in the hydraulic systems of deckedge elevators on US Navy aircraft carriers it was announced recently by Celanese Corporation of America whose chemical division produces the fire-resistant fluid. Use of the product, which minimizes fire and explosion hazards, followed comprehensive testing in Celanese laboratories.

Marketed under the name Cellulube 220, the new safety-type fluid is a straight chemical synthetic (non-petroleum) oil. The fluid was used during 1955 aboard the US Navy carriers Bennington, Shangri-La and Ticonderoga. Cellulube 220 will also be used in the new CVA-60 Saratoga, which is due to be accepted by the Navy in early Spring. Fire-resistant fluids are also scheduled for use on carriers now under construction, as well as on other carriers now in service which will be converted on a shipavailable basis.

Mr. R. W. KixMiller, vice president and general manager of the Celanese chemical division, said that production requirements for Cellulubes were being met currently by facilities at Newark, New Jersey. Mr. Kix Miller said these facilities would be supplemented by a new Celanese chemical plant, now under construction near Point Pleasant. West Virginia, which will start large volume production by mid-Spring.

*

THE Dustfoc 55 Respirator made by Mine Safety Appliances Company Ltd., Queenslie Industrial Estate, Glasgow E2, has been introduced to meet the need for an efficient lightweight respirator in industry. It is claimed to have 25 per cent less weight, 50 per cent less breathing resistance, 25 per cent decreased maintenance, and to be 35 per cent smaller than earlier types on the market. It has a 'static web' filter and a counter gravity air flow.

Problem most commonly met in the introduction of respirators in a plant is the refusal of employees to wear the unit; the Dustfoe 55 is designed to meet the criticisms offered by such wearers. It weighs less than 3 oz. which meets the criticism of weight; the 50 per cent reduction in the width of the filter holder eliminates a 'blind spot' area and improves the downward vision. Reduction in length eliminates interference when bending downward. The filter is made of charged resin-treated felt. Dust particles coming into contact with the filter are charged by the dipole formed by the charged resin and fibre of the felt, giving electro-static retention of the dust and supplementing the mechanical filtering action of the fibres. No pre-filter is used, the one medium doing the entire job.

There are 10 engineered parts to the respirator which allows for fast and easy dismantling and cleaning and allowing regular 'laundering'. For applications where skin-abrasing dusts are involved, a special knitted cotton facelet is provided to be worn with the respirator, fitting over the sponge rubber of the face cushion.

Also being made by Mine Safety Appliances is the MSA Toxic Gas Detector which is claimed by the makers to be the most advanced development in the field of gas detection. By changing the tube and graduated scale it is possible to obtain readings for any one of five toxic gases. The instrument is pocket size and lightweight and has been designed to be used by untrained workers. Typical limits of sensitivity for some gases are: hydrogen sulphide, 0.0025 to 0.04 per cent by volume; sulphur dioxide, 0 to 50 ppm; and carbon monoxide, 0.001 to 0.10 per cent by volume.

* * *

IN the period 22 December to 20 January the Ardeer factory of ICI's Nobel division achieved 1,000,000 man hours without a lost time accident. This is the first time such a record has been established in this plant. The Nobel division is operating a drive to reduce time losses arising from industrial accidents.

Safety Notebook

CLOSED circuit television was used during the Safety Week at the Wallerscote works of ICI's alkali division in Cheshire to bring home the idea of industrial safety to workpeople. A studio was built in the works machinery warehouse and three industrial TV cameras were hired. Ten receivers were set up in various parts of the works.

From the Monday to Friday of Safety Week there were three programmes every day—15 minutes at 11.45 a.m. and 12.30 p.m. and 10 minutes at five p.m. The midday show usually took the form of light entertainment with only a passing reference to safety, but the other two programmes were based on news about the Safety Week, talks by the workers and staff on safety, and interviews with visiting personalities.

Statistics showed that two workers out of every three at Wallerscote could expect to get through their working lives without a lost time accident. The phrase 'Don't be the Third Man' became the slogan of the Safety Week.

It was found that industrial television could be used to put over industrial safety with an impact which it would be difficult to equal with any other medium.

* * *

A VERDICT of death by misadventure was returned at a Dewsbury inquest, held on 3 February, on William Pepper, aged 38, a chemical process worker employed by the Mirvale Chemical Co., Mirfield. Pepper died as the result of acute pulmonary oedema compatible with the inhalation of ammonia fumes, according to the evidence.

A fellow plant operative, Richard Milton. said that while working at the naphthalene distillation plant at about 7.50 p.m. on 22 January he heard a 'plopping' sound as if steam had blown. He saw Pepper lying on the floor and fumes coming from the suction side of the compressor. He managed to get Pepper out of the building within three to four minutes of hearing the plopping sound.

The works manager said that it was discovered that a cross-head valve joint was leaking at two points and the gas was coming out under pressure. The coroner.

who commended Milton for his prompt and efficient action taken in the face of considerable danger, said that it had emerged that there was no error of manipulation by the deceased, and apparently there was no means by which anyone in charge could have anticipated such a fault.

* * *

THE Birmingham and District Industrial Safety Group, which has, since 1953, successfully operated an Industrial Safety Training Centre, has now acquired premises of its own within a short distance of the Birmingham City Centre and is at present adapting them for use as a new training centre. There will be a large machine room in which practical demonstrations and tuition can be given, a lecture and cinema room, and adequate open space on which it is hoped to give instruction and training in the handling of power driven industrial trucks, fork lift trucks, etc. It is proposed to continue the present series of courses for power press operators.

Other courses will be organized for supervisors and foremen, electrical installation and maintenance workers, for those engaged on lifting and slinging heavy objects, and other subjects where a comprehensive course of training may be expected to reduce the risk of injury to operators.

It is anticipated that the new centre will open in April of this year and a special syllabus is at present being prepared for distribution to safety officers, works managers, personnel and welfare officers, etc., to acquaint them with the new programme. Copies will be available towards the end of March and will be gladly supplied on application to the honorary secretary of the Group, S.A.F.E. House, 22 Summer Road, Acocks Green, Birmingham 27.

DECHEMA Annual Congress

The DECHEMA annual congress will be held in Frankfurt am Main from 6 to 9 June, 1956. The main theme of the series of plenary lectures to be delivered at this congress will be 'The Basic Principles of Chemical Engineering as Applied to Chemical Reactions on a Large Scale". The 9th meeting of the European Federation for Chemical Engineering will also be held in connection with the DECHEMA annual congress.



ANTI-COMPOSITION TABLES FOR CARBON COMPOUNDS. By H. H. Hatt, T. Pearcey & A. Z. Szumer. Cambridge University Press, London. 1955. Pp. 191. 21s.

Tables of the theoretical elementary compositions of series of organic empirical formulae are very familiar time-savers. The process of spoon-feeding the organic chemist is continued by this volume of anti-composition tables which provides the reserve boon. By means of this compilation the found composition figures of a compound of unknown structure may be used to derive an empirical formula with the minimum of effort. The inevitable experimental error in elementary analysis might at first sight appear to limit the usefulness of such tables, but in practice this ambiguity is not serious. For a number of test analyses, allowing an error margin of \pm 0.3, about 10 possible formulae were derived from the tables for each example. In every case, however, a knowledge of the context of the work eliminated the obvious monstrosities to leave only two or three firm possibilities.

The gain in convenience over the trial and error procedure hitherto necessary is impressive, and the reassurance that no possible formula has been overlooked is a marked advantage. The arithmetic of the tables was carried out by an automatic computer and the results printed directly by a technique photolithographic process, a eliminating proof-reading errors. This volume covers compounds of the compositions CH, CHO, CHS, and CHOS up to those containing fifty carbon atoms. It is good to know that a further compilation covering nitrogen compounds is in preparation. The book should obviously be available to all organic research workers and this end is furthered by its remarkably low price. -R. A. RAPHAEL.

THE CHEMISTRY OF MICRO-OGANISMS. By Arthur Bracken, Sir Isaac Pitman & Sons Ltd., London. 1955. Pp. 343, 30s.

The modest title of this comparatively small book gives all too little indication either of the wealth of fact which it contains or of the facile manner in which many widely different facets of the general topic are presented. Despite the statement that this text is intended both for the qualified and the unqualified reader, probably only the former will be able to appreciate the volume of structural, biological, biochemical and to a lesser extent medical, technical and industrial detail which is probably assembled here for the first time. Perhaps some impression will be conveyed by mentioning that over the 13 chapters some 350 leading references are given while the subject index contains about 3,500 entries.

The emphasis is almost throughout on the derivation of the structural formulae of specific organic compounds of microbial origin and the book makes no pretence to be 'practical' either from the chemical or biological view-point. It is no mean achievement to have welded into one entity chapters as diverse, as for example, ' Micro-Organisms and Enzymes', 'The Story of Colouring Penicillin', 'Pigments and Agents' and ' Micro-Organisms in a Changing World' (largely concerned with the study of micro-organisms on newer conceptions such as the tropolone system, cell adaptation and general aspects of antibiotics).

Indeed the canvas is so large that logical cohesion can scarcely be expected and indeed one finds a well-balanced account of penicillin succeeded by one on streptomycin and other antibiotics with emphasis on the elucidation of structure. This is followed in turn by 'Pigments and Colouring Agents' which incidentally contains no mention of yeast pigments and then by a valuable semi-systematic account of aliphatic, aromatic and heterocyclic compounds of microbial origin. At a late point the 'inorganic' chemistry of micro-organisms is discussed although actually much even of this chapter is devoted to a miscellany of organic compounds such as gliotoxin chloramphenical, aspergillic acid, geodin and griseofulvin. The latter is representative of a number of compounds which some may think are discussed at somewhat disproportionate length as compared, say, with yeast fermentation which is quite briefly dismissed in Chapter IV but even if this be the case the accounts are always clear, amply illustrated and refreshingly up-to-date and accurate

Without doubt this is a book which for its topicality, size, price and information value deserves to be widely read and consulted. It probably has no rival in terms of convenience and coverage even among much larger works.—A. H. COOK.

METHODEN DER ORGANISCHEN CHEMIE, Houben-Weyl). 4th Edition, Volume IX. HERSTELLUNG UND UMWANDLUNG VON SCHWEFEL-, SELEN-UND TELLURVERBIN-DUNGEN. General Editor, E. Müller. Georg Thieme Verlag, Stuttgart. 1955. Pp. xxxxi + 1337. DM 218 (Subscription Price DM 196.20).

Organic compounds containing sulphur are of unusual interest not only for the academic worker but also in industry. Dyestuffs, rubber accelerators, pesticides and chemotherapeutic agents containing this element are becoming of increasing importance and recent work has shown that sulphur compounds also play a major part in It is therefore surbiological processes. prising to find that the documentation of this branch of organic chemistry has received but scant attention; there is little to guide the research worker through the complex maze of sulphur compounds apart from a few isolated review articles and a book on the oxygenated derivatives. Volume IX of the new edition of 'Houben' will therefore receive a warm welcome.

Most textbooks of organic chemistry regard sulphur as a poor relation of oxygen and pay little attention to the fascinating complexity of the derivatives of the former element. This complexity is due to the larger number of valency states exhibited by sulphur, as well as to the greater stability of the sulphur-sulphur bond; both these factors not only increase the diversity of sulphur compounds but also explain the high reactivities of many of these substances. The task of surveying this large field is of no mean magnitude, and the compilers of this volume, are to be congratulated on the way in which they have impressed order and clarity on a vast mass of material.

In this book the organic compounds of sulphur are arranged in order of the valencies exhibited by this element, and the volume therefore opens with chapters on mercaptans, thiophenols, hydrogen polysulphides, disulphides, polysulphides, thioethers and ethylene sulphides. A section on sulphonium compounds is of special interest in view of the importance of these compounds in biological methylation. It is followed by chapters on mercaptals, sulphoxides, sulphones, sulphenic acids, sulphinic acid and the derivatives of these compounds. In view of the importance in industry of the sulphonic acids and their derivatives, it is not surprising to find that more than 300 pages are devoted to this sub-Here the material extends over several ject. chapters, one of which gives a useful survey of sulphochlorination with a mixture of sulphur dioxide and chlorine. Later chapters deal with thiosulphonic and thiosulphinic esters, thioaldehydes and thioketones, and mono- and di-thiocarboxylic acids. The section on sulphur compounds ends with a lengthy chapter on carbonic acid derivatives. which supplements the discussion of sulphurfree carbonic acid derivatives found in Volume VIII.

The last 300 pages are devoted to the organic chemistry of selenium and tellurium. This is discussed in some detail and the reviewer was surprised to find that so much research had been done on these toxic and often highly unpleasant compounds. It is clear, however, that many gaps remain to be filled before a detailed comparison can be drawn between the organic chemistry of these elements and that of sulphur.

In most of the chapters the literature has been surveyed up to the end of 1954, though some of the articles give more recent references. The careful coverage of the patent literature deserves special mention. As in previous volumes of the new 'Houben' the text is clear and concise, frequent use being made of tables. The reviewer and his colleagues have found this book of considerable value in their researches and can recommend it with confidence.—J.C.P.S.

HOME .

Plan Lancashire Factory

A. Boake, Roberts & Co. Ltd., chemical manufacturers of Carpenters Road, London E15, are seeking permission to build a factory on an 80-acre site at Castle View Farm, Widnes, Lancs.

Glass Research Laboratories

Sir Harry Pilkington, chairman of the St. Helens glassmaking firm, opened new research and development laboratories costing £200,000 at St. Helens on 21 February. He said it was significant that the Chancellor had not removed the investment allowance on research. Research was at the top of the priorities because it showed a greater return than any other expenditure.

Persia Buys British

A Persian Government scheme to train more scientists has resulted in the British firm, Quickfit & Quartz, of Staffordshire, gaining their largest ever order for glass laboratory equipment. The order, for nearly 28,000 pieces of laboratory equipment which includes almost every piece of apparatus in the company's range, is valued at several thousands of pounds.

'Science Review' Film for Loan

Baird & Tatlock (London) Ltd. announce that the film on their 'Analmatic' automatic laboratories is available for loan to societies and organizations. The film is taken from the BBC television programme on automatic laboratories which appeared in 'Science Review' last year.

Chemist to Lecture in Italy

At the invitation of the University of Naples, the British Council has arranged for Dr. H.W. Thompson, lecturer in chemistry at Oxford University, to visit Naples from 1 to 4 March to lecture under the Foreign University Interchange Scheme. He will also lecture at the universities of Rome and Bologna.

Tonnage Oxygen Plant

The tonnage oxygen plant which the British Oxygen Co. will build at Lackenby, near Middlesbrough, is expected to cost £500,000. It will supply steel and chemical plants in the area, and is scheduled to start up early next year. The plant canacity of about 250-300 tons a day will make it the biggest unit in the UK. The site covers 12 acres.

Manchester Office

Hoechst Chemicals Ltd. have opened a branch office at 75 Piccadilly, Manchester.

Coalite Make Catechol

A. Boake, Roberts announce that on 1 March Coalite & Chemical Products Co. Ltd. took over the manufacture and distribution of catechol.

Refinery Column En-Route

The largest refinery column ever built in the UK is now en-route for Venezuela. The £50,000 column, 141 ft. long, 19 ft. 2 in. in diameter, will form part of the catalytic cracking unit now being built for Compania Shell de Venezuela's refinery at Cardon. It was built by G. A. Harvey & Co., of London.

New Steel Laboratories

The new £75,000 laboratories of the British Steel Castings Research Association, now under construction in East Bank Road, Sheffield, are expected to be ready for occupation in the autumn. The Association comprises about 50 concerns, and research will now be centralized under one roof. A floor area of nearly 12,000 sq. ft. will contain offices, library, experimental foundry, laboratories, and workshops.

Preparing Plans

William Openshaw Ltd., chemical engineers, Grange Works, Cheadle Road, Cheadle Hulme, Lancashire, are preparing plans for a factory and office building to be built at Bradnor Road, Northenden, Manchester.

Purchasing Officers' Conference

The Purchasing Officers Association will hold a London Regional conference at the Connaught Rooms, Great Queen Street. Kingsway, London WC2, on Saturday, 21 April, from 10.30 a.m. to 4.30 p.m. In the morning, Sir Donald Perrott, K.B.E., will speak on 'The Impact of Atomic Energy on British Industry'.

Fuel Research Station

Mr. Bevins, parliamentary secretary to the Ministry of Works, recently stated that a site for a new fuel research station had been selected at Stevenage. He said that the preparation of plans and estimates was progressing and it was hoped that work would begin on the site in 1957.



Refinery for Bordeaux

The president of the Bordeaux Chamber of Commerce has announced that Esso-Standard is to build an oil refinery in the area. Oil from the Parentis field is at present shipped to the company's refinery at Le Havre.

Export Sulphur Cheaper

The Freeport Sulphur Company of New York have announced that their export prices have been reduced to \$ 28 per ton for bright sulphur and \$27 for dark sulphur fob Port Sulphur, Louisiana, thus illiminating the differential hitherto existing between domestic and export prices. These lower prices apply to tonnage loaded on or after 13 February.

Israel's Plastics

Dr. A. Markovitz, the director of the Israeli Chemicals Department of the Ministry of Commerce and Industry, said at the recent founding convention, in Tel Aviv, of the Chemical Products Research Organization, that Israel's plastics industry now has an annual turnover of IL.4,000,000.

Aluminium Scrap

The Government of India has decided that the import of aluminium scrap, having a purity of 99 per cent and above, would be liberally licensed from soft currency areas to all categories of importers during the current half-year. A portion of these licences will also be validated for imports from the dollar area.

Geiger Counters on the Rhine

Geiger counters are to be installed along the River Rhine where it flows through German territory. This decision was made by the community of waterworks in the lower Rhine area in order to detect radio-active pollution of the water. Control of the river's water is necessary because the first German atomic reactor is being built near the Rhine at Karlsruhe.

Canadian Nylon Resins

Du Pont of Canada Ltd. is planning to produce moulding powder at its nylon plant at Kingston, Ontario, to meet increased demand. At present, the resins are imported from the US. Broader markets for Zytel nylon resins have also resulted in the second price reduction in less than a year.

Fluorocarbon Products Agents

The Saint-Gobain Co., manufacturers of glass and industrial and agricultural chemicals, has been appointed the exclusive agent in France and spain for the sale of The M. W. Kellogg Co.'s range of fluorocarbon products.

Ethylene Glycol Plant

Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp., has announced that provision is being made for the additional production of 65,000,000 lb. of ethylene glycol at its Seadrift, Texas, plant. This will bring the total ethylene oxide capacity of the plant to more than 200,000,000 lb. per year. This company has developed commercially more than 100 derivatives of ethylene oxide.

Titanium Dioxide Plant

A plant for producing titanium dioxide is being built by the Bayer Farben Works in Urding, West Germany, at a total cost of DM 100.000,000. The first of the plant's buildings are to go into operation by the end of 1957. The output of the new plant is expected to cover the entire West German demand for titanium dioxide and to make some available for export.

Synthetic Rubber Factory

A factory for producing synthetic rubber using nationally-produced alcohol as its base is to be set up in Miranda de Ebro. at a capital cost of Ptas. 400.000.000. A total annual production of 8.000 tons is anticipated. Of the machinery to be used. Ptas. 98,000,000 worth will be Spanish and Ptas. 95,000,000 imported.

Canadian Cement Output

Mr. J. M. Breen, president of the Canada Cement Company said at the company's annual meeting that the total productive capacity of the Canadian cement industry by the end of 1956 will be about 37,000,000 barrels. This figure exceeds anticipated consumption by a wide margin. In 1955. 27,000,000 barrels were consumed.

MEK Plant for US

Shell Chemical Corporation are building a methyl ethyl ketone plant at Norco. Louisiana, US, with a capacity of 40,000,000 lb. a year. The plant is expected to come into production early in 1957.



MR. A. G. NORTH, technical manager of Cray Valley Products Ltd., is touring Scandinavia where he is delivering a series of lectures on thixotropic alkyds.

Fisons Ltd. announce that MR. C. E. HORTON, C.B.E., M.A., their director of research, has been appointed a director of the company.

MR. J. L. ARMSTRONG, finance director, is retiring from the board of Imperial Chemical Industries Ltd. on 29 February. MR. P. T. MENZIES, has been appointed an additional director as from 24 February, and will take over the duties of finance director on 1 March.

MISS JOYCE TOOTHILL, B.SC., A.R.I.C., a chemist and spectrometist at the West of Scotland Agricultural College, has been awarded the Ph.D. degree by London University for a thesis on organic chemistry.

MR. WALTER A. HAMILTON has joined the Nuclear Development Corporation of America (NDA), of White Plains, NY. Last month Mr. Hamilton resigned from the staff of the Joint Congressional Committee on Atomic Energy to enter private industry. His most recent assignment was as the executive secretary of the panel on the impact of the peaceful uses of atomic energy, which reported to the Joint Committee on 31 January. Mr. Hamilton served as staff member for reactor development to the Joint Committee for several years, in which capacity he kept the committee appraised of the status of reactor development in the US and elsewhere.

MR. CHARLES WILLIAM HOTCHEN has been appointed to the newly created post of works manager (production) at the factory of Smith Aircraft Instruments Ltd., Cheltenham. Mr. Hotchen, who served his apprenticeship at the Royal Ordnance Factory, Woolwich from 1929 to 1934 before joining Negretti & Zambra Ltd., was, from 1948 to 1950, chief engineer of the components division of Plessey Co. Ltd. In 1950 Mr. Hotchen joined the aviation division of S. Smith & Sons (England) Ltd. as assistant works manager. MR. ALFRED READ, C.B.E., F.C.I.S., who has been secretary of Powell Duffryn for the past 30 years, relinquished that office at the end of February 1956. He has been succeeded as secretary from 1 March by MR. ALFRED TURNBULL PURSE, LL.B., F.C.I.S., who is at present the assistant secretary of the Company. Mr. Read will continue to be a member of the Powell Duffryn board of directors.

Obituary

The death is announced of MR. QUENILUS C. RUSSELL, the proprietor of Bryce & Rumpff, chemical merchants, of Robertson Street, Glasgow, with whom he had been associated for more than 58 years.

The death is announced at Glenburn of MR. JAMES KING STEEL, B.Sc., A.R.I.C., A.R.T.C., head of the research laboratory at the Anchor Mills, Paisley. of J. & P. Coats Ltd., since 1929. He was closely associated with the firm's research activities and had made frequent trips abroad.

DR. ERNST A. HAUSER, professor of chemical engineering at the Massachusetts Institute of Technology and an internationally-known authority on colloid science, died at his home at Cambridge. Mass., on 10 February, at the age of 59. Dr. Hauser, who was born in Vienna, Austria, and became a naturalized American citizen in 1941, was awarded the degree of doctor of philosophy by the University of Vienna and an honorary doctorate in science by Worcester Polytechnic Institute. He began his career as an assistant at the University of Goettingen, Germany. He served as a research chemist from 1922 until 1925, when he was named chief chemist of the Colloid Laboratories of Metallgesellschaft. From 1932-35, he was chief chemist of the Austra-American Rubber 'Semperit' Works Ltd., in Vienna. Before coming to the US, Dr. Hauser was non-resident associate professor of colloid chemistry at MIT from 1928-31. He became a resident associate professor of chemical engineering at the Institute in 1935, and a full professor in 1948. Author of numerous books and

papers on colloids and allied chemical fields, Dr. Hauser received citations and honours from scientific societies throughout the world. He was a fellow of the American Association for the Advancement of Science, American Institute of Chemists, Institution of the Rubber Industry (London). and the New York Academy of Sciences; and a member of the American Chemical Society, National Research Council, American Institute of Chemical Engineers and the Society of the Chemical Industry (London).

Bryce & Rumff

Messrs. Bryce & Rumff, chemical merchants, 62 Robertson Street, Glasgow, C2, announce the death of their principal, Mr. Q. C. Russell, who had a life-long connection with the chemical trade. It has been decided that Mrs. Russell, who has for many years been actively associated in running the business, will continue to manage it and that it will be carried on as before.

Knock-Rating of Petrol

Two British Standards Published

THE British Standards Institution announces publication of a new volume 'Determination of Knock-rating of Motor Fuel' comprising two standards; B.S. 2637: Determination of Knock-rating of Motor Fuel (Motor Method), and B.S. 2638: Determination of Knock-rating of Motor Fuel (Research Method).

It has been demonstrated through years of research that no single laboratory test can be used as an accurate measure of the knock characteristics of a motor fuel. The tendency of the fuel to knock varies in different engines and depends on the weather conditions, the adjustment of the spark, carburettor, etc. and the design, condition, load and particularly the speed of the engine. When used in a given engine, the complete knock characteristics of a given motor fuel can be determined only by running the fuel in that engine under varying operating conditions.

B.S. 2638. Determination of Knockrating of Motor Fuel (Research Method).

This is technically identical with IPI26/55 and technically equivalent to ASTM D.908-53.

The Research Method of Test, which is also known at the CRC-F1 Method, is intended for determining the knock characteristics of fuels for use in sparkignition engines in terms of an arbitrary scale of octane number (ON) under relatively mild conditions.

The Research ON of a fuel must not be taken as a measure of the performance of the fuel in any engine, but may be used in conjunction with the Motor ON, B.S.0001, to determine the 'sensitivity' of the fuel, that is, the difference between its research and motor ON. This is a measure of the response of the fuel to a specific change in the severity of engine conditions.

These two British Standards are published in one volume which is available from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 6/-.

Iso-Flow Orders

RECENT orders for Petro-Chem Iso-Flow Furnaces placed with the British Licencees. Birwelco Ltd., of Chester Street, Aston, Birmingham, include units for installation at Bahrain, Grangemouth, Stanlow and Ellesmere Port.

E. B. Badger & Sons Ltd. have placed an order for a Radiant Convection type hot oil heater for heating heavy alkylate from 525 to 650° F with a throughput of 290,000 lb. per hour. The furnace will be oil fired.

Caltex Services Ltd. have ordered for one of their associated companies a Radiant Convection type fractionator and reboiler heater for heating hydrocarbon liquids with 40 per cent vaporization at an outlet temperature of 540°F and a throughput of 271,000 lb. per hour.

Cabot Carbon Ltd. have ordered a Radiant Separate Convection type heater for heating carbon black raw material at Ellesmere Port and George Wimpey & Co. Ltd. have ordered an all Radiant type heater for heating Dowtherm to an outlet temperature of 617°F at the rate of 46,000 lb. per hour. This will be gas fired.

Brazilian Nitro-Fertilizers

Brazil's first nitro-fertiliser factory, now under construction, is expected to be in production by August 1956. The factory will use residual gases from the adjacent refinery and will cost some \$7,000,000. Scheduled daily output is 375 tons of fertilizer. This is more than Brazil's present consumption.

Publications & Announcements

THE British Plastics Year Book, which is claimed to be the only classified guide to products and manufacturers in the plastics industry, has this year been revised and extended to 740 pages. As before, it is divided into nine sections of which three are devoted to classified lists of manufacturers and suppliers of materials, finishing products and equipment. A further section contains a list of trade and proprietary names connected with the plastics industry, covering materials as well as finishing products. Each trade name is followed by a definition of the product, the manufacturer concerned, and, where the manufacturer is overseas, the country of origin. A glossary of technical terms used in plastics is also included in this section. In the names and addresses section are listed nearly 4,000 firms associated with plastics, grouped into countries. Names and positions of prominent people in the industry are given in the Who's Who section.

RECOMMENDED practice when aluminium is used in contact with other materials is described in the ADA Information Bulletin No. 21, 'Aluminium in Contact With Other Materials', published by the Aluminium Development Association, 33 Grosvenor Street, London W1, price 2s. The selfhealing oxide film on aluminium gives this metal good corrosion resistant properties. When, however, it is used in conjunction with other materials some simple precautions are sometimes required, and this pub-A brief lication gives these precautions. description is given of the causes and types of corrosive attacks and it discusses the practical means of preventing corrosion, such as use of inhibitors and jointing compounds. the method of cathodic protection, the use of cladding and metal spraying, and refers to the advantages of all-aluminium construction. A section of the publication describes the behaviour of aluminium in contact with specific materials such as iron and steel, nonferrous metals, and non-metals.

ADVANTAGES and disadvantages of silicone rubbers are discussed in a brochure 'A Pattern to Make It Possible', published by the Dunlop Rubber Company, Cambridge Street, Manchester 1. The one great

advantage of silicone rubbers, says the brochure, lies in their retention of physical properties over a wide range of tempera-In their outward characteristics tures silicone rubbers are similar to conventional rubbers; they can be stretched, bounced and deformed, and can be converted by moulding, extruding, calendering or spreading into a variety of forms. Photographs in this brochure illustrate the use of silicone rubbers in scientific research, and in the chemical, pharmaceutical, electrical, engineering, motor, printing and radio industries, On the last page is a warning about certain limitations inherent in silicone rubbers. They are not suitable for use with kerosine, petrol or aviation fluids, and should not be used with live steam at pressures exceeding a few pounds per square inch.

A NEW electronic thermometer manufactured in Germany by Ultra Kust Geratebau is now being marketed in this country by Headland Engineering Developments Ltd., 164-8 Westminster Bridge Road, London SE1. Four models are available at present, covering the temperature ranges 25°C to 45° C (for medical use), -10° C to 110° C, -50° C to 160°C and 0°C to 210°C. On request they can be supplied with Fahrenheit markings. The probe element is a germanium based alloy semi-conductor 0.25 mm in diameter. Exchange can be effected rapidly. Extension cables of any length can be fitted. The instrument is about the size of a folded $\frac{1}{4}$ plate camera and weighs less than $2\frac{1}{4}$ lb. It operates off a $1\frac{1}{2}$ volt standard torch battery and a 22.5 volt hearing aid battery. Accuracy is claimed to be of the order of $\pm 1^{\circ}$ C. The distributors claim that temperatures of emulsions, solids, liquids, powders and gases can be measured in a matter of seconds.

NEW qualitative and quantitative methods or improvements in existing analytical techniques involving the use of iodine and its compounds are described every month in the scientific literature of the world. The Chilean Iodine Educational Bureau has now published a bibliography which classifies 367 of the more important papers published during a period of two years, 19531955. Their subjects range from the determination of the edibility of fish to the estimation of lithium in air. The list of references is numbered and arranged alphabetically according to the names of the elements, radicals and compounds which are determinable by the new procedures. Following the list is an index to the headings of the divisions in the bibliography.

ALIPHATIC di-esters have been found by Esso Petroleum Co. Ltd., 36 Queen Anne's Gate, London SW1, to provide a solution to the problem of lubricating modern jet engines says an article in the current issue of the Esso Magazine. In modern aircraft great variations of temperature are often encountered in a very short time. Ground heating equipment and flight cooling apparatus can reduce this temperature range, but, save the article, it is clearly preferable that lubricating oils for aircraft should be independent of the need for such equipment. It was found that no one petroleum oil could be produced capable of meeting all the requirements. The lubricant had to be such as to enable a jet engine to start at -40° C, and to provide efficient lubrication for very high temperature bearings (around 300°C), and give equivalent performance in propeller reduction gears to that of current aviation piston engine oil. After many substances had been tested, certain di-esters were found to have the necessary properties, and eventually a new lubricant was evolved and given the name EEL 3. The writer says that the efficiency of this oil has been proved by many hundreds of thousands of flying hours. It is now known as Esso Aviation Turbo Oil 35. It is used in all the latest British military gas turbines and is the accepted lubricant on which current engine designs are based.

*

ACID, alkali, oil and solvent resisting cements and coating compounds are described in a leaflet published by Acalor (1948) Ltd., Kelvin Way, Crawley, Sussex. These include the latest types of synthetic resin cements and plastics compounds and membranes. Among formulations which may be mentioned are: Acolor No. 11 anticorrosive cement for resisting dilute acid and alkaline conditions, Acolor No. 21 which is resistant to both acids and alkalis and is for application to concrete, steel, wood etc. and Acalastic PLE which is apolythene material suitable for tank linings and fume ductings. Enquiries can be answered by the Acolor advisory service which, it is claimed, consists of a qualified staff of corrosion specialists.

* *

CONTROLLED crystallization b١ the Krystal process is the subject of a new brochure published by The Power-Gas Corporation, Stockton-on-Tees. This process was invented by Finn Jeremiassen, a Norwegian engineer and physical chemist. and is sometimes known as the 'Jeremiassen' or 'Oslo' process. A supersaturated solution of uniform temperature is conducted upward through a dense bed of crystals, which are held in suspension by this upward flow of liquor. This arrangement provides an automatic classifying action as the largest crystals are suspended in the bottom layer of the bed and the smallest crystals in the top layer. The plant is available in several different forms to suit different purposes. The cooling crystallizer is used mainly for salts which have steep solubility curves, e.g., copper sulphate pentahydrate and magnesium sulphate heptahydrate. Advantages may be obtained in the vacuum crystallizer process by making use of the heat of crystallization if positive. In this variation of the process evaporation and crystallization take place in one vessel, bringing an immediate saving in the floor space occupied. Power-Gas hold the manufacturing rights for the Krystal apparatus for the whole world, excluding the North and South American continents and Scandinavia.

WHAT are believed to be the first data to be published on the manufacture of polvpropylene by a new catalytic technique are contained in Belgian patent 538,782, filed 6 June 1955 and published 8 December 1955. The patent was issued to Karl Ziegler of Germany and the Montecatini Company of Italy and describes the process, giving 31 examples, details of catalyst, process conditions and properties of the polymer produced. Belgian patents are granted without examination for validity and are frequently available before patents in other countries. A translations of this patent has been prepared by Chemonomics Inc., 270 Park Avenue, New York 17, NY, and is available at a price of \$45.00. Further details can be obtained from Chemonomics.

Next Week's Events

MONDAY 5 MARCH

RCI (London)

London: Chemical Society's Rooms, Burlington House, Piccadilly W1, 6.30 p.m. 'The Production & Uses of Sequestering Agents' by J. T. Aiken, Ph.D.; R. L. Smith, B.Sc., Ph.D., A.R.I.C.; and N. E. Topp, B.Sc., Ph.D., A.R.I.C.

The Chemical Society

Leicester: University College, 4.30 p.m. 'Liquid Crystals' by Professor Brynmor Jones, Ph.D., Sc.D., F.R.I.C.

Cardiff: Department of Chemistry, The University, 5.30 p.m. 'Melting & Crystal Structure' by Professor A. R. Ubbelohde, M.A., D.Sc., F.R.S.

SCI (Yorkshire)

Leeds: Chemistry Theatre, The University, 6.30 p.m. 'New Developments in Inorganic Chemistry' by Professor R. S. Nyholm, D.Sc., F.R.A.C.I., A.R.I.C.

TUESDAY 6 MARCH

Society for Analytical Chemistry

Birmingham: The University, 7 p.m. 'Modern Qualitative Analysis & Industrial Practice' by Professor Dr. C. J. van Nieuwenburg.

Royal Institution

London: 21 Albermarle Street W1, 6 p.m. 'Colloids & Their Behaviour' by Sir Eric Rideal, M.B.E., M.A., D.Sc., F.R.S.

Institution of Chemical Engineers

London: Geological Society, Burlington House, Piccadilly W1, 5.30 p.m. 'The Development of Mixer-Settler Equipment for Liquid-Liquid Extraction' by B. T. Bell. and F. Roberts, B.Sc., A.I.Chem.E.

WEDNESDAY 7 MARCH

Institution of Chemical Engineers

Birmingham: Midlands Institute, 6.30 p.m. 'Recent Developments & Their Future Trends in Petroleum Refining Technology' by F. W. Harvey.

RIC (London)

London: Chelsea Polytechnic, Manresa Road SW3, 6.30 p.m. 'Analytical Chemistry, Chemical Analysis & the Analyst' by R. C. Chirnside, F.R.I.C.

Reading: The University, 7.30 p.m. 'Recent Advances in Acetylene & Allene' by Professor E. R. H. Jones, Ph.D., D.Sc., F.R.I.C., F.R.S.

Royal Society of Arts

London: John Adam Street, Adelphi

WC2, 2.30 p.m. 'The Debt of Chemstry to Medicine' by Sir Charles Dodds, M.V.O., M.D., D.Sc., F.R.I.P., F.R.S.

THURSDAY 8 MARCH

RIC (London)

London: West Ham College of Technology, Romford Road E15, 'Chromatography' by Tudor S. G. Jones, B.Sc., Ph.D., A.R.I.C.

The Chemical Society

Dundee: Queen's College, 5 p.m. 'Chemical Engineering & its Place in the University' by Professor K. G. Denbigh, Ph.D., F.R.I.C.

SCI (Bristol)

Bristol: The University, Woodlands Road 8, 7 p.m. Annual general meeting.

SCI (London)

Southampton: Chemistry Department, The University, 7.30 p.m. 'The Production & Properties of Titanium & Its Alloys' by Dr. N. P. Inglis, M.I.Mech.E., F.I.M.

FRIDAY 9 MARCH

Royal Institution

London: 21 Albermarle Street W1, 9 p.m. 'Radioactive Isotopes & Their Applications' by P. I. Dee, C.B.E., M.A., F.Inst. P., F.R.S.

Oil & Colour Chemists' Association

Liverpool: Bradford Hotel, 6.30 p.m. 'Styrenated Alkyds' by E. A. Bevan, B.Sc., F.R.I.C.; W. Moon, A.M.C.T., A.R.I.C.; and M. J. Heavers.

The Chemical Society

Birmingham: The University, 4.30 p.m. 'Some recent Trends in the Synthesis of Coloured Substances' by Dr. H. T. Howard.

Dublin: Trinity College, 7.45 p.m. 'The Spontaneous Formation of Structure in Solutions of High Polymers' by Dr. C. Robinson, B.Sc., F.R.I.C.

Swansea: Chemistry Department, The University, 5.30 p.m. 'Some Recent Developments in the Chemistry of Free Radicals' by Professor D. H. Hey, D.Sc., F.R.I.C., F.R.S.

SATURDAY 10 MARCH

Institution of Chemical Engineers

Manchester: Reynolds Hall, College of Technology, 3 p.m. 'Efficiency & Wetting Characteristics in Perforated-Place Columns' by Professor F. H. Garner, O.B.E., B.Sc., Ph.D., M.I.Mech.E., F.R.I.C., M.I. Chem.E.; S. R. M. Ellis, Ph.D., F.R.I.C., A.I.Chem.E.; and J. W. Hill, A.I.Chem.E.

Law & Company News

Commercial Intelligence

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

Mortgages & Charges

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

PLASTICS IMPROVEMENTS LTD., Worthing. -24 January, debenture to Martins Bank Ltd. securing all moneys due or to become due to the bank; general charge.

THOS. CLARKE & SONS (CLARDYE) LTD., Loughborough, dyers.—20 January, charge, to Barclays Bank Ltd. securing all moneys due or to become due to the bank; charged on dyeworks, seven cottages and a house at Devonshire Square, Loughborough. £5,500. 20 May 1955.

Satisfaction

BARBADOS GAS CO. LTD., London EC.— Satisfaction 27 January, of debentures registered 22 April 1947.

Increases of Capital

SHELL CHEMICAL CO LTD, St. Helens Court, Great St Helens, London EC3, increased by $\pounds7,000,000$, in $\pounds1$ ordinary shares, beyond the registered capital of $\pounds3,000,000$.

G. W. (PHARMACEUTICALS) LTD., 180 Chadderton Road, Oldham, Lancs, increased by $\pounds 1,000$, in $\pounds 1$ ordinary shares, beyond the registered capital of $\pounds 500$.

EDWARD GURR LTD., manufacturers of pharmaceuticals, drugs, etc. 42 Upper Richmond Road, London SW14, increased by $\pounds 24,000$, in $\pounds 1$ ordinary shares, beyond the registered capital of $\pounds 1,000$.

SWAN CHEMICAL CO. LTD. 40 Brazennose St, Manchester, increased by £9,000 in £1 ordinary shares, beyond the registered capital of £6,000.

R. GRAESSER LTD. manufacturing chemists, carbolic acid manufacturers, picric acid

makers, coke, tar and gas production, tar distillers, etc., Chemical Works, Sandycroft. Chester, increased by £80,000, in £1 shares (ordinary), beyond the registered capital of £100,000.

Changes of Name

BRITISH PETROLEUM CHEMICALS TRUSTEES LTD. Devonshire House, Mayfair Place, London W1, to British Hydrocarbon Chemicals Trustees Ltd., on 30 January 1956.

New Registrations

Fisons Properties Ltd.

Private company (561,538). Capital £1.000 in £1 shares. To acquire land, etc. Subscribers (each with one share): S. A. Soore Smyth and Marian Beadle, of 6. Austin Friars, London, EC2.

J. & J. Colman Ltd.

Private company (561,568). Capital £100. To carry on (inter alia) the business of chemists, druggists, drysalters, oil and colour men, manufacturers and converters of and dealers in starch, starch products, mustard, mustard products, chemicals, drugs, soaps, perfumery, toilet preparations; blue and other colours; polishes, dressings and blackings etc. Subscribers (each with one share):

A. M. Bell and G. G. Williams of 18 Austin Friars, London EC2.

Reckitt & Sons Ltd.

Private company (561,576). Particulars are similar to J. & J. Colman Ltd. (q.v.). (Capital £100 in £1 shares).

Nugget Polish Co. Ltd.

Private company (561,573). Capital £100 in £1 shares. Other particulars are similar to J. & J. Colman Ltd. (q.v.).

Harshaw Chemicals Ltd.

Private company (561,226). Capital £100 in £1 shares. To carry on the business of manufacturing, disposing and marketing of chemical and related substances of all kinds etc. Subscribers: T. P. Walmsley and Geoffrey G.Williams, of 18 Austin Friars, London EC2. The first directors are not named.

[continued on page 552

SAFETY IN THE CHEMICAL INDUSTRY

Articles on Non-sparking Tools, Safe Floors, Bursting Discs, Fire Precautions, Protective Clothing, etc., have and will be regularly appearing in THE CHEMICAL AGE.

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New Registrations

continued from page 550]

Construction Chemical Co. Ltd.

Private company (561,735). Capital £500 in £1 shares. To carry on the business of manufacturers of building materials and chemicals etc. Subscribers (each with one share): Isaac Norvick, 83 Reedley Road, Bristol 9, chemical engineer, Mrs. Dora Norvick and Mrs. Lily Tuckland.

Company News

Greeff-Chemicals Holdings Ltd.

The directors of Greeff-Chemicals Holdings Ltd. announce that of the total of 400,000 ordinary Shares of 5s each offered to ordinary stockholders at 10s, by means of provisional allotment letters, 389.333 were accepted. leaving 10,667 available to meet applications for excess shares totalling 281,134. Those who applied for up to 12 shares have received allotment in full; all other applicants have been allotted 12 shares each, the small balance remaining having been allotted pro rata to employees.

Anchor Chemical Co.

Group trading profits of Anchor Chemical Co. for the year ended 30 November, 1955, amounted to £144,532, against £145,753 for the previous year. Net profit, however, was £72,771, compared with £68,107 for the previous year. A final dividend of $12\frac{1}{2}$ per cent makes a total of $17\frac{1}{2}$ per cent for the year on the ordinary capital of £270,000 as doubled by a one-for-one scrip issue. This corresponds to the 35 per cent paid for the previous year on half the present equity.

Power Gas Corp.

Total value of orders placed with the Power Gas Corp. in the year ended 30 September 1955 was £10,750,000, a record for the company, and almost double the figure for the previous year. This was reported by Mr. N. E. Rambush, chairman of the company, in his annual statement. The annual general meeting of the company will be held on 22 March at Stockton-on-Tees.

Ilford Ltd.

In his annual review of Ilford Ltd., the Hon. James P. Phillips, the chairman, said that during the past year the company had increased both home and overseas sales, and that profit for the year could be considered satisfactory. Commenting on Phenidone,

which had replaced Metol as a proprietary developing agent, the chairman said that it was clear that one of its most important uses was in the manufacture of concentrated liquid developers. It had recently been introduced to cine film processing laboratories which might prove to be an important outlet. Discussing the Azoflex profor reproducing documents, cess the chairman said that the process was safer and generally cheaper than the old ammonia gas process. To promote exports 10 the US the company recently formed a subsidiary, Ilford Inc.

Market Reports

LONDON.—Activity in the various sections of the industrial chemicals market has been steady with a fair volume of new enquiry both for home account and for shipment. While the supply position generally is easier. spot offers of some items, notably titanium oxide, are difficult to obtain. As from 23 February the following higher basis prices for the lead compounds have been in operation:—white lead, £155 10s, red lead, £151 5s; litharge, £153 5s; otherwise quotations are unchanged and firm. The coaltar products market remains steady at recent levels with no new features to recall.

MANCHESTER.—Prices on the Manchester market for heavy chemical products continue on a steady to firm basis, the outstanding change since last report being an advance in sulphate of copper to £120 15s per ton, less 2 per cent, f.o.b. Liverpool. The demand from leading industrial consumers in Lancashire and the North-west generally has been on steady lines, with generally good deliveries being called for under contracts. Fresh enquiries have been on a fair scale. Fertilizers are being taken up in fair quantities.

GLASGOW.—A slightly better week's trading has to be reported from the Scottish heavy chemical market, with deliveries against contracts being steadily maintained. In regard to fertilizers, the demand here has shown signs of renewed activity for the coming season. On the whole, prices show little or no change, and generally continue firm. The export market is still fairly active, with quite a varied range of enquiries being received.

ADVERTISEMENTS

SITUATIONS VACANT

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

A RMSTRONG SIDDELEY MOTORS have a vacancy for a SENIOR CHEMIST in their Chemical Laboratory. This is a new position of unusual responsibility, since the successful applicant would be expected to take charge of chemical work and be directly responsible to the Chief Chemist. A Degree in Chemistry is essential, although in certain circumstances an Honours Degree in general science would be acceptable. Applicants should be over 25 and have had previous experience in executive positions. The position carries commensurate salary and senior executive status. Applications will be treated in School Cacconfidence and should be sent to the TECHNI-CAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY quoting Reference SC/Lab.

CHEMISTS, with a bias towards Physical Chemistry, required by the Research Laboratories of a rapidly expanding company specialising in Timber Preservation. Applicants must possess an Honours Degree in Chemistry. Applicants must possess an Honours Degree in Chemistry. Salaries according to qualifications and experience and will not be less than £700 per annum. In addition to the basic salary, successful candidates will participate in a generous bonus scheme. Applications should be addressed to THE TECHNICAL DIRECTOR, HICKSON'S TIMBER IMPREGNATION CO. (G.B.), LTD., INGS LANE. CASTLEFORD, YORKS.

Ministry of SUPPLY requires CHEMIST at Harefield, Middlesex, to assist technical direction of inspection of non-metallic aeronautical materials such as adhesives, glass, de-icing fluids rotproofing agents, etc., involving all types of analyses. *Qualifications*. British of British parents. Hons, degree chemistry or chem. eng. A.R.I.C. parents. How agree chemistry of chem. eng. A. C.R. or equivalent. Appropriate experience essential, know-ledge inspection procedure desirable. *Salary*. Within ± 675 (age 25) – $\pm 1,055$. Application forms from M.L.N.S. Technical and Scientific Register (K), 26 King Street, London, S.W.L. quoting F.116/6A/BZ.

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PATENTS & TRADE MARKS

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