The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XXVIII. March 11, 1933 No. 715

Notes and Comments

Compulsory Research

WE shall hope to comment at greater length next week upon the report of the Department of Industrial and Scientific Research. There is, however, one aspect of that report to which reference may here be made in view of our own recent comments upon the propriety or otherwise of financing industrial research by means of a compulsory levy. The Department, presumably because of the specific instance of the rubber industry, has considered the same question and has arrived at the contrary conclusion. As the Department has under its aegis no fewer than 27 research associations, this conclusion might be regarded as authoritative. Nevertheless we are inclined to wonder if the last word has yet been said upon this subject; even the Department does not seem too sure of the ultimate validity of its conclusion, for it qualifies its statement by adding: "We are not prepared, *at the present time at all events*, to make any representations with a view to the introduction of a general measure in Parliament to authorise the compulsory adoption of a levy." It is conceivable that a firm compelled against its desire to support a research association would give such grudging assent, and would be a continual source of so much embarrassment as to hinder the work rather than help. It may be considered that a few definitely antagonistic units—antagonistic because subject to unwilling compulsion—would be potential wreckers of the organisation. Compulsion might lead to a demand for the removal of government "interference" and make the provision of research facilities into a political question. Due regard must also be paid to the possibility of a research levy proving a tax which might press hardly on certain firms. Firms which support a central organisation might be persuaded that such an organisation was in itself sufficient and that there existed no necessity for them to employ a private research staff. There are no doubt other reasons that could be adduced for the decision of the Department and for the advice given by the individual research organisations consulted. It must not, however, be forgotten that the Department, spending over £500,000 every year, is itself supported by a compulsory levy upon the taxpayer at large. We have never heard anyone complain that the principle was iniquitous, although some may have disagreed with certain of the Department's activities.

Although a directorate may resent a compulsory levy, the real work of appreciating the discoveries of the research association and of collaborating with that association falls on the staff. Unless the board of a company specifically forbids its employees to collaborate in this way there is every possibility that the advantages gained from the compulsory subscription will soon become recognised. The onus is thus upon the central body to justify its existence by proving of real assistance to the industry it serves. The question then becomes: Have we confidence in the value of the research organisations and have these organisations confidence in themselves? It is manifestly wrong that a few firms should be called upon to support voluntarily an organisation that cannot fail to advantage all; the experience of the rubber organisation proves that there is a real danger in this attitude. Is it not possible that to each industry might be applied something equivalent to the "local option" of the brewery trade or the picture palace?

The Voluntary Method

THERE is evidence that the voluntary method, as so often happens in this country, is working out well in most instances. It is gratifying to read that in difficult times such as those of the year under review (August 1931 to August 1932) there has been a marked increase in the industrial support afforded to several of the research organisations established under the Department. Sir Robert Witt, chairman of the National Institute of Industrial Psychology, also records in a letter to the "Times" that he has "many opportunities for appreciating the fact that individual employers are becoming more and more deeply interested in industrial investigations and research." There was a time when Science—with a big "S"—was regarded by the "man-in-the-street" as the archangel of plenty and the panacea of all ills, whether bodily, mental, political or economic. We are perhaps a little wiser now, but there is still danger that the limitations of Chemistry and Science—still with capital letters—are not understood even by those who would use them. The insistence upon conducting research *under proper conditions and safeguards* that has permeated some of the correspondence is all to the good.

A Study of Personnel

IT is of the utmost importance to realise that materials are not the only things upon which research must be conducted. A letter in our columns recently asked how directors of research and other important office-holders were selected. Sir R. Witt's letter reminds us that the selection of personnel is equally as important as experimenting upon materials. "The possible area for investigation and research, which can take many forms, is almost as wide as business itself, and they may be conducted on a large scale or small. On the material side the problems include the organisation of

production and distribution and working methods; on the human side *personnel*, selection, training, promotion, incentives, and the devising of methods of removing causes of friction and unhappiness, waste of effort and material, undue fatigue and boredom."

Has the chemical industry given sufficient attention to what is referred to as the "organisation of distribution"? Modern industry does not consist only of manufacture; marketing is equally important, and it is of considerable interest to observe from a letter contributed to our columns to-day, that in one great industry research on marketing has preceded research on manufacture. When, therefore, we ask that research should not become unbalanced, we ask not only that it shall be conducted under those conditions that make for success, but also that within its purview shall be included the whole gamut of modern industry, manufacture, salesmanship and the selection of personnel within the scope of industrial research is shown by the statement contained in the letter of Professor Gibbs and Dr. Underwood (THE CHEMICAL AGE, February 25, p. 177) referring to the failure of some research organisations to justify the expectation of those who established them "because they were entrusted to workers who, either by temperament or training, were not suitable for the work." Human material is more valuable than inanimate material, and its management is more difficult. There are signs that the value of investigations upon the human raw material is being recognised in industry; but the chemical industry has clearly some lee-way to make up.

The Approaching Re-Assessment

THE Rating and Valuation Act, 1932, made some important alterations in the method by which rateable assessments were to be made and the manner by which they were to be announced. Under the Act of 1925 the rating authority had to send to the owner or occupier of a property a questionnaire asking for detailed particulars of the property, but under the new Act it is open to the authority either to submit a questionnaire or not. Certain authorities have followed the old practice but others have not. All the rating authority is compelled to do is to prepare draft lists; when those are completed they will be placed in the offices of the authority for public inspection, and the time and place where they may be inspected will be advertised. The where they may be inspected will be advertised. The lists will remain on the table for a period of 21 days, and formal notice of objection must be within 25 days from the date when the lists were first deposited for inspection. The first stage of objection is to a local assessment committee. If necessary, a further appeal must be lodged at Quarter Sessions. All lists must be finally approved by January 31 next, and they will be operative for all rates levied as from April 1, 1934.

A point for consideration is the great decline in the value of property which has taken place in recent years. Factories, business premises and houses do not command anywhere near the rents they would have done a few years ago, and when it comes to a matter of purchase the buyer is frequently able to dictate his own price. It would not be unfair to estimate that bricks and mortar property stand to-day at quite 25 per cent. below the values of five years ago. At the last valuation, uniformity in the method of valuation was claimed to be imperative and post-war building costs and post-war rents were taken as the standard. It will be but just if ratepayers demand that present-day building costs and present-day rents be the maximum standard for the new assessment, and that regard be also paid to the fact that those costs are still falling.

The American Crisis

THE last thing the normal Englishman would think of doing is to rejoice over the misfortunes of his chief industrial competitors. How formidable those misfortunes have become is shown by the news from the United States, Germany and Japan. It is clearly to the interest of the whole world in general, and of Great Britain in particular, that the storms which are sweeping those great countries should rapidly subside. Both the Americans and the Germans are passing through almost identical phases of the trouble which suddenly descended upon Great Britain in August 1931. So fine an instrument is the British banking system and such a perfect appreciation has the nation at large of its working that when the crisis came and the gold standard was abandoned, there were no panic, no attempt at hoarding, and no need of any of the drastic restrictions to which every State in the American Union has been forced.

Similarly when we felt the urgent need of a National Government, we accomplished our end and secured its endorsement by a popular vote through the straightforward working of our representative institutions and without doing violence to the conscience or the person of a single member of the community. It is by contrast with what has been happening all around us that the tone and temper of the British public in face of almost superhuman difficulties can be appreciated at its real worth. When the revival of trade does come, the British manufacturer, merchant and workman will have given the nation a flying start by their reassumption of the moral leadership of the world.

A Renewed Call for Reduced Taxation

THE Edinburgh Chamber of Commerce recently passed a resolution affirming that still further effort in the direction of the reduction of national expenditure was a necessity if the trade and industry of the country was to receive the impetus which only a reduction in taxation could bring, and calling upon the Government to take every possible step towards that end. Similar resolutions have been passed by other trading organisations, and there is no question that every chamber of commerce up and down the country will enthusiastically endorse the attitude taken up at Edinburgh.

The Government could not have had a clearer mandate for reducing taxation, first by the voting at the general election, and next by the reports of the two Parliamentary committees which investigated the problem last year. These committees both came to the conclusion that no less a sum than £40,000,000 could still be saved in national and municipal expenditure, and the Government is running a serious risk in hardly making a beginning with the opportunity presented to them. A large body of opinion in the House of Commons has already been aroused to the peril of the maintenance of national expenditure at its present swollen height, and agitation may yet have to be revived to enforce a peremptory national demand.

Application of Scientific Research to Industrial Problems

Annual Report of the D.S.I.R. and Research Associations

THE annual report of the Department of Scientific and Industrial Research, reviewing the work carried out under the various research organisations of the Department during the year 1931-1932, was issued on March 4. The report (Cmd. 4254) is published by H.M. Stationery Office (3s. net). The report includes an introductory note by Mr. Stanley Baldwin, Lord President of the Council, and a general report from the Advisory Council, signed by Lord Rutherford, its chairman.

STRESSING the need for industrial research at the present time, the Advisory Council says: "The political, financial and economic developments that have occurred in this country since the end of the period covered by our last report, must profoundly modify for good or for ill the outlook of many of our established industries, and the development of new ones. With the arguments for and against tariffs as a means for reviving British trade we are not concerned. But the efficiency of our manufacturing industries is a matter that does fall within our purview, and we earnestly hope that the protection which has now been afforded to certain industries in the home market will be regarded as an opportunity for effecting the changes in organisation, the installation of modern plant, the development of research work, and the employment of educated staffs which the experience of the last few years has shown to be necessary in some industries if they are to compete on level terms with industries in other parts of the world. No industry can afford in these times to neglect any opportunity for increasing its efficiency and, of all the means to this end, the pursuit of research and the application of the results achieved are often the most far-reaching and fruitful."

The Task of Research Associations

The necessity for finding new uses and new markets for the products of industry has provided an incentive to the more enterprising research associations to endeavour to widen the basis of their membership by the inclusion of industrial groups which are interested, either as manufacturers or users, in materials discovered or improved by scientific research. While the committee does not under-estimate the difficulties of securing financial support from the users of the products which a research association is investigating, it feels that the interest of the user in the quality of his raw materials or his plant is in some industries so great as to make research into the possibilities of their improvement a vital necessity. It has always been the policy of the committee to encourage research associations to become self-supporting at the earliest possible opportunity and, in considering the claims of each research association for the continuance of State aid, it has endeavoured to secure that the Department's grants should be conditional upon the maximum effort being put forth by the industry concerned.

Consideration has been given to a suggestion that research associations would be greatly assisted towards a stable financial position if an Enabling Act could be passed by Parliament giving statutory authority for raising funds from industry for purposes of industrial research by means of a compulsory levy on raw material, output, or some other convenient basis of assessment. The great majority of research associations were, generally speaking, unfavourable to the compulsory principle, the general trend of opinion being that, if firms could not be induced in their own interests to support research associations, there was little to be gained and possibly something to be lost by compelling them to do so.

The committee is not prepared, at the present time at all events, to make any representations with a view to the introduction of a general measure in Parliament to authorise the compulsory adoption of a levy. It would welcome any scheme brought forward by a research association to place its finances on a sound footing by voluntary effort on the part of the industry, and if an individual research association should succeed in procuring the introduction of a Bill in Parliament to make a levy compulsory, it hopes that it will receive full support from the industry concerned.

The National Physical Laboratory

In no branch of the Department's activities were the effects of the industrial depression of 1931 felt more acutely than at the National Physical Laboratory. The estimates for that year provided for receipts amounting to £67,050 from outside bodies, representing fees for tests, payments for special investigations and contributions to the cost of particular industrial researches. This sum was approximately one-third of the total estimated expenditure on the laboratory from the Department's vote. The actual industrial receipts for the year amounted only to £54,466, showing a deficit of over £12,000. This reduction in the amount paid by industry for routine tests and specific services by the National Physical Laboratory was obviously attributable to the circumstances of the time, and it was reasonable to expect that, unless this country was to lose its place among the manufacturing countries of the world, the return of confidence and the improvement of trade would again call for the services of the laboratory on the scale of recent years. The problem to be faced was how to maintain the trained staff in readiness for a return to prosperity without sacrificing unduly other work of the Department of equal importance to industry. Work of a more fundamental character has in many cases been slowed down by not appointing new staff to fill vacancies which have occurred. In other directions the utmost economy has been exercised in the normal work of the laboratory.

As part of the general policy of concentrating attack upon problems of immediate importance to industry, it was found necessary to make some reduction in the provision for grants for scientific research. Having regard to the extent to which the available funds were required to continue grants already current, the committee was obliged not only to adjust the value of individual grants, but to curtail substantially the number of new awards made.

Applications for Patents

Twenty-nine British patents were applied for during the year. These applications include processes for colouring and coating metals and alloys for protection against corrosion, for producting green patina on copper, and for treating cellulosic fibres with alkaline liquids for mercerising and other processes, improvements in concrete and concrete products, in the manufacture of bricks, in radio direction finding apparatus, methods of automatic monitoring of the frequency of a radio transmitter or oscillator, in fruit storage, in methods of preserving and storing meat and meat products, improvements in hygrometric apparatus, domestic grates, spanners, wood-working machinery, and impact testing machines, processes for purification and decolourisation of phenols and neutral oils, and for producing cellular material from laminated rocks, improvements in cooling systems and apparatus, catalysts for the hydrogenation of organic materials, improved alloys containing beryllium and silver, catalysts for the destructive hydrogenation of carbonaceous materials, improved methods and means of controlling humidity, and of heat insulation, improvements in wireless signalling and a process for the destructive hydrogenation of coal and allied carbonaceous materials.

The total net expenditure of the Department during the last financial year was £534,700.

Fuel Research

After referring to the recent development of narrow brick retorts for the low temperature carbonisation of coal at the Fuel Research Station, the report emphasises the importance of the comprehensive scheme now in hand for studying under semi-commercial conditions processes for the conversion of the tar produced through the carbonisation of coal into motor spirit and oil fuel.

The fuel problem, the report continues, is perhaps the most crucial problem with which the Department is faced. The committee therefore thought it desirable, during the course of the past year, to carry out a review of the arrangements made for the conduct and direction of the Department's researches on fuel. What emerged most clearly from this review was the importance in fuel research, as in other branches of applied research, of provision for an effective programme of laboratory work. In the laboratory the research worker is

free from the restrictions in planning his work which are inevitable when experiments have to be conducted on a large scale, while intensive laboratory work is the best way of developing that real understanding of root problems which may lead not merely to improvements of a relatively minor nature in existing processes, but to suggestions for radical changes in production or in methods of utilising a raw material.

The Chemical Research Laboratory

The report states that it is becoming increasingly evident that the Chemical Research Laboratory under the direction of Professor G. T. Morgan, past-president of the Society of Chemical Industry, is beginning to be appreciated as an institution where useful chemical information may be obtained. About 21 chemical firms and other outside organisations have applied for advice and assistance. In many instances this assistance takes the form of a supply of samples of research products. In one case experiments made by commercial firms with the semi-works scale extractor developed at the laboratory led to the manufacture and extraction of ethyl-*meta*-aminophenol, a colour intermediate hitherto imported from abroad. The laboratory has for some time undertaken the preparation and supply to Universities and other institutions of carbon monoxide of a high degree of purity, this gas not being obtainable in quantity in a pure state from other sources. The laboratory has also placed its practical knowledge of high-pressure technique at the service of organisations interested in pressure reactions.

The employment of high-pressure plant is no longer confined to the group of workers specially engaged on high-pressure condensations with carbon monoxide and hydrogen. The laboratory autoclaves, of which there are now seven, are in constant request by workers in five research groups and several important chemical reactions have been thereby facilitated. Even in the corrosion section the interaction of compressed oxygen up to 25 atmospheres and steel immersed in salt solution is being examined as a means of developing an acceleration test likely to be of technical value in the iron and steel industries.

Corrosion Problems

Attention has been directed to the aerial corrosion of zinc, steel and iron immersed not only in salt solutions but also in sea water. A study of the aerial corrosion of copper in moist atmospheres containing traces of sulphur dioxide has now been completed and an electrolytic process has been devised for producing on copper or bronze a green patina having some degree of permanence. An interesting relation has been traced between the chemical composition of such quickly-formed patina and that of the patina developed on long exposure. The protection of industrially important magnesium alloys by selenium coating has been examined systematically, and some improvement has been evolved. This application of selenium may be regarded as a two-fold example of the reduction of waste. Although arising in considerable quantities as a by-product of copper refining, selenium still awaits industrial exploitation and to this extent is a waste product. The protection of magnesium alloys from corrosion by sea water is accordingly another example of the reduction of waste.

Catalysts containing chromium and manganese oxides when impregnated with alkali such as rubidia and employed in the carbon monoxide-hydrogen condensation induce the formation of notable quantities of higher alcohols. An account of these alcohols which was published at the beginning of 1932 included a description of a new heptanol, namely 2 : 4-dimethylpentanol. In order to characterise this compound three heptyl alcohols had to be synthesised, of which two were new.

Tar Research

An extended investigation has been made of the effectiveness of higher phenols as wetting out agents. Extremely effective phenolic fractions have been isolated from low temperature and from vertical tar. Considerable quantities of these materials have been prepared and are now under examination by the British Cotton Industry Research Association. Further progress has been made in the identification and characterisation of the chemical constituents of low temperature tar. 2 : 3 : 6 : 7-tetramethylanthracene, a new homologue of anthracene, has been synthesised and identified as a constituent of low temperature tar; its oxidation product 2 : 3 : 6 : 7-tetramethylanthraquinone has also been synthesised. Two olefines and four naphthenes have been added to the list of new components of low temperature tars and these tarry distillates have also yielded mesitylene, pseudo-cumene and α- and β-methylnaphthalenes. Some seven or eight industrial tars have been separated into their main constituents. Hydrogenation experiments with molybdenum sulphide catalyst have been made on the three main groups of resinoids, namely the resinenes, resinols and resinamines. In each case a considerable yield of light oil was obtained. High pressure technique has been applied to the amination of phenol and its homologues with ammonium chloride and in collaboration with the synthetic resin section the scope of this condensation has been extended to the preparation of mono-, di- and triethylamines from ethyl alcohol.

The alkylamines have proved to be efficacious catalysts in the formation of phenol-formaldehyde resins. Such resins have been prepared by a simplified process from low temperature tars and from vertical retort tars. These resinous products have, in the former case, been found to possess good insulating properties as determined by high breakdown voltages, low power loss factors and high surface resistivities. The effect of various basic catalysts on breakdown voltages and on times of formation of phenol-formaldehyde resins has been studied. Isolation of crystalline intermediates has thrown light on the mechanism of resin formation. Resinous products having many desirable properties have been obtained from the products of acetone-formaldehydes condensations.

General Research

A systematic study of the dehydrogenation of pyridine by anhydrous ferric chloride under pressure at high temperature has been completed and published. The principal product is 2 : 2′-dipyridyl, accompanied by four out of its five remaining isomerides, 3 : 4′-dipyridyl being present in considerable amount. By carrying out this dehydrogenation on a considerable scale some 20 products were identified, including a new tripyridyl, (2 : 2′-dipyridyl-2 : 6-pyridine), which gave rise to remarkable co-ordination compounds with salts of iron, nickel, cobalt, silver, platinum and other metals. The complex nickel salt with dipyridyl $[Ni\ 3dipy]Cl_2,\ 6H_2O$ has been resolved by means of *d*- and *l*-ammonium tartrates into dextro- and lævo-enantiomers in which optical activity is dependent on co-ordinated nickel.

A general method of preparing the homologues of phenanthridine is under examination and many derivatives of this series of bases have been prepared and the more promising members are being submitted for tests by the Chemotherapy Committee. 9-Amino-phenanthridine has been obtained by interaction of phenanthridine, ammonia and sodium in a suitable medium such as dimethylaniline. A suggested application of boron trifluoride as catalyst in high pressure reactions has led to the preparation in a crystalline form of co-ordination compounds of this gas with various organic esters. These products have the general formula, $R.CO_2R',BF_3$ where R is H, CH_3 or C_6H_5 and R′ is CH_3 or C_2H_5.

Four additional autoclaves with capacities ranging from 25 c.c. to 9 litres have been constructed in the workshop. These pressure vessels are in constant demand for the most varied chemical experiments. A special type of high vacuum distillation apparatus has been constructed in mild steel for use with pressures of 0.001 mm. or less. This instrument has proved very useful in the distillation of the least volatile crystalloids of coal tar.

Work of the Research Associations

A new design of cupola for the manufacture of cast iron, developed by the British Cast Iron Research Association, is reported to be giving satisfactory results in practice, not only in fuel economy, but in the reduction of wastage. One firm, for example, which found its defective castings totalled 4.4 per cent. over a period of ten years prior to the installation of the new cupola, reduced this figure to 0.7 per cent. in one year by its use.

Dealing with research directed to the saving of fuel costs in the iron and steel industry, to which the Department has materially contributed financially, the report of the Industrial Research Council of the National Federation of Iron and Steel Manufacturers states: "In 1924 10.34 million tons of coal were consumed in iron and steel works, for purposes other than pig-iron production, in the production of 6,708,500 tons of finished steel, equivalent to over 31 cwt. of coal per

ton of finished steel. In 1930, 7.1 million tons of coal were used in the production of 6,120,000 tons of finished steel, equivalent to just over 23 cwt. per ton of finished steel—a saving of over 8 cwt. If the average value of coal be taken at 12s. per ton, the saving on coal used after the pig-iron stage amounted to over £1,468,000 on the production of 1930.

Amongst the new research investigations of the British Non-Ferrous Metals Research Association a study of the frost bursting of water pipes has been commenced by a thorough investigation of the properties of the materials at low temperatures, and this work has secured the interest and financial support of some of the leading associations of the water supply authorities. Another new investigation which is likely to be of wide public interest is concerned with assessing the retention of brightness of polished white metals, such as are used for shop fronts, name plates, etc.

Refractory Materials

A number of the investigations initiated in 1930-31 by the British Refractories Research Association were continued during the year. The determination of the permeability of refractory materials to gases at higher temperature has shown that, as the temperature increases, the permeability decreases in a manner almost independent of the nature of the material.

The report states that results now being obtained in researches undertaken by the British Cotton Industry Research Association may soon lead to revolutionary ideas which will greatly increase the efficiency of opening and cleaning machinery. As a result of careful study of the Lancashire loom, effective remedies have been found for certain defects appearing even in cloths of the highest quality, which have been traced to the imperfect functioning of the loom. Examination of the factors involved in the process of mercerisation and the dyeing qualities of mercerised material has proved of great practical value in the hosiery industry. Better tests have been developed, based on physical methods, for measuring the air permeability of cotton goods, water-proofing, shrinkage, deterioration of strength, lustre, colour. The application of these tests means that better and more reliable goods will be offered to the purchaser.

Dealing with the work of Linen Industry Research Association, the report states that the greatest hindrance to the setting up of a prosperous flax industry in the British Isles arises from the cost of the excessive amount of hand labour at present necessitated. The general plan now evolved aims at a complete mechanisation of the industry. Encouragement has been given by the results of the pedigree flax crop grown on the Royal estates at Sandringham. Processed under ordinary conditions this crop produced treble the yield per acre and a fibre worth over £20 per ton more than the flax from the U.S.S.R. which at present forms 80 per cent. of the raw material of the British linen industry. The high germination of the seed from the Sandringham crop points to the suitability of that part of England for pedigree seed production to meet the requirements of the flax grower.

Other Investigations

One of the main pieces of work carried out by the British Leather Manufacturers' Research Association was the study of the vegetable tanning process. This involved the following through of the processes employed by various members of the research association. Samples of the tanning liquors and of the pelt passing through them have been taken at various stages of the process and examined both chemically and microscopically. In this way a complete record has been obtained and the various processes have been compared and classified. In several cases, the research association has been able to suggest means by which certain processes might be adjusted to give a better product and they have also been able to show which stages of the process were unbalanced and likely to have an adverse effect on the structure of the leather.

An important development, involving both co-operation between manufacturing and producing interests and the development of research into the problems of the utilisation of rubber, is reported by the Research Association of British Rubber Manufacturers. With the object of increasing the consumption of rubber, the Federated Malay States Government has provided the Rubber Growers' Association with a grant to be devoted to the study of any difficulties which may be hindering general or specialised uses of rubber, and to the study of the possibilities of new applications. The co-operation of the research association has been enlisted, and it has undertaken the responsibility of two important items on the programme of work. The first is a study of the means for enhancing the resistance of rubber to oils, a subject which follows naturally from the work on the swelling of rubber; this has already occupied a prominent place in the Association's programme, and bears upon an extensive field of uses for rubber. The second is the compilation of a handbook of Physical and Chemical Properties of Rubber, a publication long needed by engineers and others requiring definite data for constructional design as well as for manufacturing purposes generally.

The study of the ageing of a representative range of motor inner tubes under normal and tropical conditions of storage, is now nearing completion. The results reveal considerable differences in performance and should assist manufacturers in the development of qualities to meet the exceptional climatic conditions in certain overseas markets. Water absorption has also received attention. Although rubber is associated in the public mind with waterproofness, it is to some extent permeable to water vapour and is capable of taking up appreciable quantities of moisture. This is a factor of importance in many fields of use, but especially in connection with the applications of rubber as an electrical insulating material in the manufacture of articles such as ebonite and cables.

Rayon Trade Organisation

New Section of Manchester Chamber of Commerce

THE inaugural meeting was held at the Manchester Chamber of Commerce last month of the recently-formed Artificial Silk (Rayon) Trade Section of the Chamber. Mr. Richard Bond, vice-president, occupied the chair and expressed the satisfaction of the board of directors at the formation of the Section, which would not only prove a valuable extension of the organisation of the Manchester Chamber but was also capable of rendering very great service to an important and growing trade.

According to the "Monthly Record" of the Chamber, already between 60 and 70 representative firms have become members of the Section, including those engaged in the production of artificial silk, the manufacture of artificial silk fabrics, merchanting and finishing. In addition, the processing of yarns will be well represented. It is hoped that this wide representation will make it possible for the Chamber's organisation to be used to secure not merely regular and intimate exchange of opinions between the different sections but also on many occasion a reconciliation of points of view which might otherwise diverge. Fresh applications for membership are being received at the Chamber and it is expected that the membership of the Section will be considerably enlarged in the course of the next few weeks.

The meeting was presented with a review of some of the problems which are already awaiting the attention of the new Section. These included technical questions associated with the revision of the excise and import duties at present imposed on artificial silk, the need for representations to the Board of Trade on behalf of the artificial silk trade in connection with the pending tariff negotiations with various foreign countries, and the question of Japanese competition (which is already receiving attention from a general cotton trade point of view at the hands of a special committee sitting at the Chamber). A temporary sub-committee was appointed to deal with detailed matters and prepare agendas for further full meetings of the Section. The personnel included J. S. Addison (Courtaulds, Ltd.), M. Spilman (British Celanese, Ltd.), representing producers; J. A. Barber-Lomax (Arthur Bromiley and Co., Ltd.), Harold Hindley (Hindley Bros., Ltd.), A. Nahum (Nahums), representing manufacturers; C. W. Lamb (Broome and Foster, Ltd.), representing merchants; W. A. Grierson (Greenhalgh and Shaw, Ltd.), representing yarn processors, E. Copley (C.P.A., Ltd.), representing finishers; and W. R. Wadsworth (Wm. Frost and Sons, Ltd.), representing Macclesfield interests.

Sir Ernest Thompson was requested to act as temporary chairman of the new Section until a permanent chairman and committee were elected.

Plastics, with Special Reference to Cellulose Materials

The Problems of a New Industry

ALTHOUGH a great deal of work on the laws of plastic flow had been done by Bingham and others in the United States and in this country, a great deal more was required to be done, said Dr. W. J. Jenkins, of Imperial Chemical Industries, at a joint meeting of the London Section and the Plastics Group of the Society of Chemical Industry, held at Burlington House, London, on March 6, when Dr. G. W. Monier-Williams, chairman of the London Section, presided. From the existing terminology there was a certain difficulty in classifying the available plastic materials in any logical order but he, himself, had grouped these materials as (1) thermo-plastic, (2) thermo-hardening, (3) chemical hardening, and (4) high temperature hardening ceramic materials. Each of these was sub-divided and it was with certain aspects of cellulose and cellulose thermo-plastics that Dr. Jenkins dealt, confining his attention principally to nitro-cellulose.

Speaking generally about cellulose, Dr. Jenkins pointed out that the use of cellulose to the large extent we are now accustomed to, especially as cotton in the textile trade, is due more to its high tensile strength than to its chemical properties. Indeed, the tensile strength of high quality cotton was superior to that of most other materials and was inferior only to high quality steel and some of the heavy materials. A great deal of the structure of cellulose had now been elucidated and it had been established that it is built up of long chain molecules, the formula being $(C_6H_{10}O_5)$ and the chain of molecules was built up of glucoside units linked in the chain by primary valencies. These chains were apparently of various lengths but as the result of a considerable amount of work in recent years by Howarth and his collaborators, it had been established that the chains had from 100 to 200 of these units.

Cohesional Forces

There was, however, still controversy going on as to these values. It seemed to be agreed that the chains in any simple or fibre cellulose were of various lengths and that there were at least 100 glucoside units in each chain, the chains being held together by cohesional forces. The cohesional forces were so powerful that when the temperature was increased the kinetic energy of the chains was increased, but increase in kinetic energy was not sufficient to tear the chains from one another.

After a brief outline of two processes of manufacture of nitro-cellulose, *viz.*, the dipper process and the displacement process, Dr. Jenkins pointed out that the long chain molecule persists also in cellulose derivatives although the chain length is reduced. The formation of esters led to some displacement between the chains; at the same time a certain amount of the interlocking of the fibres was removed so that the fibres were loosened, and the effect of this on the tensile strength was very marked with the result that all the cellulose derivatives were lower in tensile strength than the parent cellulose. Another effect noticeable in cellulose derivatives was the temperature effect. The characteristic of cellulose was that it was not thermo-plastic, but cellulose derivatives were thermo-plastic and it was this property which made them very attractive. In the cellulose derivative, the cohesional forces were reduced by the introduction of the radicle and when the temperature was increased, the kinetic energy of the chain molecule became sufficient to allow it to tear itself away from its neighbour. In this way we obtained the phenomenon of softening and there was a range of softening temperatures with cellulose derivatives. Another noticeable feature of derivatives was the change of rigidity which again was associated with the breakdown of the chain length weakening the cohesional forces, and that gave some idea why organic solvents dissolved cellulose derivatives more readily.

Gelatinisers and Softeners

It was not generally known that nitro-cellulose is a plastic. Most cellulose derivatives were plastic and could be moulded under high pressure without the addition of a second material. They were thus capable of being used for plastic work, film manufacture, lacquers or such materials as celluloid or moulding powders.

Referring to plasticisers, Dr. Jenkins said there was some difficulty about a clear definition of the term "plasticiser." Both castor oil and tri-cresol-phosphate were used in maintaining pliability and it was now becoming usual to refer to tri-cresol-phosphate as a gelatiniser, and to castor oil as a softener. There was a change of structure with tri-cresol-phosphate but no change of structure with castor oil. With camphor there was also a change of structure and this was an indication of compound formation. Gelatinisers had solvent properties and actually tended to dissolve plastics but they differed from solvents in that their volatility was very low but plasticisers should be good solvents for both cellulose derivatives and the resins used in plastics. Solid plasticisers were unsatisfactory in that they tended to crystallise but camphor was exceptional in that respect.

Tensile Strength and Viscosity

Dealing with the relationship between tensile strength and viscosity, Dr. Jenkins referred to work done but never published and to which he had had permission to refer on the present occasion. From this it was seen that when nitro-cellulose absorbed water there was an increase of tensile strength but with continued absorption the tensile strength fell off and there was a parallel result in the case of the elongation. Acetone had been found to cause a regular fall in tensile strength but the elongation test shewed an increase with increased acetone absorption. This work also demonstrated that the tensile strength seemed to be independent of the viscosity. Different results were obtained with different plasticisers. For instance, using tri-cresol-phosphate as the plasticiser it was found that the tensile strength increased to a certain maximum and thereafter there was a falling off. New cellulose derivatives have been introduced for the purposes of uses previously held by celluloid. Their advantage lay mainly in their lower inflammability but they had the defect that they took a long time to mature in order to get rid of the last traces of solvent, and this extra time might extend to weeks or even months.

Reference was also made to the compression and injection methods of making celluloid plastics of the bakelite type, the latter being referred to as the more novel. The literature regarding it, however, is not extensive. The essential part of the injection method, as practised with thermo-plastics, said Dr. Jenkins, is injection into the cold moulds where a pressure of 6 to 8 tons per square inch is applied. When the pressure is released the article can be removed immediately and in this way it is possible to get three, four or five injections per minute.

Points from the Discussion

Mr. H. V. POTTER, chairman of the Plastics Group, said he gathered that Dr. Jenkins's view was that the production of plasticity in a cellulose derivative depends rather on breaking down the adherence between the chains by chemical reaction and thus, as it were, removing some of the affinity which existed in the chains. Would Dr. Jenkins ascribe "plasticity" generally in plastics to be very much of the same physical nature? Personally he doubted that. In the case of a material like an ordinary synthetic resin, used in the form of a moulding powder, the plasticity could hardly be ascribed to the same phenomena as occurred in the case of a cellulose plastic. Another matter was the true function of plasticisers both from a physical and chemical point of view. Was it, in a way, a lubricating effect on the molecules or was there some deeper chemical effect than would appear on the surface? Finally, he asked the author whether a plasticiser must necessarily be a solvent or a gelatiniser.

Mr. FOSTER SPROXTON said he would like to have heard a little more from Dr. Jenkins on the question of cellulose generally. It was true that Professor Howarth, from chemical evidence, had put forward the view that cellulose generally consists of from 100 to 200 glucoside units arranged in a straight line end to end but on *a priori* grounds it was difficult to imagine that a molecule of that kind could ever come to an end. It seemed to him, as a matter of fact, that the 100 to 200 glucoside units mentioned by Professor Howarth

could not be regarded as the maximum, but only as the average size for cellulose generally after certain chemical operations had been carried out on it. As to the author's suggestion that X-ray evidence points to the formation of a compound between camphor and nitro cellulose, that matter had been debated for some years with a great deal of heat but not a great deal of light. As a celluloid manufacturer he had never been able to bring himself to believe that there was a compound formation because it was possible to make large variations in the camphor content of celluloid without any sudden change in properties. Therefore, although there might be some evidence pointing in that direction he did not think at the moment that the argument was a very conclusive one. As a matter of fact, celluloid was one of the most difficult materials to deal with. There was very often a skin effect which gave certain results under certain degrees of loading in testing, but when the loading was increased the material under the skin came into action and then the results were very different.

Viscosity of Cellulose Products

Dr. L. A. JORDAN said that the viscosity of cellulose products is an important commercial consideration. It was generally accepted that cottons could be obtained with widely varying viscosities and, generally speaking, it was agreed that there was a parallelism between the viscosity of cellulose and nitro cellulose, but he had always been a little mystified why it should be so. He had therefore been surprised that the parallelism between the viscosity of the raw material and the viscosity of the nitro-cellulose should have been found. As to the length of the chains, he should have thought that the rather viscous chemical disturbance would break down the orientation of the chains. Viscosity was generally explained on the ground of mechanical slipping, and the idea of viscosity—as mechanical slipping—was linked up with what Dr. Jenkins had said about the cohesional forces between the different chains. He was a little disturbed, however, as to how far Dr. Jenkins was prepared to carry the mechanical explanation of plasticity at the other end of the curve corresponding to the viscous end of the curve, and how far Dr. Jenkins connected the two, namely, viscous mechanical treatment at one end and plastic mechanical treatment at the other end of the scale.

Mr. H. TALBOT said he did not like grades of definition such as the author had suggested because in matters of this kind there was not a definite figure which characterised any particular property of cellulose. That had been well brought home by Mr. Sproxton's reference to his experience of celluloid sheets, and it also coincides with his own experience in another field of activity. Even if one knew what was on the surface it was certainly difficult to know what was inside, and therefore it was only an average that could be dealt with; there was not a unit of crystallisable definite magnitude which was the same yesterday, to-day and to-morrow.

The Author's Reply

Dr. JENKINS, in reply to Mr. Potter, said his view was that plasticity of cellulose derivatives is due to cohesional affinity, *i.e.*, the plasticity of the material alone without the addition of a second substance in the form of a gelatiniser or softener. There was definite evidence showing that the change was a change in the cohesional force. As regards thermo-hardening materials, not nearly enough was known about these yet. Imperial Chemical Industries, Ltd., had investigated certain aspects of plastics much more than other combines had done, and up to the present no softener or plasticiser for phenol-formaldehyde had been found. The true function of a plasticiser was a big question and everything depended upon the purpose for which the material was to be used. In certain cases it was used for increasing the toughness of the plastic because the absence of brittleness was important in many uses. In other cases the plasticiser was used to induce gloss or perhaps to increase the resistance to abrasion, which latter was one of the tests to which cellulose lacquers for motor cars were subjected. As to whether a plasticiser must be a solvent, the answer was perfectly definite. A gelatiniser was a solvent but a softener was definitely not a solvent. As regards Mr. Sproxton's reference to Professor Howarth's figures for the chain length, the evidence seemed to be that the structure was a long chain structure and that the chain varied in length. The question of the actual figures mentioned by Professor Howarth must remain a matter of argument although personally he was inclined to agree that they should be taken as a minimum and not as a maximum.

In reply to the point made by Mr. Sproxton as to the compound formation between camphor and nitro cellulose he held the view that it had been established that some form of compound formation exists.

The question of parallelism between the viscosity of cellulose and cellulose nitrate had been mentioned by Dr. Jordan. The position was that if one started with a cellulose of high viscosity and nitrated that, a nitro-cellulose was obtained of fairly high viscosity. If, on the other hand, a cellulose of low viscosity was started with, a nitro-cellulose of low viscosity was obtained. Apparently this indicated, in Dr. Jordan's view, some faulty logic in the argument relating to chain structure, but personally he did not think it was established that any chemical or physical treatment of cellulose derivatives altered the chain length, and that there is a fall of viscosity when this occurred. The chemical disturbance in esterification was considerable, and might be expected to break down the structure, but the disturbance was not so considerable as might be expected and there was no breakdown in the visible structure. As to the point made by Dr. Jordan concerning the mechanical explanation of plasticity, Bingham had done a great deal and had distinguished between plastic flow and viscous flow, but this was a new process being developed and very little more had been found out than the explanation given many years ago in Maxwell's theory of heat.

Letters to the Editor

World Power Conference Papers

SIR,—In the list of British papers for presentation at this year's sectional meeting of the World Power Conference, which we sent you early in February, and which was published in THE CHEMICAL AGE of February 11 (page 113) there was included a paper entitled "Some Notes on English Diesel-Electric Practice," to be contributed by Mr. Alan Chorlton, M.P., and stated to be sponsored, as "authoritative body," by the Diesel Engine Users' Association. This was a complete mistake; the paper in question is being sponsored by the British National Committee of the World Power Conference. We shall be grateful if you will give publicity to this correction.—Yours faithfully,

C. H. GRAY.

British National Committee, World Power Conference.
63 Lincoln's Inn Fields,
London, W.C.2.

Compulsion in Research

SIR,—I was much interested in your editorial note upon the ethics of State compulsion in research. There is much to be said for the compulsion of the individual when that compulsion is in his own interests or in the interests of his neighbours. It may not benefit a car owner to compel him to insure against third-party risks but it assuredly benefits those whom he may disable.

Each industry may require separate treatment. In some the leaders are thoroughly awake, in others the trump of doom must sound before they turn over in their beds. The coal industry is an instance somewhere between the two extremes. Although that industry has assisted to finance research in connection with many of its mining problems, it has remained far behind in the utilisation of the coal it produces. Leading technical fuel experts do not hesitate to say openly that the coal owner is quite ignorant of the product by which he lives. As a colliery chemist I know they are right.

Although there is a multitude of problems in coal utilisation awaiting solution, matters which would greatly assist the further use of coal, the only step that the industry can be persuaded to take is to establish a commercial bureau to sell more coal, and even that is so short of the necessary funds that but little can be done. Funds must be provided voluntarily, but few will subscribe. A trifling levy on each ton of coal raised would provide ample money for a large research programme, which might lead to a demand for millions of tons more coal per year.—Yours faithfully,

"COLLIERY CHEMIST."

Accelerated Weathering of Paints and Varnishes

Effects of the Absorption of Ultra-Violet Light

ATTEMPTS to break down paint and varnish film by submitting them to varying conditions of moisture, light, heat and cold, uncomplicated by the presence of chemical agents in the form of industrial gases or salt solutions, were discussed by Dr. V. G. Jolly, B.Sc., A.I.C., at a joint meeting of the Manchester Section of the Society of Chemical Industry, and of the Manchester Section of the Oil and Colour Chemists' Association, held at Manchester, on March 3. It was a matter of common observation, said Dr. Jolly, that a paint product applied on the weather side of a building bearing the full brunt of the rain and sunshine, would generally lose its gloss, and chalk and crack long before the same material exposed on the sheltered side. The difference of behaviour in the two cases was sufficient to demonstrate that the ordinary weathering agents, namely, sunshine and rain, and the consequential changes of temperature, were in themselves sufficient to bring a paint film to such a state of disintegration that it no longer fulfilled its decorative and protective purposes. At the same time it was difficult to say which of the two elements was the more destructive and to what combina- of them the film was least resistant.

Nature of the Paint Film

A dried oil paint film consisted of a high concentration of a pigment embedded, and sometimes chemically combined with, a plastic matrix or linoxyn or oxidised drying oil. An enamel paint film contained a lower concentration of the solid pigmentary constituents and the medium or vehicle carrying them was often rather harder owing to the presence of hard resins. In both cases the film was dependent for its resistance to weathering influences on the nature of the solid pigment and the plastic drying oil medium, and upon the orientation of the one to the other. It was known that the incidence of sunlight on such a film was attended by obscure photo-chemical reactions between the complex compounds present in the linoxyn, and, as these reactions took place, the uniformity and usefulness of the film decreased. It lost its elasticity and contracted with a consequential loss of its hold on the embedded pigment particles. The result was a slight powdering of the surface of the paint known as "chalking," which might be succeeded by cracking. Chalking conditions were more commonly observed in paints containing certain white pigments.

Sometimes cracking took place without chalking. The vehicle was more or less protected by the solid pigment which was often capable of absorbing those wave-lengths in the sun's spectrum responsible for the photo-chemical changes in the oxidised oil. Zinc oxide, for example, completely absorbed the wave-lengths in the near ultra-violet whilst white lead was comparatively transparent to them. It had been shown by Merz that there was a distinct variation in the capacity of different drying oils to absorb those destructive wave-lengths, China wood oil being superior to linseed oil in that respect. The absorption of ultra-violet light by paint vehicles had also been measured by Stutz who observed that the absorption was increased by bodying a raw oil by means of heat treatment or blowing with air; also by exposure to ultra-violet light. Such treated oils which were commonly used as paint vehicles, and also clear varnishes, had a high absorption capacity for the shorter ultra-violet wave-lengths (under 2,800 Å). These were said to be absorbed at the surface, thus accelerating the hardening of the latter, whereas the higher wave-lengths were less easily absorbed and might therefore be expected to exert their action more uniformly throughout the film. Such results pointed clearly to the risk of utilising, for accelerated weathering purposes, wave-lengths which were absent from the sun's spectrum.

Combined Action of Light and Water

The action of sunlight and ultra-violet light from a quartz mercury lamp had been contrasted by Clark and Tschentke, who studied their effect on the density of drying oil films. They found that sunlight created greater density changes in the surface than in the under layers of the film, whereas the mercury lamp radiation had a more uniform action. Sunlight, therefore, could give rise to a physical incompatibility of the surface and under layers of the film with consequential cracking. Comparative determination carried out in darkness emphasised the importance of photo-chemical action and pointed to the probability that light may initiate rearrangements which proceeded at a velocity independent of the effect of any further irradiation of the film and which might contribute to the final breakdown.

All drying oil films were more or less permeable to water and a variety of effects became possible when water was allowed to permeate the plastic film. With less resistant materials such as clear varnishes, emulsification of the surface took place, resulting in discontinuity and the development of stresses when the material dried out again. Rapid alternations of humidity were thus likely to play a big part in determining the life of an oil film, more particularly if they took place simultaneously with changes in temperature and in sunlight. Further possibilities were encountered when the combined action of light and water was considered, and it was a matter of speculation to enumerate the likely effects of allowing radiation in the form of light or heat to fall on a film whose surface was more or less permeated with water. This, of course, was the problem as we saw it in England where the alterations of light, heat, cold and moisture were so rapid and varied that it was extremely difficult to set down anything approximating to a standard weather. In a comprehensive series of tests on varnishes, Nelson found that the life of a varnish film could be shortened most effectively by subjecting it to a water spray, followed by exposure to light or refrigeration, and it was reasonable to assume that paints incorporating non-reactive pigments would behave similarly under such treatments.

Precipitation of Moisture on the Film

It might be supposed that it would be an easier matter to formulate an artificial weather cycle to be comparable with conditions obtaining in tropical countries where the alternations of sunlight and moisture, heat and cold, were often more dependable than in England. This was open to doubt, however, for even in such places there were likely to be abrupt changes of humidity and temperature whose effect on the film was unknown, but which is suspected to be by no means insignificant. In this connection it was to be noted that Nettmann had called attention to the possible influences on paint films, of small forces, hitherto disregarded, and although his suggestions had been discredited, it was well to bear in mind that a small force or combination of forces such as a rapid decrease in temperature occurring simultaneously with a rapid increase in humidity, might be more critical in a strained film than larger forces regularly applied and increasing in intensity more slowly. Unfortunately, data were lacking regarding the precise chemical disintegrating effect of heat, light and moisture, and one was obliged in formulating an artificial weathering cycle to consider, on the grounds of general observation and experience, what were the relative intensities of the weathering forces and in what proportion and order they should be used. The difficulties attendant on an intensive study of the mechanism of the breakdown of a drying-oil film might thus be covered by seeking a suitable cycle.

Experience in Tropical Countries

As Kempf had pointed out, paints designed for use in tropical countries had been known to fail rapidly when exposed in England and *vice versa*. Whether or not this was due to frequent precipitation of moisture on the warm films was not certain, but it suggested that in experimental cycles, rapid failure might be attained if the films were subjected to a cold shower of water immediately after a prolonged exposure to the artificial sunlight and heat radiation. Kempf had called attention to the fact that there was probably no such thing as an average weather, for there was always the risk of sharp changes in temperature, such as accompanied a hailstorm, taking place which might have a disastrous effect on the film. Such a change might occur in a year otherwise normal in respect of sunshine, rain and daily and seasonal variations in temperature. The performance of a protective coating,

furthermore, depended largely on the time of the year it was exposed, and in the case of a durable product, whether it started life in a cold season followed by a hot one or *vice versa*. Kempf had shown that a nitro-cellulose lacquer exposed in summer broke down consistently in 75 days but stood up for 275 days in winter. From this it would seem to be futile to judge the reliability of an accelerated weathering cycle by the extent of the agreement between the behaviour of paints weathered by it and by the natural weather conditions obtaining at any one place or in any one period of the year. This might be true for products breaking down in one season but the argument lost much of its force when one was testing the durability of the large class of protective paints and enamels whose normal life was at least two or three years. In such a period fortuitous sharp changes were of less consequence.

The Choice of Source of Light

Although the carbon arc spectrum was by no means identical with that of sunlight it was a fairly continuous one and might be expected to yield similar photo-chemical changes. On the other hand, the energy curve of the mercury arc rose sharply at certain wave-lengths in the far ultra-violet region which might conceivably induce unnatural chemical rearrangements in the film, leading to stresses of a magnitude far greater than might be encountered under more natural conditions. Further, the source of light should be as constant as possible, and, in this connection, the mercury arc lamp was at a disadvantage inasmuch as its effective intensity fell off with time owing to changes in the quartz.

The open carbon arc was free from this drawback, but needed more attention owing to the replacement of carbons every few hours. A closed arc would continue without attention for 24 hours or more, but the globes needed cleaning and could not be guaranteed to maintain their transparency indefinitely. A nearer approach to the solar spectrum could be gained by using cored carbons, but these burned away more rapidly and further vitiated the atmosphere so badly that paint films drying in the vicinity did not yield normal films. Tung oil films were particularly likely to web under these conditions. The plain carbon arc emitted little energy of wave-lengths less than 3,200 Å whereas the arc from white flame carbons, which are impregnated with fluorides or the rare earths, was stronger in that region and compared favourably with the sun. The pure carbon arc emitted a wide band of radiation at 2,500 Å of low intensity band at 3,890 Å (the cyanogen band) but with impregnation of the carbons or modification of their relative position or the current passing, the intensity of these wave-length bands and other parts of the spectrum might be entirely changed. For example, a five-fold increase in the current might be attended by a fifty-fold increase in spectral intensity. Even impregnated carbons emitted only a very small percentage of their total energy in the ultra-violet region, in that respect comparing favourably with sunlight. The quartz mercury arc, on the other hand, emitted a much greater percentage of its radiation in the ultra-violet, much or it in the shorter wave-lengths. The mercury arc, although considerably faster than the carbon arc in its action, seemed to favour that surface breakdown known as "chalking," and it had been shown by Schmutz and Gamble that the wave-lengths inducing this type of breakdown might be filtered out by glass transmitting nothing below 2,690 Å. The filtered light, however, still induced cracking of the paint films.

The Aims of Research

By J. H. WEST, M.I.Chem.E.

IN the interesting and important discussion now taking place on the need for research, there seems to be some confusion between the different types of research. It appears to the writer that research may be divided into three main categories :—

(1).—Pure research, that is, the investigation of new phenomena, and the discovery of facts regarding the behaviour of materials under new conditions, without any regard to the commercial usefulness or otherwise of the results obtained.

(2).—Long-range industrial research, in which a deliberate search is made for new processes or methods applicable to a given industry.

(3).—Immediate industrial research, where new ways are sought for overcoming problems and difficulties in connection with existing processes and methods.

About the first little need be said, save that it provides an inexhaustible mine from which workers in the other categories can draw inspiration and raw material.

The second category is the one the writer had in mind when discussing recently the qualifications of the ideal director of research, and it is probably the one present in the minds of Professor Gibbs and Dr. Underwood. The problem here generally boils down to taking some known series of scientific facts, usually the product of pure research, and from them developing an industrial process which will be economically profitable. The great difficulty, and the one which causes directors of companies and financiers to shy away from this kind of research, is that the whole thing is a gamble. There is no certainty that a new process will be economically sound when, after the expenditure of perhaps hundreds of thousands of pounds, it has been worked out, and there is no way of finding out without spending the money.

Reducing the Percentage of Failures

Anybody who finances this sort of research must be prepared for failures, and cannot expect to back a winner every time. Hence the need for an exceptionally good man, with a flair for winners, to select the subjects for investigation and guide the work along lines which are most likely to result in economic success, thereby reducing as much as possible the percentage of failures. The ultimate measure of success or failure in this class of research must be whether the profits from the winners are greater than the losses from the failures, or the reverse. This will depend to some extent on luck, but still more on the genius of the director of research.

The third category is a much simpler one where it applies to backward industries which have hitherto been run on unscientific and rule-of-thumb methods, such as the laundry and textile industries ten years ago. Here there was abundant scope for the application of scientific methods to existing problems, and almost any properly trained chemist with initiative and common sense would be able to show improvements, though naturally the bettter the man the more far-reaching the improvements are likely to be. This kind of research is far less of a gamble and more certain of results, and is consequently far more attractive to directors and financiers. It may be considered as the first stage in the application of science to industry, and when the most pressing problems have been successfully dealt with, it tends to merge into the second stage of long-range research.

An Interesting Question

The question whether co-operative research of either the third or second category could be applied to the chemical industry in this country is a very interesting one. It would be very difficult in the writer's opinion, because the industry, unlike the rubber or cast iron industries, is exceedingly heterogeneous and overlaps many other industries, and further it is to a considerable extent dominated by two immense organisations which are apt to be definitely hostile to any developments which might conflict with their own interests, whilst any co-operative efforts which left these out would be rather like Hamlet without the ghost.

It would be instructive if Professor Gibbs and Dr. Underwood, and others would follow up the matter by making some concrete suggestions for translating their ideas into terms of practical politics, or shall we say getting down to brass tacks. Nearly everyone, except perhaps Dr. H. E. Armstrong, agrees that more research is needed, and probably he also would agree if it is stipulated that the research must be of the right kind; the question is, how is it to be organised, financed and got going?

Financial Position of the Chemical Industry

By S. HOWARD WITHEY, F.C.I.

(Senior Fellow of the International Accountants' Corporation)

As the result of scientific advertising and publicity the sales of certain brands of enamel paint and car polish expanded considerably during the past year, although the reduced prosperity of the building trades, and of railway and shipping companies, severely limited the demand for other paints and varnishes, while exchange restrictions and tariff barriers were mainly responsible for the decline of export trade. In the case of Lewis Berger and Sons, Ltd., the gross profit for the twelve months ended July 31, 1932, worked out at £57,825, or a decline of £4,717 in relation to the figure shown in the previous account, but owing to increased income from subsidiaries, and a balance received on account of interest, the net profit for the year was £57,322, as compared with £30,978 realised during 1930-31. After adding the sum of £68,519 brought in from the previous account, there was a disposable balance of £125,841, which enabled a dividend of 5 per cent. to be paid on the ordinary shares, and an increased amount to be carried forward to the next account. Registered in 1879 as a private concern, and converted into a public undertaking in 1926, this company specialises in the manufacture of paints, colours, varnishes, enamels, distempers, and a product known as Proxcelin, which is used extensively for motor car and other industrial finishing processes, the authorised share capital being £1,000,000, of which a total of £927,275 has been issued and paid up, comprising £400,000 in the form of 7 per cent. cumulative preference £1 shares—the dividend on which absorbs £28,000—and £527,275 in ordinary £1 shares—the dividend on which takes £26,364. After making the distributions, the company's profit and loss account shows a credit balance of £71,477. During the financial year to October 31, 1932, a net profit of £26,627 was realised by Blundell, Spence and Co., Ltd.—paint, colour and varnish manufacturers—which figure compares very favourably with the net profit of £16,602 shown in the previous account, and enables a dividend of 3 per cent. to be paid on the ordinary shares. This company was registered in 1889, the authorised share capital being £700,000 of which £599,300 has been issued and paid up, consisting of £200,000 in the form of 5 per cent. cumulative preferred shares, and £399,300 in ordinary shares, all of £1 denomination. After deducting income tax at the standard rate, the preferred dividend absorbed £7,500 and the ordinary dividend £8,985, the sum of £4,875 being transferred to general reserve, and £2,844 allocated to taxation account. This leaves a credit balance of £10,071 to go forward to the next account, as against the sum of £7,648 brought in.

Chemical Manure Manufacture

Profits realised by firms specialising in chemical manure have been fairly satisfactory, and the final accounts of Lawes' Chemical Manure Co., Ltd., covering the financial year ended June 30 last, disclosed a net profit of £3,316, which figure compares with £1,515 realised during the preceding twelve months. After adding the sum of £919 brought forward from the previous account, there was a disposable balance of £4,235, and this enabled a dividend of 7 per cent. to be paid on the £38,375 of non-cumulative participating preference shares. The company, which was registered in 1872, absorbed the London Manure Co. in 1892, and holds a controlling interest in the Jersey Trading Co., Ltd., and in W. S. Ferguson and Co., Ltd., the authorised share capital being £400,000, of which a total of £164,340 has been issued and paid up, *viz.*, £38,375 preference, and £125,965 ordinary. The preference dividend accounted for £2,686, leaving a credit balance of £1,549 to go forward to the next account. In the case of Langdale's Chemical Manure Co., Ltd.—which was registered in 1871—the profit for the twelve months ended September 30, 1932, worked out at £990, or a decline of £169 in relation to the figure for the previous year, the debit balance on profit and loss account being consequently reduced from £1,278 to £288. In 1903 the authorised share capital of this company was reduced from £175,000 to £109,000, all of which has been issued and paid up in the form of £5 shares of one class.

Chemical manufacturers and tar distillers have reported satisfactory results, and during the financial year to June 30, 1932, the trading profit realised by Burt, Boulton and Haywood, Ltd., amounted to £98,488, which figure was arrived at after adding income from investments and deducting administration expenses. The balance of net profit was £45,800, after providing £20,878 for depreciation, which compares with a net profit of £51,934 realised during the preceeding twelve months, enabling the ordinary dividend to be maintained at the rate of 8 per cent. at the expense of the carry forward. In addition to chemical manufacturing and tar distilling, this company—which was registered in 1898—engages in the business of timber merchants and sawmill proprietors, and controls the Soc. Chimique de Selzaete, in which the Imperial Continental Gas Association also holds a considerable interest, the authorised share capital being £720,000, of which a total of £669,790 ranks for dividend, comprising £150,000 in 7 per cent. cumulative preference £1 shares—the dividend on which absorbs £10,500—and £519,790 in ordinary £1 shares. There is also an issue of 6 per cent. first mortgage debenture stock, recently quoted at 101½. Manufacturers of chemicals used in textiles and agriculture have encountered may obstacles, and after allowing £4,014 for depreciation, a loss of £5,989 was sustained by Eastern Chemical Co., Ltd., during the year ended March 31, 1932, thereby increasing the debit balance to £39,488.

Profits realised by manufacturers of bitumen have been well maintained, and the figures submitted by George M. Callender and Co., Ltd., were very satisfactory, the net profit of £5,523 for the financial year ended June 30, 1932, comparing with £6,647 realised during 1930-31 when conditions were somewhat better. This company was registered thirty years ago, and the authorised capital is now £30,000, consisting of £25,000 in the form of 6 per cent. cumulative preference shares, and £5,000 in ordinary shares. After paying a dividend of 12 per cent. on the preference shares, and 25 per cent. on the ordinary shares, the profit and loss appropriation account shows a credit balance of £1,706 to be carried forward, as against £1,179 brought in.

Retail Drug Trade

The development of drug business and the expansion of shops on the part of multiple chemists resulted in an increase in the profit margin in several instances. The audited accounts of Timothy White (1928), Ltd., covering the twelve months ended September 30 ,1932, revealed a total profit of £186,263, which figure included dividends received from subsidiaries, and compared with £199,241 for the preceding fourteen months. After debiting £17,898 under the heading of depreciation, and providing £49,611 for income tax, the balance of net profit for the year was £118,753, enabling the deferred dividend to be raised from 7 per cent. to 10 per cent., and a slightly increased amount to be carried forward. The authorised share capital of this company is £2,000,000, and £1,999,800 has been issued and paid up, made up of £1,676,000 in 7½ per cent. cumulative preferred ordinary £1 shares, and £323,800 in deferred ordinary shares of 1s. denomination. Apart from remuneration under service agreements, no directors' fees were paid, but the board asked for a removal of this restriction, which request has not, however, been proceeded with. In the absence of unforeseen contingencies, it is expected that the profits during the current financial year will be more than maintained. Although the final figures submitted by Taylors (Cash Chemists), London, Ltd., only partially reflect the economies which have been effected by this company during the financial year ended October 31, 1932, the gross profit was £40,272, as compared with £39,632 in 1930-31, but the need for writing off £6,527 in connection with branch shops closed during the accounting period reduced the balance of net profit by £4,514 to £17,362, to which must be added the sum of £1,216 brought forward from the previous account, giving a disposable balance of £18,578. The authorised share capital of this company is £2,000,000, of which only £862,500 has been issued and paid

up, consisting of £750,000 in the form of 7½ per cent. cumulative preferred ordinary £1 shares, and £112,500 in deferred ordinary shares of 1s. The preferred shareholders received a dividend of 2½ per cent., absorbing £14,062, the balance of £4,516 being carried forward to the next account.

Manufacturers of explosives and chemical products report better results, and the audited accounts of Explosives and Chemical Products, Ltd., revealed a net profit of £11,443 for the financial year ended June 30, 1932. This figure compared very favourably with the profit of £9,981 shown in the previous account, and enabled a slightly increased amount to be carried forward to the next account after distributing £8,574 as ordinary dividend (16⅔ per cent.), and £1,599 as deferred dividend (6.07d. per share). Registered in 1905, the company has an authorised share capital of £100,000, of which £54,605 ranks for dividend, *viz.*, £51,445 in ordinary shares and £3,160 in deferred shares. The majority of paper and board manufacturers also realised more satisfactory profits, and in several instances the rate of dividend has been increased.

The Human Factor in Industry

Factory Investigation Work

IN no year during the history of the National Institute of Industrial Psychology has such an advance been made in every department, as in 1932. The annual report of the Institute gives an interesting account of the work carried out during last year, under various headings; and a brief outline of each of the industrial investigations which has been undertaken by the Institute is given in the section on investigation work.

During a short investigation in a dyeing and cleaning works the lay-out of one department was replanned, new equipment was introduced and existing equipment improved. Measures were devised for reducing unproductive time, for increasing the efficiency of inspection processes, and for improving lighting and ventilation. A rest pause was introduced, and many minor practical changes were recommended.

Investigations were carried out in three food products factories. The first of these investigations, which had begun in May, 1931, ended early in the year. Its last weeks were devoted to ensuring a more accurate allocation of overhead expenses among the various departments and to determining methods for reducing breakages to a minimum. In another such factory, the Institute was asked to examine the relative merits of re-organising the present factory and of building a new factory. It reported that the factory could be reorganised to deal efficiently with the present production, but that any considerable increase in the company's trade could not be met by the present building. Accordingly, the company decided to erect a new factory, and the Institute was asked to plan its layout, paying due regard to the needs of the human factor and giving details of the equipment and machinery which would be required in it.

Savings in a Food Factory

The Institute dealt also with the problem of utilising the existing factory to the best advantage before the new factory is ready. It showed that improved packing methods for some of the products would effect an immediate saving of £700 a year; and it submitted recommendations concerning storage and stock control, production supervision, equipment, etc. The first investigation in the third food products factory lasted from March, 1930, to March, 1931. Six months later the Institute was again called in to study further problems which had arisen owing to the installation of new machinery and the introduction of new technical methods. The design and the fittings of benches were altered, the layout of three departments was modified, and in one of them a scheme of production control was introduced, by which arrangements were made for drawing up a programme for each day's work. Standard output rates were determined. A system of analysing faults in packing was devised, the aim of which was to prevent the recurrence of faults by drawing the workers' attention to them. Analysis of factory records showed that the increases in output and the economies in the consumption of raw material which were achieved during the Institute's first investigation have been maintained. This second investigation afforded indications of how some of the new methods, adopted on the Institute's recommendation, might be used more effectively to yield still greater economies.

The Institute conducted three investigations for a company of manufacturing chemists during 1932. One, which is still in progress, has been concerned with the manufacturing side of the business. In the first department investigated, analyses of the percentage of orders fulfilled from stock and of the time taken to despatch orders demonstrated the need for further stock space, for which purpose a new room is now being constructed. Alterations in plant layout were necessitated by the provision of this new room and of a new transformer house; the Institute therefore prepared for this department a complete layout scheme, which will considerably reduce unproductive time. Improved methods of producing one product have resulted in the following savings: A net saving of £218 a year through a reduction in the percentage of material re-processed, a yearly saving of £31 in packing material, and a saving of £432 a year through more accurate weighing for an expenditure of £100 in the purchase of more accurate weighing machines. The Institute has been able to apply the results of an investigation conducted by the Industrial Health Research Board into the provision of special glasses for employees engaged in "close" work.

The second investigation was concerned with the warehouse and delivery system. After a detailed analysis the Institute recommended a complete alteration of the layout of the warehouse to permit of better and quicker work, and it also drew up a new delivery system which, it was estimated, would give a greatly improved service to the company's customers. Finally, the Institute conducted a research into the market for and the methods of distribution of certain of the company's products, as a result of which recommendations were made concerning the products, their packing, advertising and price, the development of distributing and sales methods, etc.

Other Improvements

During a short investigation the layout and lighting of a new polishing powder factory were under consideration. The Institute modified the proposed layout of two departments, and submitted detailed lighting schemes. In the wrapping room new benches were designed to simplify work and to provide storage for the various materials required. The Institute recommended that the workers should be seated on special chairs for two of the packing processes, and that they should stand for the third, in order to benefit from a change of posture. Improvements were recommended in the existing rest pause arrangements.

In addition to the more prolonged investigations, short surveys have been conducted by the Institute during the past year with a view to ascertaining the applicability of its methods in factories engaged in the manufacture of automobiles, windscreens and similar products, glass, paper, buttons, clothing, paint, steel furniture, aluminium utensils, screws, biscuits and food products; and in a retail stores, a printing works, an iron foundry and in two engineering factories. Consultative visits have also been paid to various companies in order to follow up recommendations made by the Institute during investigations. The report also gives an account of the research carried out during the year. One of the most interesting pieces of research was the colour discrimination tests, to select those who have the keenest power to discriminate between slight differences in shade.

THE central laboratory of the Aluminium Trust, at Walchow, has discovered a new process for the manufacture of hydrofluoric acid, by a chemical process utilising the residual products from aluminium manufacture. Experts interested in the subject estimate that Soviet Russia will be able to produce enough acid for home requirements, which up to now has been supplied from Germany.

Progress in Non-Ferrous Metals Research

Papers at the Annual Meeting of the Institute of Metals

THIRTEEN papers dealing with various aspects of non-ferrous metallurgy were presented at the annual general meeting of the Institute of Metals held at the Institution of Mechanical Engineers, London, on March 8 and 9, under the chairmanship of the president, Sir Henry Fowler, D.Sc. The meeting concluded with a visit to the headquarters of the British Non-Ferrous Metals Research Association, where the laboratories were open for inspection and exhibits were on view to illustrate the progress and results of researches carried out under the auspices of the Association.

The distribution of porosity in typical copper ingots was dealt with by N. P. Allen, who conducted this investigation by means of systematic density determinations throughout the ingot. Tough-pitch high-conductivity and arsenical-copper, cadmium-copper, and deoxidised copper ingots have been examined, and a study was made of certain arsenical-copper ingots cast under pressure. The results showed the existence of regular variations of density, the nature of which was discussed.

Reaction Between Steam and Copper

In their paper on the equilibrium of the reaction between steam and molten copper, N. P. Allen and T. Hewitt described an experimental method for determining the equilibrium conditions in the reaction between steam and molten copper, reporting results which have been obtained over a temperature range of 1,090° to 1,350° C. and a water vapour-pressure range of 90 to 350 mm. of mercury. The behaviour of this system is consistent with the ordinary mass-action laws, and the oxygen dissociation pressure of cuprous oxide has been calculated. The work represents a further stage in the researches undertaken by the British Non-Ferrous Metals Research Association on the porosity of copper castings, and was carried out at Birmingham University under the supervision of Professor D. Hanson, D.Sc.

The effects of hydrogen and oxygen on the unsoundness of copper-nickel alloys were reported upon by N. P. Allen and A. C. Street, about ten alloys covering the range of the copper-nickel alloys having been investigated. On melting in hydrogen, all the alloys took up enough gas to render them very unsound on casting, the amount of unsoundness varying in a complex manner throughout the series. All the alloys melted in hydrogen could be largely degasified by passing nitrogen over the melt; this degasification was rapid, but was appreciably slower in alloys containing about equal proportions of copper and nickel. Alloys so degasified cast soundly provided that oxygen was absent. When oxygen was present, a second form of porosity appeared, provided that the oxygen exceeded a certain critical content. This "critical oxygen content" varied with the composition of the alloys, and was low for all alloys containing below 30 per cent. nickel, and of the order of 0.02 per cent. for alloys richer in nickel. The second form of porosity was due to the reaction of oxygen with hydrogen in the melt, and the "critical oxygen content" appeared to be connected with the solid solubility of oxygen in the alloy.

Copper-Aluminium Alloys

Following an investigation of the copper-aluminium alloys, by A. J. Bradley and Phyllis Jones, the copper-aluminium system has been re-examined, using the X-ray powder method, with special attention to methods of heat-treatment. The authors, in agreement with earlier investigators, find that the body-centred β-phase cannot be retained by quenching; contrary to the experience of Obinata, they found that a homogeneous β' structure was invariably produced on quenching the powdered alloy.

Graphitic silicon, heat-treatment, and the electrical conductivity of aluminium was the subject of a paper by L. H. Callendar, discussing results by a new method which show effects of heat-treatment of the metal on the graphitic silicon figures obtained from sheet, wire, and cast aluminium. The first separation of graphitic silicon was shown to correspond in certain experiments with the beginning of a rise in the electrical conductivity of the metal.

The physical properties of zinc at various stages of cold-rolling were dealt with by R. Chadwick, who has recently studied the effect of progressive small rolling reductions on commercially pure electrolytic zinc strip. The amount of work-hardening obtainable by rolling was found to be quite small, and after reaching the maximum hardness further rolling produced a progressive softening. The changes in both physical properties and microstructure found to take place subsequent to rolling have been investigated over a period of three months. The nature of the changes depended on the amount of cold-work which the material had received. The effect of alloying constituents on the changes produced during cold-rolling was comparatively small, but the extent and rapidity of the changes occurring subsequent to, rolling were profoundly influenced by small additions of alloying elements. The most notable features of the changes taking place during, and subsequent to, rolling were (1) the improved physical properties produced by light cold-rolling were permanent, but the accompanying twinned structures failed to persist, and in many cases no twin bands could be observed within a few weeks of rolling; (2) self-annealing of electrolytic zinc after heavy cold-rolling reductions, softening being found to commence immediately after rolling, and to be complete in periods varying from a few hours to one month. The author of this paper discussed the mechanism of cold-working, and advanced a theory to account for the principal changes observed both during and subsequent to cold-rolling.

Tests on Copper Alloys

In a paper on the application of the diamond pyramid indentation test to copper and copper-rich alloys in the form of thin strip, Maurice Cook and Eustace C. Larke, demonstrated the practicability of using, in the testing of thin metallic materials by the diamond pyramid indentation method, smaller loads than those now specified, and also the degree to which the anvil effect influences the results when standard loads of 5 or 10 kg. are used. Tests were carried out on copper, 70:30 brass, and phosphor-bronze in the form of cold-rolled strip, each material being tested at seven different thicknesses between the limits 0.040 and 0.0025 in., and in four different tempers ranging from fully-annealed to hard-rolled at each thickness, under loads of 0.5, 1, 2.5, 5 and 10 kg. It would seem, from the present practical study of the applicability of the test to commercial routine testing of thin materials, that the use of very small loads is neither necessary nor desirable, for the degree of accuracy and consistency obtainable decreases with decreasing load. As the load is decreased, the results are affected to an increasing extent by external factors, such as the surface condition of the material under test, and, moreover, with decreasing load the diagonal length units indicate larger ranges of hardness numerals. Using a hardened steel anvil it has been found that copper can be tested under 10 kg. down to 0.010 in. in thickness and under 5 kg. down to 0.005 in. for all ranges of temper, whilst brass and phosphor-bronze for all ranges of temper can be tested satisfactorily down to a thickness of 0.005 in. under a load of 10 kg.

Fatigue Resistance of Aluminium Alloys

The fatigue-resisting properties of light aluminium alloys at elevated temperatures was the subject of a paper by J. W. Cuthbertson, who pointed out that examination of the fatigue-resisting properties of some aluminium alloys by a modified form of the rapid load-deflection test gives results which, although usually somewhat too high, compare favourably with those of determinations made by the method of endurance, and are of particular value where a saving in time is essential and accuracy of high order is not required. The importance of checking the work by periodical endurance tests was explained, and the results of a number of such tests were compared with those of the rapid test, and the discrepancies discussed. As the temperature of these materials is raised, the fatigue limit falls progressively, but still has quite a high value at 300° C.

In their paper on the electrical conductivity of aluminium wire, A. J. Field and J. H. Dickin gave evidence that the

conductivity of hard-drawn wire is affected by heating and hot-rolling conditions and the characteristics of the rolling mill. Heat-treatment of the rod or finished wire increases the conductivity, the increase depending on the amount of work-hardness prior to treatment. As with all metals, impurities affect the conductivity—iron less so than silicon.

Influence of Volatile Chlorides on Magnesium

According to a paper presented by J. D. Grogan and T. H. Schofield, the soundness of magnesium is improved by melting the metal under a flux and treating with the vapour of certain volatile chlorides. Treatment with titanium tetrachloride does not produce an alloy molten at the usual casting temperature of magnesium alloys. The density of cathode copper is raised by melting under borax and treating with carbon tetrachloride, but not with titanium tetrachloride. The electrical conductivity of the treated copper is low, probably owing to the absorption of a small quantity of iron by the molten metal during treatment.

Interpretation of the tensile test with reference to lead alloys, was the subject of a paper contributed by Professor Bernard P. Haigh and Brinley Jones, who pointed out that test figures alone do not give an adequate idea of the character of a material. Elongation can be divided into " stable distributed strain " and " local strain." The separation of these types is considered theoretically, and the practical significance of each is discussed. Where severe plastic strains must be expected, stable distributed strain is invaluable for delaying fracture. By means of " ductility diagrams " the authors showed that ultimate stress is only indirectly related to fracture, and the conditions for a long range of stable distributed strain here deduced.

Experiments on the effects of variations in mould and pouring temperatures on the macro- and microstructures of some low melting-point metals and alloys, were described by Frances D. Weaver (Mrs. Harold Heywood). In this paper the author criticised definitions of macro- and microstructure as used by previous workers, and results, that are apparently contradictory, were correlated without the use of these terms. The primary crystal structure, whether determining the macro- or the microstructure, was shown to be coarsened by raising either the mould or pouring temperature. Cored structures within the crystal grain, generally described as microstructure, are either coarsened or refined by increase in pouring temperature, according to whether the mould temperature is above or below some critical temperature not yet defined exactly.

Addition of Tellurium to Lead

Some effects of the addition of tellurium to lead were reported upon by W. Singleton and Brindley Jones. Experiments on lead to which small amounts of tellurium have been added show that the resistance of the metal to concentrated sulphuric acid is remarkably increased. The physical properties of lead are also profoundly affected. The temperature of recrystallisation is increased, and tensile tests carried out on rolled sheet show that tellurium-lead can be permanently work-hardened. The work-hardening can be regulated, so that rolled sheet with a wide range of physical properties can be produced. The material exists in the fully softened condition after normal extrustion, but that it can work-harden under strain. Tensile and freezing tests prove that tellurium-lead in the extruded state will undergo more distortion before fracture than any other metal examined.

Spectrum Analysis

Present Limitation Briefly Reviewed

THE first attempts at quantitative spectrum analysis were made by counting lines in spectra, as it was observed that if only a small quantity of an element is present in a mixture then only the stronger lines of its spectrum will appear, said Mr. E. H. S. van Someren in a lecture delivered to the Birmingham Section of the Institute of Metals, on March 2. Between 1890 and 1910 workers in France and England enumerated the spectrum lines of each element which are the most persistent when the element is diluted; these are known as ultimate lines. These are sometimes different lines in arc and in spark spectra, but are the same whatever the main constituent of the mixture. A further important step in spectrum analysis was made by Gerlach in comparing lines of minor and major constituents of a mixture within the same spectrum, instead of having to compare lines in one spectrum with the same lines in other spectra. This is known as the method of internal standards, and the selection of lines for this work has been the subject of much useful work in Germany and England.

In cases when no suitable lines for comparison with impurity lines are provided by the main constituent of an alloy recourse may be had to photographing the spectrum of some other metal on each plate by the samples to be analysed. After verifying the correct intensity ratio between the two spectra, lines due to impurities in the alloy may be compared with the faint lines in the other spectrum, and for certain alloys tables for analysis by this method have been published. A variant of this method applied by the author to the routine testing of certain zinc alloys is to spark each sample with a piece of an alloy of pure zinc and antimony which has been selected so as to provide suitable antimony lines in the spectrum to compare with lead, cadmium and copper lines in the zinc alloy. This method saves a great deal of time in the routine testing of these alloys, allows an accuracy of about 20 per cent., and of course precludes the detection of antimony, which is unlikely to be present.

A further refinement in the comparison of the intensities of two lines in a spectrum is the use of a micro-photometer to measure the density of the image on the photographic plate. This has been widely applied in research work, but is rarely used in industrial practice as the increased accuracy obtained is rarely sufficient to justify the heavy expense of apparatus. Another method of comparing the intensity of spectrum lines is to vary the exposure along the slit of the spectrograph so as to make the length of the lines some function of their density. For this purpose wedges are used in the visual range, and the use of a rotating sector whose profile is a logarithmic curve has been applied by Scheive and Neuhausser. More accurate results can thus be obtained with little decrease in speed. The photo-electric cell has been used to measure the intensity of a spectrum line directly, radiation of a definite wave-length being isolated by means of a monochromator. This has been applied to a flame rather than to a spark, as the photo-cell is easily upset by the electrical disturbance associated with the spark; two lines can, of course, be compared by this method.

The use of flames for spectrum analysis has been widely applied since the beginning of the method. Some experimenters use a flame of the bunsen type in which the air is first saturated with a spray of the solution to be analysed; alternatively a sample can be reduced to ash in an oxy-hydrogen flame. Two English workers developed a technique for detecting metals in vegetable or animal substances in the flame, and were able to test for thirty-five metals, of which fifteen were widely distributed in animal tissues. Analysis by the flame has also been applied recently to the internal combustion engine, the light of the explosion emerges through a silica window in the cylinder head, and its spectrum varies with the rate of detonation of the mixture. Arc spectra are usually the best for the detection of small quantities of impurities in metals.

Spark spectra are more easily reproducible, and solutions as well as solids have been sparked. In France and Germany the electrolysis of solutions, and subsequent sparking of the small wire electrodes, has been applied to estimating minute quantities of many elements. A high-frequency spark from a transformer of the Tesla type is specially applicable to solutions, wet-filter papers, and small precipitates. Where very small samples have to be tested a great deal of energy can also be dissipated in them by discharging a battery of condensers through a wire of the sample; this has been applied particularly to tungsten.

Analysis by Ultra-Violet Light

By J. C. O. TURFERY

WITHIN recent years considerable interest has been aroused by the possibilities of using ultra-violet as an industrial research agent. Upwards of eight hundred papers have been prepared by workers in various fields, but development has been so far hampered by the lack of a comprehensive guide, in English, to the subject as a whole. Hitherto the only authoritative reference works available were those by Danckwortt (German) and by Bernheim and Guyot (French), but an English work on the subject is shortly to be published* and there is no doubt that this new book will facilitate the development of ultra-violet research and render its wide possibilities more apparent.

Ultra-violet rays produce fluorescence in many substances which do not visibly fluoresce in daylight, and by means of the characteristic colour of the fluorescence it is possible to discover something of the nature or composition of a substance. Briefly, therefore, ultra-violet analysis consists of comparing the fluorescence of a sample, the composition of of which is unknown, with the fluorescence of a standard substance, the composition of which *is* known. From a practical point of view, while ultra-violet analysis must be regarded as an indicative test rather than an ultimate test, it can not only be the means of effecting a considerable saving in time in the laboratory, but can also provide definite confirmation in a most decisive manner.

Progress in the Use of Daylight

Considerable progress has recently been made in the use of daylight for the transmission of ultra-violet rays. In this connection the Callophane, introduced by Griffin and Tatlock, Ltd., has proved a very cheap and useful instrument which covers practically the same ground as the analytic cabinet equipped with mercury vapour lamps, whilst having the additional advantage of being portable. By the use of a special filter, fluorescence results of a remarkably intense nature are obtained from daylight. This instrument, when folded, measures 9 in. by 6 in., and in appearance is rather similar to a photographic dark slide. The user is entirely independent of any lighting apparatus and tests can be conveniently made anywhere where daylight is available. When daylight is not available it is possible to use the instrument with artificial light from ordinary lamps; satisfactory results have been obtained from a 200-watt gas-filled bulb.

The ultra-violet test is extremely useful in the examination of textile piece goods in which faults are suspected. The most common of these is staining of the fabric with mineral oil. This is revealed very characteristically with ultra-violet rays by the violet blue fluorescence of the oil spots on the material previous to dyeing. In this connection the Callophane can be used for testing pieces of reasonable size by removing the panel in the base of the instrument and examining the material through the resulting aperture. By moving the Callophane over the surface of the fabric a fairly large area can be conveniently examined. Fermentation of sizing materials in cottons due to damp or wetting previous to singeing produces patches in the dyes which are revealed in the form of white fluorescent areas. Mildew is indicated by yellow, white and blue fluorescence spots. In the case of oil or wax spots on cotton fabrics the fluorescence varies according to the age of the stain. Thus a mineral lubricating oil will fluoresce bright blue in the case of a new stain and yellow after a period of several months; paraffin wax varies from whitish blue to yellow.

Detection of Fading

The ultra-violet test has also proved useful in distinguishing different varieties of cotton. Bleached and mercerised cotton, for example, produces a more brilliant fluorescence than bleached unmercerised cotton. Similarly pure silk has a more intense fluorescence than artificial silk, and pure wool a more intense fluorescence than woollen mixtures. It is also possible, by means of simple tests with alcohol, ammonia and caustic soda to distinguish cellulose acetate, cuprammonium and viscose silks. Another useful application is found in the detection of fading in dyed materials. The sample of material can be tested for fading by exposure to sunlight and then compared with an unexposed sample under the rays which reveal the slightest shade of difference in the colour values.

Freshness and Adulteration of Food

Ultra-violet radiation has many applications to all types of food products, including sugars, jams, honey, flours, seeds, wines, eggs, oils and fats. It is possible, in the case of sugar, to determine its purity by means of comparison with standard samples containing known quantities of adulterants. The presence of blue dyes has little or no effect on the fluorescence, but very minute percentages of ash content are readily detected. Glucose syrup fluoresces blue, while milk sugar, grape sugar and glucose fluoresce red. In a sugar solution containing fruit syrups, blue fluoresce is an indication of the presence of glucose syrup. Saccharine appears grey but the addition of sodium hydroxide produces an intense violet fluorescence.

The age of eggs may be determined by fluorescence, both by comparing the shell and the albumen. The shell of a fresh egg fluoresces violet; an egg which is not fresh fluoresces

The Callophane in Use

a rose colour. The albumen may also be compared with a series of gelatine solutions of known content in order to estimate the age of the egg. The albumen of a fresh egg has no fluorescence, but a blue fluorescence develops and increases in intensity as the egg becomes older. Similar tests have been applied very successfully to the determination of the freshness of various other food products and for detecting traces of adulteration, fermentation and mouldiness.

Examination of Fish and Meat

Deterioration of fish, for example, may be immediately revealed by violent green or red fluorescence, while deterioration of meat is indicated by a violent fluorescence. The presence of gristle or sinews is clearly shown in preserved meat in the form of a characteristic bluish fluorescence, which stands out clearly in the uniform red colour of the muscular meat. Fresh salmon is immediately distinguished from preserved or coloured salmon.

The content of cream in skimmed milk is indicated by the intensity of the brilliant yellow fluorescence, which disappears gradually with age; traces of iron in milk produce a bluish yellow fluorescence. With cheeses it is possible to distinguish between natural cheese and chemically manufactured cheese. Living fungi show a brilliant green fluorescence, which is not present in the case of dead fungi and this constitutes a valuable method for the examination of Roquefort and other similar cheeses. Pure butter is characterised by a golden yellow fluorescence. Margarine fluoresces strong blue

* "Fluorescence Analysis in Ultra-Violet Light," by J. A. Radley, B.Sc., A.I.C., and Julius Grant, Ph.D., M.Sc., F.I.C.

and it is thus possible to detect even small quantities of margarine added to butter.

The fluorescence test has wide applications to the paint trade, particularly with white pigments, such as zinc oxides, titanium white, white lead, etc. Here the Callophane provides a useful and convenient testing apparatus for the buyer of pigments or paints, with which to check his deliveries against standard samples. If the fluorescence is different then the delivery is different, and the test provides an indication at least of any departure from the standard. The theory has been put forward that a white paint which fluoresces darkly is a better paint than the one which produces a brilliant fluorescence. The ultra-violet rays from daylight, which contribute to some extent to the disintegration of paint, are absorbed by it and re-emitted at a longer wave-length. Thus, the longer the wave-length the greater the molecular strain, and therefore, the lower resisting power of the paint. In the case of lithopone it has been found so far that light-fast lithopone is hardly fluorescent at all, but that a highly fluorescent lithopone will fade rapidly on exposure.

It is possible to detect small percentages of linseed oil in wood oil, and as little as 1 per cent. of mineral oil in linseed oil. Resin and mixtures of resin can be identified by means of the capillary test, which consists of absorbing a piece of filter paper in the solution for about 20 minutes, and examining under ultra-violet rays. With this method it is possible to distinguish between resin varnish and resin-free varnish. Soya bean, arachis and linseed oils can also be detected in raw rape oil. Arachis oil may be distinguished when mixed with raw linseed oil.

Rubber and Leather Industries

Ultra-violet radiation is useful for detecting the various pigments, such as lithopone, zinc oxide, barium sulphate, etc., used in compounding rubber. It is also useful for distinguishing the various powders covering the rubber and for checking accelerators. The presence of oil stains on rubber are readily distinguished and it is frequently possible to detect impurities in the raw material.

The natural vegetable tanning extracts reveal hardly any fluorescence, but the most important artificial extracts present very distinct and characteristic fluorescences. When mixed and in spite of the destructive effect of natural tannins, fluorescence may still be distinguished in 10 to 20 per cent. of artificial mixture by means of the capillary test.

In the fine chemical industry fluorescence tests are particularly suitable for testing alkaloids, preferably in solution, by means of the capillary test. Strips of paper when examined under the ultra-violet rays, after having been partially absorbed in the solution, reveal distinctive coloured zones by means of which it is possible to identify the alkaloids. The test papers are prepared by suspending filter paper in heaters containing solutions of the material to be examined, and allowing the paper to dry after the solution has crept into it by capillary attraction.

Transformer Oils

The fluorescence test for transformer oil has been evolved after careful experiment, and it has been found possible to dispense altogether with the usual lengthy analysis. Professor Fritz Frank, of Berlin, has ascertained that the loss of the essential properties which determine the serviceableness of transformer oil, is combined with a change of the luminous colour revealed upon radiation with filtered ultra-violet light. The unused oils are highly luminous upon radiation, namely of a cobalt-blue colour. During use the deterioration of the oil is indicated by a decreasing intensity of the luminous properties, and finally with a change of colour from blue to a yellowish-green colour. By experiment it has been proved that this final change of luminous colour is related to the passing of the serviceable limit of the oil, as ascertained by the usual analytical methods.

Examination of the oils can be effected using a non-fluorescent water-colour basin, with three divisions (a small porcelain plate, 4⅜ in. long, ½ in. high, 1¾ in. wide, having three basin-like concave divisions about 1⅜ in. in diameter). Using a strip of filter paper, spread three drops of the oil evenly over the surface of the centre basin, using just enough oil to allow one drop to accumulate in the middle of the basin. Samples for comparison, consisting of unused and rejected oil of the same origin, are placed in the other basins. In this manner the difference in fluorescence can readily be seen. The colour of the thin layer of oil along the curved walls of the basin should be particularly examined. The oil can also be examined in test tubes of thin non-luminous glass, which permits the passage of ultra-violet rays. One third part of the test tubes should be filled with oil and examined again between two samples for comparison. Here the colour of the edge of the concave surface of the oil should be noted.

Britain's Fuel Problems

Professor W. A. Bone's Outspoken Comment

VIGOROUS comments upon the meddlings of politicians were voiced by Professor W. A. Bone in the course of an address on "Britain's Coal Problems," delivered at Cardiff, last week. The science of coal, declared Professor Bone, was being drowned by its politics, and there was, perhaps, no industry which suffered so lamentably from the meddlings of ignorant politicians who, of the world's vast army of futilities, were easily the "corps d'élite."

Referring to the extraction of oil from coal, Professor Bone said that in considering its possibilities it behoved them to consider the economics as well as the technical aspects of the question, for there was a narrow limit to justifiable expenditure in preparing any raw fuel to perform its proper function, either under a boiler or in an internal combustion engine. When nature supplied an abundance of petroleum for the mere drilling of a hole into the earth it was not much that man could really afford to spend upon converting nature's coal into oil, however clever he might become at it. If he so pleased he might tax petroleum for revenue purposes, but deliberately to set about using taxation to circumvent nature's bounty in order, with the aid of science, to make oil fuel dearer than it need be seemed a queer way of helping trade, though in a mad world it might pass for wisdom.

Sir Richard Redmayne's Scheme

Referring to Sir Richard Redmayne's scheme, which, amongst other things, advocates the replacement of the annual domestic consumption of raw coal by the consumption of low temperature semi-coke; the prohibition, within a period of five years, of the use of bituminous coal in all towns of a population of over 300,000; and the maintenance of the present excise duty on all imported petrol, Professor Bone declared that several of the proposals of the scheme were fantastic. Except at ruinous cost, which would certainly not be justifiable in present circumstances, it would be impossible to render Great Britain self-supporting as regards petrol and fuel oil any more than as regards foodstuffs. They must accept the risk and direct their policy towards keeping open the seas without which they must in any case starve in wartime; and anything calculated to undermine Britain's relative financial strength, such as needlessly imposing the handicap of dear petrol and oil fuel in peace time, might fatally impair our power in war. He (Professor Bone) had long thought we ought to concentrate our research upon the solution of the problem of utilising de-ashed pulverised coal in internal combustion engines, and he felt confident that it would ultimately be solved. Indeed, the whole problem of de-ashing coal and its use in pulverised form for power purposes generally was of the greatest importance. The coal industry should raise its own research funds to investigate all other problems relating to the cleaning and marketing of coal, including the de-ashing of coal, and also investigate, comprehensively, the use of pulverised coal.

A New Method for the Production of Bromide

THE Gipchimpron Institute of Leningrad, which has completed a new process for the production of bromine from the carnallite found at Solikamsk, has decided to construct new factories for the manufacture of bromine in that region. In addition similar factories are to be erected on the banks of the Kolunder lakes in the Western Siberian steppes. The sodium carbonate, and magnesium chloride which the lakes contain, besides the bromine salts, will be exploited in the future by a new process, by the Chemical Institute of Western Siberia.

Drying Enamels, Lacquers and Varnishes

Improvements in Gas Fired Conveyor Ovens

A SURVEY of the problem of drying the various types of enamels, lacquers and varnishes now in use and of the application of gas fired conveyor drying ovens to this work has been published by the British Commercial Gas Association in No. 226 of "A Thousand and One Uses for Gas," with the object of helping the manufacturer towards a wise choice of new methods and plant.

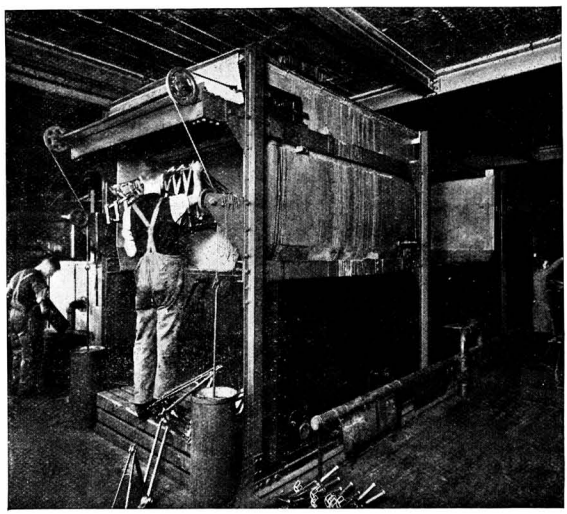

Fig. 1.—Coslettising plant at the works of New Hudson, Ltd., Birmingham.

The Drying Process

The purpose of an enamelling, lacquering or varnishing oven is to effect one or more of three distinct actions: (1) The evaporation of a solvent by heat; (2) the polymerisation of certain constituents by heat alone; and (3) the polymerisation of certain constituents by heat and oxidation in the air. For the evaporation of a solvent by heat, the only requirement beyond the necessary amount of heat is that the proportion of solvent vapour in the oven atmosphere should be maintained as low as possible in order to increase the rate of evaporation. For the polymerisation of certain constituents by heat alone, the temperature and time of the operation are the only variables affecting it. For the polymerisation of certain constituents by heat and oxidation in the air, the maximum possible proportion of oxygen in the air is required to speed up the oxidation process.

The first action occurs in every case, its relative importance depending on the volatility of the solvent. The second occurs with the synthetic resins, such as the bakelite type (phenol-formaldehyde), the plastopal type (urea-aldehyde), and the glyptal type (glyceral-phthalic-anhydride). The third action occurs with vegetable drying oils such as linseed and tung oils; and also with the newer type of synthetic products, modified glyptals, in which drying oils or fatty acids of drying oils have been incorporated in the glyceral-phthalic-anhydride condensation product.

The varnishes and lacquers which require only solvent evaporation by heat are the spirit varnishes and the cellulose ester varnishes. Ovens are used to give forced drying and to speed up production. In certain cases such as shellac varnish the metal to be coated is preheated. The evaporation of the solvent is accelerated and the adhesion of the shellac film to the metal is improved. Shellac varnishes are used in a great number of industries, and by suitable blending with other resins and oils, such as manila resin, sandarach, Venice turps, castor oil, etc., the properties are varied to suit particular purposes. Where spirit varnishes are force-dried the temperatures employed are usually between 150° F. and 180° F. The temperature employed with cellulose ester varnishes is usually between 160° F. and 180° F. Nitro-cellulose lacquers are now used in enormous quantities for motor car finishes, and in the majority of plants ovens for forced drying are used.

Condensation Products

The most important group of products where drying and hardening involves only actions in which no oxidation occurs are the synthetic resins of the bakelite, plastopal and glyptal type. These are all condensation products, made by the preliminary interaction of chemical substances. They are initially soluble and fusible resins and further heating converts them into insoluble and infusible products. The bakelite type is the most important and large quantities are used in the electrical industry for the production of moulded materials for insulation. Other uses are in the manufacture

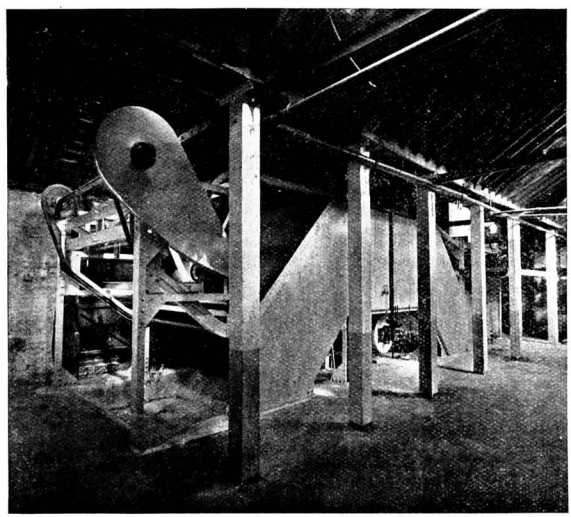

Fig. 2.—Conveyor enamelling oven for cycle parts at the works of the Kent Plating and Enamelling Co., Ashford.

of the so-called laminated forms for the electrical and mechanical industries. Paper and cloth are impregnated with a solution of the uncured resin in alcohol, and subsequent heat and pressure blends the sheets into a compact mass.

With the plastopal type (urea-aldehyde) of synthetic resin the final phase of polymerisation reached under heat, generally at 190° F., results in the formation of a transparent colourless solid which is very pale in colour and fast to light.

Varnishes and baking enamels which contain vegetable drying oils undergo actions (1) and (3). Oxygen from the air and heat convert the vegetable drying oil constituent of these into a tough, elastic polymerisation product. These varnishes may consist of natural resins such as Copal and Kauri or synthetic resins, such as oil soluble bakelites and modified glyptals, blended with the drying oils, linseed and tung oil, and dissolved in suitable solvents such as turpentine or mineral spirit. For coloured enamels pigments are incorporated by grinding. The black baking enamels form a special class in which the pigment, and most of the resin, is replaced by a hard bituminous oil soluble product such as asphaltum.

The Choice of Oven

Points to be decided in designing or choosing a gas-fired conveyor drying oven are: (*a*) Whether it shall be direct fired (*i.e.*, the products of combustion pass through the oven) or heated indirectly by air circulated through an air heater; (*b*) the temperature at which it is to be run; and (*c*) the volume of air to be circulated, how much is to be recirculated, and what special arrangements are to be made for filtering or separating out solvent vapours. These three factors have varying effects on the amount of heat required, it is found not to spoil the colour or quality of the finished product. Direct firing can generally be used with black enamels and with synthetic resin varnishes which yellow much less during drying than those made with natural gums. Very little experimental work appears to have been done on the effect of the products of gaseous combustion on varnishes, lacquers and enamels, so that chemists' ideas on the subject are largely based on experience with batch-type ovens with no postive circulation. Results with conveyor ovens and positive

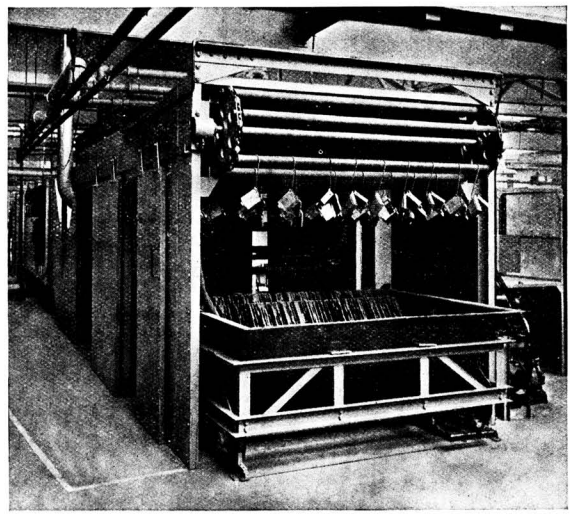

Fig. 3.—Black and white enamelling cast iron electrical switchgear boxes (Midland Electric Manufacturing Co., Ltd., Birmingham).

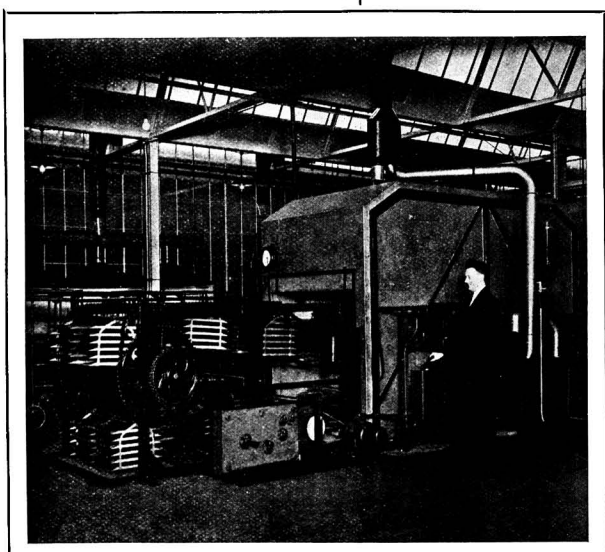

Fig. 4.—Stoving black enamel on metal telephone parts at the works of the Automatic Electric Co., Ltd., Liverpool.

the speed of the drying operation and the colour and quality of the finished product.

Direct firing leads to higher thermal efficiencies than are obtained with indirect firing, and is usually adopted where circulation may well be very different and lead to the use of direct firing for colours.

Increasing the drying temperature used decreases the drying time required—an important consideration. The baking time for any temperature may easily be calculated from two experiments on a varnish or enamel. The limiting factors are the temperatures at which chemicals decomposition and colour changes occur. The highest temperatures (up to 480° F., *i.e.*, 250° C.) are used with black enamels, while delicate colours can only be stoved at temperatures of about 250° F. (120° C.). Nitro-cellulose begins to decompose above 160° F.—180° F. (70° C.—80° C.).

Air Circulation

In many cases, especially where large work is concerned, the amount of air to be circulated depends merely on its temperature drop in the oven and the amount of heat required to raise the temperature of the work passing through the oven to the required extent, and to allow for heat losses. Some oven makers obtain much reduced drying times by rapid recirculation of the air in the oven through an air heater and a centrifugal type of separator from which the fraction containing the heavy vapours is continuously extracted. In this case a comparatively small amount of air is used, but is recirculated a number of times. The principle is theoretically sound, and its practical success must depend on capital and other costs.

We are indebted to the British Commercial Gas Association and to the firms concerned for permission to reproduce the illustrations.

New Dyestuffs Licences

Applications in February

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 532, of which 432 were from merchants or importers. To these should be added six cases outstanding on January 31, making a total for the month of 538. These were dealt with as follows:—Granted, 525 (of which 519 were dealt with within seven days of receipt); referred to British makers of similar products, ten (all dealt with within seven days of receipt); outstanding on February 28, three. Of the total of 538 applications received, 529 or 98 per cent. were dealt with within seven days of receipt.

Chemical Matters in Parliament

Low Temperature Carbonisation

IN the House of Commons on February 28, Mr. J. Wallace (Dunfermline) asked the Secretary for Mines whether he was aware of the proposals recently propounded for the development of low temperature carbonisation in Scotland on a large scale with a central refinery at Rosyth or Port Edgar for treating the oils obtained; and whether he was taking steps to assist the scheme being carried out in the near future, and to ascertain the accuracy of the statistical data which had been published in this connection.

In reply Mr. E. Brown said that while the commercial development of low temperature carbonisation was undoubtedly making some progress in this country he did not regard the particular scheme referred to as one which it would be practicable to carry out in the near future.

Mr. Wallace then asked the Secretary for Mines if he was aware that the Duke of Montrose was reported to have said that with a capital of £8,000,000, for a low temperature carbonisation scheme of this nature there would be an annual return of £2,000,000.

Mr. Brown said he could not take any responsibility for the calculations made or for the statements made.

Coal Tar Naphtha

New British Standard Specifications

THE advantages of being able to market the various fractions of tar distillates to a standard specification has been realised by the principal producers for some time. The National Benzole Association set up a committee which has carried out an excellent piece of work in the preparation of specifications for the more general light oils products used in commerce. It was felt, however, that the value of these specifications would be increased if they were made national standards. They were accordingly referred to the British Standards Institution and, after review by a representative Committee under the Chemical Divisional Council, are now being based as British Standards.

In June, 1932, a group of specifications for xyloles (B.S.S. No. 458) was issued, and a similar group of specifications for coal tar naphthas has just been published as B.S.S. No. 479 (1933). There are three grades of coal tar naphtha covered by this publication—coal tar solvent naphtha (sp. gr. 0.855), heavy coal tar naphtha (sp. gr. 0.860 to 0.910), and heavy coal tar naphtha (sp. gr. 0855 to 0.945). A complete specification is given for each grade and includes amongst others, requirements for distillation range; specific gravity; freedom from impurities such as water, acids and alkalies; and residue on evaporation. Detailed information as to the manner in which the various tests are to be made is given in the appendices and conforms to the recommended methods prepared by the Standardisation of Tar Products Tests Committee. Copies of both specifications are obtainable from Publications Department, British Standards Institution, 28 Victoria Street, London, S.W.1, price 2s. 2d. each, post free.

News from the Allied Industries

Iron and Steel

NO OFFICIAL CONFIRMATION is forthcoming of a report current in Middlesbrough that a merger between Dorman Long and Co. and the South Durham Steel and Iron Co., involving capital totalling nearly £13,000,000, will take place shortly.

Rubber

AN issue of £250,000 new 4½ per cent. debenture stock is being made by the British Goodrich Rubber Co. Holders of the £169,250 6½ per cent. debenture stock which is to be repaid on July 31 next are offered to exchange into the new stock at par, and will receive a cash payment of £6 6s. 3d. per cent., including interest. Shareholders and debenture-holders may subscribe in cash for the balance of the new stock at par.

Non-Ferrous Metals

THE INTERNATIONAL CONFERENCE of zinc producers at Brussels has resulted in an agreement to prolong until July 1 next the existing understanding. The authorised output is maintained at 45 per cent. If the stocks of 148,000 tons increase to 155,000 tons between now and July, producers exceeding their quota will have to restrict further. Another meeting later is to draw up the bases upon which the Cartel can be renewed for two years from July 1.

Cement

LORD DILLON, the chairman of Oxford and Shipton Cement, Ltd., at the company meeting held on March 1, withdrew his resolution to appoint four additional directors, and the motion to re-elect Mr. F. R. Allen (the retiring director) was carried. The payment of a dividend of 1½ per cent., to which Lord Dillon had been opposed, was agreed to. Lord Dillon said that the auditors and the bank advised against the payment. In the opinion of Lord Dillon's colleagues, the balance-sheet should be "cleaned-up" by writing off not more than 5s. a share. Lord Dillon disagreed on this matter. A vote of confidence in the chairman and directors closed the proceedings.

Beet Sugar

A SCHEME is reported to be nearing completion for the manufacture of beet sugar in Sussex. It is stated that a site has been chosen about a mile from Chichester and plans are in preparation for a factory which will be equipped with modern beet handling, crushing and refining machinery, with ample provision for storage and transport. Negotiations are proceeding with farmers in Sussex and Surrey, where the soil is particularly suited for the laying down of about 10,000 acres of sugar beet. The announcement adds that the scheme will enable many farmers to keep in production land which would otherwise be turned over to grass for milk production, a state of affairs which is causing considerable over-production in many parts.

Society of Public Analysts

Mr. F. W. F. Arnaud re-elected President

THE annual general meeting of the Society of Public Analysts was held at the Chemical Society's Rooms, Burlington House, on March 1, when Mr. F. W. F. Arnaud delivered his presidential address.

The following were elected as officers and council for the year 1933:—President: F. W. F. Arnaud; past presidents serving on the Council: E. Richards Bolton, J. T. Dunn, Bernard Dyer, Edward Hinks, P. A. Ellis Richards, G. Rudd Thompson, J. Augustus Voelcker; vice-presidents: John Evans, H. M. Mason, G. W. Monier-Williams, George Stubbs; hon. treasurer: E. B. Hughes; hon. secretary: G. Roche Lynch; other members of Council: H. H. Bagnall, W. T. Burgess, G. D. Elsdon, L. Eynon, C. H. Manley, S. E. Melling, J. R. Nicholls, L. H. Lampitt, H. Lowe, C. E. Sage, J. R. Stubbs, J. F. Tocher.

An ordinary meeting of the Society followed, the president, Mr. F. W. F. Arnaud, being in the chair. Certificates were read in favour of: Gilbert F. Caley, William Dracass, and Y. V. Srikanteswara Iyer. The following were elected members of the Society: Alfred T. S. Babb, Sidney H. Cakebread, Henry Phillips, and Walter D. Raymond.

Weekly Prices of British Chemical Products

Review of Current Market Conditions

THE following market report is based on information supplied by the British manufacturers concerned, and unless otherwise qualified the figures quoted apply to fair quantities, net and naked at makers' works. Where no locality is indicated, the prices are general for the United Kingdom. Particulars of the London chemical market are specially supplied to THE CHEMICAL AGE by R. W. Greeff and Co., Ltd., and Chas. Page and Co., Ltd., and those of the Scottish chemical market by Chas. Tennant and Co., Ltd.

PRICES of chemical products in London continue firm and there is a steady demand. The market for coal tar products remains quiet. In spite of occasional slight reaction in one or two lines, chemicals generally on the Manchester market have been steady to firm in tone. The financial upset in America has done nothing to improve confidence in the trade outlook and the hand-to-mouth basis of buying operations lately in evidence has continued. There is a possibility of a seasonal spurt but only in odd cases so far has there been any evidence of this and then only of limited extent. Meanwhile, users are taking moderate deliveries of materials on order. Buying has been slightly better during the week in the Scottish market. With the following exceptions, prices of chemical products remain as reported in THE CHEMICAL AGE of January 28 (pp. 84-85).

General Chemicals

ACID, CITRIC.—LONDON: 10d. per lb.; less 5%. MANCHESTER: 9½d.

ANTIMONY OXIDE.—SCOTLAND: Spot, £24 per ton, c.i.f. U.K. ports.

ARSENIC.—LONDON: £22 14s. c.i.f. main U.K. ports for imported material; Cornish nominal, £23 f.o.r. mines. SCOTLAND: White powdered, £27 ex wharf; spot, £26. MANCHESTER: White powdered Cornish, £23 at mines.

CARBON TETRACHLORIDE.—£42 to £47 per ton, drums extra.

LEAD ACETATE.—LONDON: White, £34 per ton; brown, £1 per ton less. SCOTLAND: White crystals, £34 to £36; brown, £1 per ton less. MANCHESTER: White, £33; brown, £31.

NICKEL AMMONIUM SULPHATE.—£53 per ton d/d.

NICKEL SULPHATE.—£53 per ton d/d.

POTASSIUM CHLORATE.—3¾d. per lb. ex wharf London in 1-cwt. kegs. LONDON: £37 to £40 per ton. SCOTLAND: 99¾/100% powder, £37. MANCHESTER: £38.

SODIUM PRUSSIATE.—LONDON: 5d. to 5½d. per lb. SCOTLAND: 5d. to 5¾d. ex store. MANCHESTER: 4¾d. to 5¾d.

SULPHUR.—£12 per ton. SCOTLAND: Flowers, £11; roll, £10 10s.; rock, £9; ground American, £10 ex store.

VERMILION.—Pale or deep, 4s. 5d. to 4s. 9d. per lb.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—Export, £5 15s. per ton f.o.b. U.K. ports in single bags; home, £6 10s. per ton, delivered in 6-ton lots to consumer's nearest station.

NITRATE OF SODA.—£8 16s. per ton, delivered in 6-ton lots to consumer's nearest station.

CYANAMIDE.—£7 per ton, delivered in 6-ton lots to consumer's nearest station.

NITRO-CHALK.—£7 5s. per ton, delivered in 6-ton lots to consumer's nearest station.

CONCENTRATED COMPLETE FERTILISERS.—£10 9s. 6d. to £11 per ton according to percentage of constituents as follows:—

PERCENTAGE OF CONSTITUENTS.

	Nitrogen.	Phosphoric Acid. Water Soluble.	Insol.	Potash.	Price per Ton.
No. 1	12.5	12.5	—	15.0	10 14 0
No. 2	10.4	10.4	—	20.8	10 16 0
No. 4	10.4	20.8	—	10.4	10 12 6
No. 5	8.0	16.0	5.5	16.0	10 9 6
No. 6	7.5	26.0	6.0	7.5	11 0 0
No. 7	6.5	22.5	3.0	13.0	10 12 6

The above prices are for delivery to farmer's nearest station in 6-ton lots packed in 1 cwt. bags supplied free by the sellers.

Coal Tar Products

ACID, CARBOLIC.—Crystals, 9d. to 11d. per lb.; crude, 60's, 1s. 11d. to 2s. per gal.; 2% water, 3s. 0¾d. MANCHESTER: Crystals, 9¾d. per lb.; crude, 2s. 4d. per gal. SCOTLAND: 60's, 1s. 7d. to 1s. 8d.

ACID, CRESYLIC.—99/100%, 11d. to 1s. 8d. per gal.; pale 95%, 11d. to 11½d.; dark, 10d., all according to specification; refined, 1s. 8d. to 1s. 9d. LONDON: 98/100%, 1s. 3d.; dark, 95/97%, 11d. SCOTLAND: Pale 99/100%, 1s. 3d. to 1s. 4d.; 97/99%, 1s. to 1s. 1d.; dark 97/99%, 11d. to 1s.; high boiling acid, 2s. 6d. to 3s.

ANTHRACENE OIL.—Strained, 4½d. per gal.

NAPHTHA.—Solvent 90/160%, 9d. to 1s. 2d. per gal.; 95/160%, 1s. 7d. to 1s. 8d.; 90/160%, 1s. 1d. to 1s. 2d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. SCOTLAND: 90/160%, 1s. 3d. to 1s. 3½d.; 90/190%, 11d. to 1s. 2d.

PITCH.—Medium soft, £4 15s. per ton. MANCHESTER: £4 5s. to £4 10s. f.o.b. LONDON: £4 10s. to £4 12s. 6d. f.o.b. East Coast port.

REFINED COAL TAR.—SCOTLAND: 4¾d. to 5d. per gal.

XYLOL.—Common, 1s. 11d. to 2s. per gal.; pure, 2s. to 2s. 2d.

TOLUOL.—90%, 1s. 11d. to 2s. per gal.; pure, 2s. 3d.

Company News

Electrolytic Zinc Co. of Australasia.—A dividend at the rate of 8 per cent. per annum for the six months ended December 31, 1931, on the preference shares, is payable on April 29, at the registered office of the company.

International Paint and Compositions Co., Ltd.—For the year 1932, profits amounted to £102,362. This compares with a net profit for 1931 of £90,364. A final dividend of 6 per cent., making 9 per cent. for the year, is recommended on the ordinary shares, the same as in the previous twelve months.

Waxed-Papers, Ltd.—The report for the year 1932 states that the balance brought forward was £5,314, which, with the profit for the year, £1,443, makes a total of £6,757, which the directors propose shall be carried forward. The annual meeting will be held at the Institute of Chartered Accountants, Moorgate Place, London, on March 13, at 12 noon.

New Transvaal Chemical Co.— The balance standing to the credit of the profit and loss account for the year to June 30 last, including £13,818 brought forward, is £41,126, out of which dividends have been paid on the first preference and "A" preference shares for the year, leaving £17,126. The directors recommend that £525 be used in payment of remuneration of the board, and £16,601 carried forward. The annual meeting will be held at 4 Moorgate, London, on March 16, at 12 noon.

Evans Sons Lescher and Webb, Ltd.—For the year 1932 the report states that the directors do not propose any distribution on account of the dividend on the cumulative preference shares, but that the profit earned be applied to strengthen the general reserve, which will then amount to £20,000. The trading profit amounts to £23,540; from this is deducted mortgage interest and directors' fees, leaving £16,387. With the balance brought forward there is £18,478, out of which provision is made for mortgage and leasehold redemption account, £,1549, and interest on credit notes, £2,719, and £12,000 added to general reserve, leaving a balance to be carried forward of £2,210.

United Glass Bottle Manufacturers.—The profits for 1932, after providing for depreciation, tax and debenture interest, and after adding interest and dividends on investments, amount to £114,140, to which is added the balance brought forward £43,296, making a total of £157,436. The directors have transferred to debenture redemption reserve £10,970, to general reserve £35,000, and to staff benevolent fund £6,000. It is proposed to pay a final dividend on the ordinary shares of 5 per cent., making 7½ per cent. for the year, leaving to be carried forward £42,618. The annual meeting will be held at 40-43 Norfolk Street, London, on March 16, at 12 noon.

Indestructible Paint Co., Ltd.—The net profits for the year 1932, after charging all repairs, and maintenance, depreciation, and providing for bad debts, amounted to £34,653, to which is added the balance brought forward of £4,196, making £38,849. The directors recommend transferring to reserve for tax £4,000, to reserve £5,000, and to depreciation reserve £1,500, reserving for three months unpaid dividend on the 7 per cent. cumulative preference shares to December 31, 1932, final dividend of 10 per cent. on the ordinary shares, making 15 per cent., leaving to be carried forward £2,699.

Celanese Corporation of America.—The accounts for the year 1932 disclose a net balance of $1,596,162, an increase, compared with 1931, of $58,981. With other interest received amounting to $128,057, the total for disposal is $1,724,219 compared with $1,668,685. It is proposed to allow $653,799 for depreciation, to place to reserve for contingencies and unascertained charges $100,000, and to set aside for Federal taxation $75,000, leaving a net income of 891,865. Dividends paid or declared on the 7 per cent. cumulative series prior preferred stock at $5.75, require $660,207, leaving a balance of 231,659 to be carried to the surplus account. A quarterly dividend of $1.75 per share on the prior preferred stock has been declared payable April 1.

Inventions in the Chemical Industry

Specifications Accepted and Applications for Patents

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications Accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Accepted with Dates of Application

MANUFACTURE OF METHYL VINYL KETONE.—E. I. Du Pont de Nemours and Co. Nov. 11, 1930. 388,402.

PROCESS FOR PRODUCING MIXED FERTILISERS CONTAINING AMMONIUM NITRATE AND AMMONIUM PHOSPHATE.—Ruhrchemie Akt.-Ges. Sept. 2, 1930. 388,417.

MANUFACTURE OF ARTIFICIAL SILK AND OTHER ARTIFICIAL PRODUCTS.—British Celanese, Ltd., H. Dreyfus and W. I. Taylor. Aug. 19, 1931. 388,400.

MANUFACTURE OF ALKALI CARBONATE OR ALKALI HYDROXIDE, AND AMMONIA OR AMMONIUM SALTS.—A. Mentzel. Aug. 26, 1930. 388,380.

GRINDING OR LIKE OPERATIONS ON THERMOPLASTIC MATERIALS CONSISTING OF OR CONTAINING CELLULOSE DERIVATIVES.—Celluloid Corporation. Aug. 21, 1930. 388,384.

VULCANISATION OF RUBBER.—Rubber Service Laboratories Co. Aug. 30, 1930. 388,432.

MANUFACTURE OF RESINOUS CONDENSATION PRODUCTS.—International General Electric Co., Inc. Sept. 8, 1930. 388,451.

MANUFACTURE OF SYNTHETIC TANNING SUBSTANCES.—Progil. Oct. 17, 1930. 388,475.

MANUFACTURE AND PRODUCTION OF ASSISTANTS FOR THE TEXTILE AND ALLIED INDUSTRIES.—J. Y. Johnson (I. G. Farbenindustrie). Nov. 3, 1931. 388,485.

GRINDING AND PULVERISING MILLS.—British Rema Manufacturing Co., Ltd., and P. Howden. Nov. 25, 1931. 388,505.

PROCESS FOR PRODUCING EXPLOSIVES.—Lignoza Spolka Akcyjna. Dec. 22, 1930. 388,508.

TREATMENT OF ORGANIC MATERIALS OF CELLULAR CHARACTER WITH SALT SOLUTIONS, AND SALT MIXTURES FOR USE IN SUCH TREATMENT.—Nordmark-Werke Ges. Dec. 27, 1930. 388,513.

MAGNESIUM-BASE ALLOYS.—American Magnesium Corporation. Sept. 12, 1931. 388,515.

TREATMENT OF THREADS, FILAMENTS, AND THE LIKE OF CELLULOSE ESTERS.—Courtaulds, Ltd., and C. Diamond. Dec. 19, 1931. 388,520.

PRODUCTION OF ALKALOID FROM ERGOT.—Chinoin Fabrik Chemisch-Pharmaceutischer Produkte Akt.-Ges. (Dr. Jeresztyi and Dr. Wolf), and Dr. E. Wolf. Sept. 17, 1931. 388,529.

PROCESS FOR EXTRACTING WATER OF CRYSTALLISATION OR HYDRATION FROM SALTS.—Metallges Akt.-Ges. Feb. 16, 1931. 388,553.

MANUFACTURE OF COLOUR LAKES.—Cornbrook Chemical Co., Ltd., and J. Barker. Feb. 13, 1932. 388,563.

PRODUCTION OF BASE-EXCHANGING SUBSTANCES.—A. L. Mond (I. G. Farbenindustrie). Feb. 24, 1932. 388,570.

MANUFACTURE AND PRODUCTION OF POROUS RUBBER.—R. H. Koppel. July 15, 1931. 388,605.

METHOD FOR PRODUCTION OF TRIMETHYLENETRINITRAMINE.—Dinamite Nobel Soc. Anon. Italiana. May 27, 1931. 388,615.

PROCESS FOR MANUFACTURING FATTY SUBSTANCES MISCIBLE WITH WATER.—Deutsche Hydrierwerke. June 12, 1931. 388,630.

METHODS OF MAKING PLASTICIZED PITCH COMPOUNDS AND THE PRODUCTS THEREOF.—United States Pipe and Foundry Co. July 29, 1931. 388,651.

PROCESSES FOR PRODUCING PRACTICALLY PURE CELLULOSE ("ALPHA-CELLULOSE") FROM RAW CELLULOSES OF ANY ORIGIN.—F. C. Palazzo and F. Palazzo. Aug. 4, 1931. 388,656.

PRODUCTION OF DICALCIUM PHOSPHATE.—I. G. Farbenindustrie. Aug. 31, 1931. 388,663.

METHODS OF THICKENING LATEX.—Naugatuck Chemical Co. Oct. 8, 1931. 388,692.

PRODUCTION OF TETRAHYDROFURFURALCOHOL.—H. T. Böhme Akt.-Ges. Nov. 7, 1931. 388,703.

Applications for Patents

PRODUCTION OF CHLORINATED RUBBER PRODUCTS.—J. P. Baxter and Imperial Chemical Industries, Ltd. March 3. 6549.

OBTAINING ACID GASES FROM GASEOUS MIXTURES.—J. A. Brachfeld and A. Smola. Feb. 27. (Austria, Feb. 26, '32.) 5864.

CONCENTRATING VOLATILE AND FATTY ACIDS.—J. A. Brachfeld. Feb. 27. (Austria, Feb. 26, '32.) 5865 and 5866 (cognate with 5865).

ACRIDONE DYES.—P. G. Carter and Imperial Chemical Industries, Ltd. March 4. 665.

PURIFICATION OF GASES.—J. J. Cos. Feb. 28. 6151.

MANUFACTURE OF BORNYL OXALATES.—E. Darrasse, L. Darrasse, L. Dupont and E. Eliöd. Feb. 28. (Germany, Feb. 29, '32.) 6031.

MANUFACTURE OF OXALIC ACID, ETC.—E. I. Du Pont de Nemours and Co. Feb. 27. (United States, Feb. 27, '32.) 5931.

MANUFACTURE OF ARYLAMINO-1-HYDROXYNAPHTHALENE-CARBOXYLIC ACIDS.—W. W. Groves. Feb. 27. (Germany, Feb. 27, '32.) 5902.

LOW-TEMPERATURE CARBONISATION OF CARBONIFEROUS MATERIAL.—L. G. Hill. March 1. 6182.

PRODUCTION OF FORMIC ACID.—G. F. Horsley and Imperial Chemical Industries, Ltd. Feb. 28. 6140.

MANUFACTURE OF AZO DYESTUFFS.—I. G. Farbenindustrie. Feb. 27. (Germany, Feb. 27, '32.) 5901.

MANUFACTURE OF ALKALI METAL SALTS OF ADENYL-PYROPHOSPHATIC ACIDS.—I. G. Farbenindustrie. Feb. 27. (Germany, Feb. 27, '32.) 5904.

MANUFACTURE OF SULPHONATED PRODUCTS OF ALIPHATIC CARBINOLS.—I. G. Farbenindustrie. Feb. 28. (Germany, Feb. 29, '32.) 6113.

MANUFACTURE OF A MONO-AZO DYESTUFF.—I. G. Farbenindustrie. Feb. 28. (Germany, Feb. 29, '32.) 6114.

MANUFACTURE OF REACTION PRODUCTS.—I. G. Farbenindustrie. Feb. 28. (Germany, Feb. 29, '32.) 6144.

MANUFACTURE OF NUCLEAR SUBSTITUTION PRODUCTS OF ACENAPHTHALIC ACID AND 1 : 4 : 5 : 8-NAPHTHALENETETRA-CARBOXYLIC ACID.—I. G. Farbenindustrie. March 2. (Germany, March 2, '32.) 6374.

MANUFACTURE OF REACTION PRODUCTS.—I. G. Farbenindustrie. March 2. (Germany, March 2, '32.) 6437.

MANUFACTURE OF REACTION PRODUCTS.—I. G. Farbenindustrie. March 3. (Germany, March 3, '32.) 6541.

CABLE LACQUERS.—Imperial Chemical Industries, Ltd. Feb. 28. 6088.

PRIMING COMPOSITIONS.—Imperial Chemical Industries, Ltd. March 2. 6420.

PRODUCTION OF LIQUID HYDROCARBONS FOR USE AS MOTOR SPIRIT.—Imperial Chemical Industries, Ltd. March 3. 6550.

DYEING CHROME LEATHERS WITH BASIC DYESTUFFS. Imperial Chemical Industries, Ltd. March 4. 6647.

REMOVAL OF WEAK GASEOUS ACIDS FROM GASES.—J. Y. Johnson (I. G. Farbenindustrie). Feb. 27. 5931.

MANUFACTURE OF ETHERS.—J. Y. Johnson (I. G. Farbenindustrie). Feb. 27. 5962.

MANUFACTURE OF CONDENSATION PRODUCTS OF THE UREA-FORMALDEHYDE TYPE.—V. Lefebure, A. Renfrew and Imperial Chemical Industries, Ltd. March 1. 6294.

CHEMICAL MANUFACTURE.—Mathieson Alkali Works. March 2. (United States, March 24, '32.) 6414.

DISTILLATION OF SOLID CARBONACEOUS, ETC., MATERIALS.—H. Nielsen. Feb. 28. 6039.

MANUFACTURE OF INTERMEDIATE PRODUCTS, AND DYESTUFFS THEREFROM.—Soc. of Chemical Industry in Basle. Feb. 27. (Switzerland, Feb. 25, '32.) 5900.

Southall Bros. and Barclay, Ltd.

Repayment of Preference Capital

THE directors of Southall Bros. and Barclay, Ltd., chemists and druggists, propose to extinguish preference capital amounting to £130,000 (the total outstanding) by the repayment of 25s. per share, 5s. of which is by the way of compensation for redemption. The repayment will be effected out of cash assets, which at December 31 last amounted to £170,000, against a combined preference and ordinary share capital of £286,000. The ordinary capital of £156,000 in shares of £1 each is subsequently to be split into 624,000 shares of 5s. each and increased to the original figure of £286,000 by the creation of 520,000 new 5s. ordinary shares. Profits last year were £75,052, against £72,794 for 1931 and £30,806 for 1922. The distribution on the ordinary shares is maintained at 20 per cent. tax free, including a bonus of 7½ per cent., £20,000 is carried to reserve, making that fund £360,000, and a further £20,000 is allocated to establish an advertising reserve. A balance of £24,746 is carried forward, against £27,394 brought in. In addition to the general reserve there is an undisclosed but substantial internal reserve included in the item creditors in the balance-sheet, which, standing at £330,809, compares with debtors of only £176,680.

From Week to Week

MR. WILLIAM J. NICHOLSON, retired analytical chemist, 54 Caledonia Road, Saltcoats, left £6,482.

MR. CHARLES MADDOCK STUART, M.A., F.C.S., F.I.C., of 33 St. Augustine's Avenue, South Croydon, Surrey, left £36,283, (net personalty £34,461).

MR. IAN SMITH has been appointed manager of the lime works of James Reid & Co., Ltd., at Lugton, Ayrshire. He was formerly Scottish manager for the Gulf Line.

MR. H. A. S. GOTHARD, managing director of the G.K.S. Combustion Co., Ltd., has completed an arrangement whereby he becomes sole distributor for the products of Nichols Compressors, Ltd., Northallerton, Yorks, for London and the home counties.

BROTHERTON AND CO., LTD., chemical manufacturers, of City Chambers, Leeds, have opened a branch office at 68 Victoria Street, London, S.W.1. Captain Bertram L. Ratcliffe, M.C., a director of the firm, is in charge.

THE ANNUAL SOCIAL GATHERING of the employees at Falkirk of Nobels Explosives, Ltd., held in the Town Hall, Falkirk, was marked by the presentation of awards to a number of employees with over 25 years' service. Mr. Donaldson, manager of the technical department (Nobel section), Ardeer, made the presentations.

ORGANISATION AS A SCIENCE was the subject of a paper delivered by Mr. L. Urwick at the Business Research and Management Association, London, on March 7. He advocated the use of "staff" officials, who, though acting entirely in the name of the chief, should relieve him of his work of co-ordinating subordinates, by carrying out in his name many of his functions.

"RUBBER MANUFACTURE and development in Engineering," was the subject of a paper read at a meeting in Glasgow of the local branch of the Association of Foremen Engineers and Draughtsmen, by Mr. E. P. Smith on March 4. The future of the rubber industry, he said, depended on close co-operation between engineering designers and chemists.

DESPITE A DECREASE of just under 1 per cent. in gas sales during 1932, the Newcastle Gas Co., had a very successful year, and its optimism is reflected in the 1933 edition of the company's Year Book just issued. Notwithstanding acute trade depression, gas prosperity has been maintained, and the Year Book illustrates some of the extended applications of gas in the industrial field. It also contains a report of the annual meeting at which a dividend of £5 7s. 6d. per cent. was declared.

THE CHINA CLAY INDUSTRY was the subject of a lecture by Mr. E. H. Davison, of the Camborne School of Mines, at the University College of the South West, Exeter, on March 1. In the course of his lecture Mr. Davison mentioned that a large proportion of the china clay sand had to be dumped beside the pits as being useless, waiting for someone to take it on a large scale to the London market, where it could be sold for road making purposes.

ONE OF THE OMNIBUSES propelled by compressed coal gas and used for carrying passengers on the occasion of the British Industries Fair at Birmingham was provided by the Chesterfield Corporation and was filled from a gas-filling station of the Bryan Donkin Co., Ltd., in which was housed an electrically driven Donkin high-pressure 4-stage compressor with a capacity of 6,000 cu. ft. per hour and capable of supplying gas at a pressure of 5,000 lb. per sq. in. The Chesterfield omnibus was fitted with the Bryan Donkin Co's special reducing governor capable of reducing pressure of 30 to 3,000 lb. per sq. in. to a vacuum of 1½ in. water gauge.

THE OFFICIAL REPORT regarding business, done at the Birmingham Section of the British Industries Fair, which closed on March 3, was that it was a successful fair. Actual business done was "fairly good"; inquiries were better and more numerous than last year; many applications from exhibitors had been made for space at the Fair of 1934; and the board of management had decided to enlarge the buildings. To this end plans have been prepared, and no time is to be lost in getting to work. The attendance (111,213) was 30,000 less than in 1932, but the admission charge was 2s. instead of 1s. as formerly; and this explains a fall from 39,735 in 1932 to 18,124 on Saturday February 25 which was the "Public Day."

THE AIR MINISTRY has placed a contract for twelve months' supplies of aviation petrol made from British coal. The petrol is produced by Low Temperature Carbonisation, Ltd., as a by-product in the manufacture of Coalite smokeless fuel, and is taken and refined by Carless, Capel and Leonard, of London. With a view to increasing output of the new petrol, the Askern works of Low Temperature Carbonisation, Ltd., have recently been extended by 50 per cent., and other arrangements also are in hand. The works at Barugh and Askern are both equipped with the necessary plants for the production of coal petrol, and already over 4,000 tons has been produced and marketed.

FAIRY DYES, LTD., Glasgow, held their 13th annual dance in the Grosvenor Restaurant, Glasgow, last week.

THE OFFICIAL OPENING of the new extensions to the Billingham Synthonia Recreation Club House was performed by Dr. A. Fleck, of the General Chemical Group, I.C.I., on March 3.

THE LONDON SECTION of the Society of Chemical Industry had elected Dr. J. J. Fox as chairman for the ensuing year. He will take office after the annual meeting of the section in May.

AT THE MONTHLY LUNCHEON of Oil Industries Club, held at the Great Eastern Hotel, London, on March 7, Dr. T. H. Bishop, of the medical branch, Anglo-Persian Oil Co., Ltd., spoke on "Oil and Medicine—a Compatibility."

MR. DAVID LEVER has been appointed lecturer in charge of the school of sugar manufacture at the Royal Technical College, Glasgow, in succession to Mr. T. P. H. Heriot. Mr. Lever formerly held the position of chemist with the Demerara Co., Ltd., in British Guiana.

THE COUNCIL OF THE ROYAL SOCIETY has agreed to recommend for election into the society the following candidates:—Harry Medforth Dawson, Professor of Physical Chemistry, Leeds University; John Edward Lennard-Jones, Plummer Professor of Inorganic Chemistry, Cambridge University.

THE STURTEVANT ENGINEERING CO., LTD., has received an order for the supply of two electrostatic precipitation plants for the removal of grits from flue gases of pulverised fuel fired boilers at a large London power station. The volume of flue gases to be handled by these precipitators is in excess of 8,250,000 cu. ft. per hour.

RECOGNITION WAS MADE by the members of the Bristol section of the Society of Chemical Industry, of the work of their hon. secretary, Mr. Arthur Marsden, when he was presented with a silver salver at the annual general meeting of the section last week. Mr. R. D. Littlefield was re-elected chairman for the third time; Professor F. E. Francis, vice-chairman; Mr. M. W. Jones, hon. treasurer; and Mr. A. Marsden, hon. secretary.

LIKELY DEMANDS on the petroleum industry for the supply of fuel for high speed Diesel engines on the road, in the air and on rail, were discussed by Dr. A. E. Dunstan, F.I.C., in a paper read before the Newcastle Section of the Society of Chemical Industry on March 9. Dr. Dunstan outlined recent advances in distillation, cracking, and chemical treatment of distillates; methods depending on absorption were also described, together with their bearing on the criteria demanded for the various products derived from petroleum.

THE MIGRATION OF OIL AND NATURAL GAS was the subject of a paper read by Professor V.C. Illing before the Institution of Petroleum Technologists on March 7, at the Royal Society of Arts. Primary migration is said to be due to fluid movements within the source rocks, owing primarily to compaction helped by any other external or internal sources of pressure. It is held that oil originates while compaction is in process. The oil moves with other fluids through sands or other porus rocks, and is filtered from the water in these sands and cannot pass out again into the clay owing to the back pressure to oil at the coarse fine interface.

ILLUSTRATIVE OF THE MARKED PROGRESS in welding processes, two lectures on the subject have been delivered to technical societies in Glasgow this week. Advances in the electric arc process were outlined by Mr. J. L. Adam at a meeting of the Institution of Engineers and Shipbuilders in Scotland, while on March 2 a cinematograph film illustrating the oxy-acetylene process was shown to members of the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen. The film, produced by the Swiss Acetylene Association, Basle, showed the latest practice and developments in oxy-acetylene welding as applied in many of the largest railways, engineering, boiler-making, shipbuilding, aircraft works, etc., on the Continent.

SEVERE CRITICISM of the Suez Canal Company was made by Lt.-Col. Sir Arnold Wilson in an address at the sixtieth Individualist Luncheon held at the Hotel Victoria, London, on March 8. Sir Archibald Hurd presided. Sir Arnold Wilson said that the average net dividends paid by the company for the last four years had been over 40 per cent. These swollen dividends of what should, according to current ideas, be a great international public utility company contrasted strangely with those of genuine national public utility corporation whose dividends were strictly controlled and seldom in practice amounted to over 7 per cent. In the light of the figures, the Suez Canal Company appeared as a vital artery which was tenanted by growths, once beneficient but now parasitic, upon the life-stream of overseas commerce, and especially that of this country. Sir Ernest Benn, in seconding a vote of thanks, said that if Geneva could be invited to look into the principles and methods of the Suez Canal, he thought it might acquire some little wisdom as to the management of such matters as Austrian loans.

THE DEPARTMENT OF AGRICULTURE of the Irish Free State has issued a notice drawing attention to the serious decline in the use of chemical fertilisers. It is stated that there has been a sharp falling off in the demand for superphosphates and other fertilisers for the 1933 season. In the course of the official statement it is remarked: "Artificial fertilisers are at present reasonable in price as compared with other farm requisites and in relation to the increased production brought about by their use. The Free State is far behind other countries in the amount of fertilisers applied per acre."

THE IMPORT DUTIES ADVISORY COMMITTEE has received applications for a reduction in the import duty on graphite electrodes of the following dimensions: Slabs, 1,000 mm. long by 175 mm. wide by 50 mm. thick; rods, 300 to 350 mm. long by 50 mm. diameter; and for drawback under Section 9 of the Finance Act, 1932, in the case of paraffin scale mixture in respect of the white paraffin scale used in its manufacture. Representations should be addressed to the secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, London, S.W.1, not later than March 20. The committee has decided not to make any recommendations in respect of applications for the addition to the free list of "Lux" gas-purifying material (bog ore substitute), and for drawback in the case of cupro-nickel tubes for oil and water coolers.

LECTURING on the production of oil and motor spirit from coal, at the Birmingham and Midland Institute last week, Professor C. H. Lander stated that motor spirit formed by far the largest proportion of liquid fuel used in this country, our requirements at present amounting to about 1,000 million gallons annually. In his opinion low temperature carbonisation could take an important place as a means for reducing domestic smoke, but, as operations increased in magnitude, a problem of the disposal of the heavier fractions of the tar would have to be faced. Both the motor spirit and the fuel oil obtained from tar could be prepared so that they had qualities in no way inferior to those possessed by the natural material, petroleum. If a sufficiently high price could be maintained for the smokeless fuel made, the other products could compete in price with natural oils. By hydrogenation, subjecting coal to the action of hydrogen at a temperature of about 450°C. under a pressure of 3,000 lb. per sq. in., coal could be liquefied and so made to produce much larger proportions of motor spirit, upwards of 160 gallons per ton. To do this, however, for every ton of coal treated an additional ton of coal would be necessary to carry out the process. Motor spirit could then be made to sell, ex-works, at about 9d. per gallon, as against the 3d. or 4d. which it cost at present when entering our ports, to which was added an import duty of 8d. per gallon.

SEVERAL FURTHER CONFERENCES have taken place during the past few weeks regarding the starch and dextrine factory which it is proposed to open at Athlone, Irish Free State. Estimates of the quantity of potatoes to be delivered at the factory have been prepared and in the initial stages the quantity will average about 250 tons per week. It is possible that the company may request the Free State Government for financial aid, under the Trade Loans (Guarantee) Act, for the purchase of machinery.

THE CONCLUSION OF NEGOTIATIONS between Harry Balfour and Co., Durie Foundry, and an American company for the manufacture of plant which will be in universal demand at the Leven works, kindles new hopes of improved business at Leven. The firm of H. Balfour and Co. has many connections with the chemical industry. The new agreement relates to the manufacture by a new process of plant which will be in request in the chemical, distillery, and other industries. A start is to be made to the new lay-out of the works which the new plant will entail, and the manufacture will, it is expected, be in progress before autumn.

INFINITELY GREATER as the liberty of the present day chemist is within the works administration as compared with the conditions under which even his elder brother worked, there are still many who plead for a really direct representation on the Board. Mr. R. D. Littlefield, chairman of the Bristol Section of the Society of Chemical Industry, when he addressed the annual meeting of the section on March 2 on "The Laboratory and the Board Room," called for more co-operation and confidence between the purely technical and mainly commercial side of a business. Mr. Littlefield, who has been Government Inspector of Chemical Factories, sketched a regime which, though not revolutionary, would bring this state a step nearer realisation. He suggested that the chemist be given a more frequent voice in matters that are not entirely technical, and in the main that the idea of a "happy family" should be carried out.

Obituary

MR. G. W. MALCOLM, on March 4 at his home at Davenham, Cheshire. Mr. Malcolm was managing director of Salt Union, Ltd. He was also a director of the British Light and Power Corporation (1929), Ltd., the Electricity Distribution of North Wales and District, Ltd., North Wales Power Co., Ltd., and chairman of the Mersey Power Co., Ltd.

SIR WILLIAM VENO, who was chairman and governing director of the Veno Trust, Ltd., and a director of Cellulose Acetate Silk Co., Ltd., was found shot in the grounds of his residence, "The Woodlands," Altrincham, near Manchester on March 6. Aged 66.

Forthcoming Events

Mar. 13.—Institute of Metals (Scottish Section). "An Investigation with Nickel Alloys for High Pressures and Temperatures." R. J. Taylor. "Welding." M. Brownlie. Annual General Meeting. 7.30 p.m. 39 Elmbank Crescent, Glasgow.

Mar. 13.—Ceramic Society (Pottery Section). "Die Filling, Hardness and Wedging of Dust Pressed Tiles." Dr. Harry W. Webb. 7.30 p.m. North Staffordshire Technical College, Stoke-on-Trent.

Mar. 13.—Royal Society of Arts. "Welding and Allied Processes for Engineering Purposes." (Lecture II). Arthur Stephenson. 8 p.m. John Street, Adelphi, London.

Mar. 13.—Institution of the Rubber Industry. "Effect of Reclaim on the Manipulation of Rubber." G. Martin. 7.30 p.m. First Avenue Hotel, High Holborn, London.

Mar. 14.—Institute of Chemistry (Belfast and District Section). "Sulphuric Acid and Fertilisers." E. M. Reid. 7.45 p.m. Royal Belfast Academical Institution.

Mar. 14.—Institute of Chemistry (Huddersfield Section). Annual General Meeting. "Modern Light Leather Manufacture." D. J. Law.

Mar. 14.—Institute of Metals (Swansea Section). "Rolling." G. A. V. Russell. 6.15 p.m. Y.M.C.A. Swansea.

Mar. 14.—Institute of Metals (N.E. Coast Section). Discussion on "The Testing of Non-Ferrous Metals." Annual General Meeting. 7.30 p.m. Armstrong College, Newcastle-on-Tyne.

Mar. 15.—Society of Glass Technology. Stourbridge.

Mar. 15.—Royal Society of Arts. "The Chemistry of Hydrocarbon Combustion." Professor W. A. Bone. 8 p.m. John Street, Adelphi, London.

Mar. 15.—British Association of Chemists (Manchester Section). Annual Dinner. 6.45 p.m. Engineers' Club, Manchester.

Mar. 16.—Students' Chemical Society of the Manchester College of Technology. "Configuration Problems in Unsaturated Acids." Professor T. C. James. 5 p.m. Large Chemical Lecture Theatre, E.17.

Mar. 16.—Institute of Metals (Birmingham Section). "Metals in the Electrical Industries." C. J. Smithells. 7 p.m. University, Birmingham.

Mar. 16.—Institute of Metals (London Section.) "Recent Developments in Bearing Metals." A. J. Murphy. 7.30 p.m. 83 Pall Mall, London.

Mar. 16.—Institute of Chemistry (Manchester Section). Annual General Meeting. "Some Curious Features of the Composition of Fats in Plants and in Animals." Professor T. P. Hilditch. 7 p.m. College of Technology, Manchester.

Mar. 16.—Society of Chemical Industry (Nottingham Section). "The Riddle of the Roll Film." Dr. H. Baines. 7.30 p.m. University College, Nottingham.

Mar. 16.—The Chemical Society. Discussion on "The Chemical Constitution of Oestrin." Opened by Dr. G. F. Marrian. 8 p.m. Burlington House, London.

Mar. 17.—Royal Institution. "The Structure of Alloys." 9 p.m. W. L. Bragg. 21 Albemarle Street, London.

Mar. 17.—Society of Dyers and Colourists (Manchester Section). "Improvements in Piece Bleaching Machinery." A. Grunert. 7 p.m. 36 George Street, Manchester.

Mar. 17.—Society of Chemical Industry. Joint Meeting of Chemical Engineering Group and Birmingham Section. Visit to Bournville works of Cadbury Bros., Ltd. 1.45 p.m. "Personnel in Industry." W. A. S. Calder. 6 p.m. University Latin Theatre, Birmingham.

Mar. 17.—The Physical Society. 5 p.m. Imperial College of Science, South Kensington.

Mar. 17.—Society of Chemical Industry (South Wales Section). Annual Meeting. 7.15 p.m. Technical College, Cardiff.

Mar. 17.—Society of Chemical Industry (Liverpool Section). "Scientific Disarmament and Security." Major V. Lefebure. 6 p.m. University, Liverpool.

Mar. 17.—Institute of Metals (Sheffield Section). Discussion on "Annealing." Opened by E. A. Smith. 7.30 p.m. University Sheffield.

Mar. 17.—West Cumberland Society of Chemists and Engineers. "Sampling of Coal and Coke, and General Principles of Sampling." E. S. Grumell. 7 p.m. Workington.

Mar. 18.—Finsbury Technical College Old Students' Association. Dinner. Trocadero, London.

New Companies Registered

Arthur Ashworth, Ltd., Fernhill Chemical Works, Bury. Registered on March 4. Nominal capital £27,500 in £1 shares. To acquire the business of a chemical manufacturer and merchant now carried on by Arthur Ashworth at Fernhill Chemical Works, Bury, as "Arthur Ashworth," and to carry on the business of manufacturing and general chemists and druggists, drysalters, oil and colour men, makers of vitriol, bleaching and dyeing materials, etc.

J. C. Hempel, Ltd. Registered on February 23. Nominal capital £1,000 in £1 shares. Manufacturers of and dealers in paint, enamel, stains and varnish, drysalters, oil and colour men, etc. Directors: Iver Lunn, 6 Adam Street, London, W.1, and E. W. Tanfield.

Institute of Science and Inventions, Ltd. Registered February 20. Nominal capital £100 in 5s. shares. Manufacturers, repairers, letters out on hire and dealers in equipment for the chemical, electrical and mechanical trades, etc. A subscriber is K. H. Clegg, Avondale, 30 Holmfield Road, N.S. Blackpool.

Standard Boiler Compound Co., Ltd. Registered in Edinburgh February 23. Nominal capital £100 in £1 shares. Boiler compound manufacturers, feed water specialists, chemical manufacturers and importers, etc. Directors are: James Richardson, 295 Glasgow Road, Blantyre, Lanarkshire, and G. N. Strachan.

Widnes Soap Company, Ltd. Registered on February 15. Nominal capital £20,000 in £1 shares. Objects: To adopt an agreement dated December 1, 1932, with Kenmure King and Henry King, and to carry on the business of manufacturers of soap and soap powders, candles, glycerine, alkali and other chemical products, etc. Directors: R. W. Bloomer, Rockcliffe, Helsby, Cheshire, M. W. Hardwick, J. H. Wigner and E. M. Wright.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Canada.—A firm of manufacturers' agents and grocery brokers at Toronto is prepared to represent United Kingdom manufacturers of tartaric acid and citric acid, on a commission or consignment basis, in the Province of Ontario. (Ref. No. 347.)

South Africa.—A Cape Town firm desires quotations and small samples from United Kingdom manufacturers of soya bean oil and linseed oil (raw and boiled), with a view to an agency in the Western Cape Province. (Ref. No. 357.)

United States of America.—An old-established American firm wishes to represent British manufacturers of heavy and industrial chemicals, including barium compounds, calcined magnesia, coal tar acids, etc., on a commission or purchasing basis. The President of the firm will be in London until March 17 for the purpose of making personal contact. (Ref. No. 377.)

Books Received

La Teinture du Coton et les Traitements Annexes. By E. Serre. Paris: Dunod. Pp. 334. 63 Fr.

Lubricating and Allied Oils. By Elliott A. Evans. London: Chapman and Hall, Ltd. Pp. 176. 9s. 6d.

Economic Conditions in Portuguese East Africa, dated October, 1932. Report by H. A. Ford. London: H.M. Stationery Office. Pp. 94. 2s. 6d.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry 1932. Vol. XVII. London: Society of Chemical Industry. Pp. 728. Members 7s. 6d. Others 12s. 6d.

New Chemical Trade Marks

Compiled from official sources by Gee and Co., Patent and Trade Mark Agents, Staple House, 51 and 52 Chancery Lane, London, W.C.2.

Opposition to the Registration of the following trade mark can be lodged up to March 15, 1933.

Homac. 537,481. Class 1. Synthetic resins being chemical substances for use in the manufacture of paints and enamels. Walton Chemical Co., Ltd., Bull Lane, Aintree, Liverpool. December 14, 1932.

Opposition to the registration of the following trade marks can be lodged up to March 22, 1933.

Lanoplast. 537,574. Class 1. Cellulose acetate being a chemical substance for use in manufactures. Cellulose Acetate Silk Co., Ltd., Caton Road, Lancaster, Lancashire. December 16, 1932.

Neo-Cardyl. 537,267. Class 3. Chemical substances prepared for use in medicine and pharmacy. May and Baker, Ltd., Garden Wharf, Church Road, Battersea, London, S.W.11. December 6, 1932.

Opposition to the registration of the following trade marks can be lodged up to April 8, 1933.

Neofex. 538,273. Class 1. Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. North British Chemical Co., Ltd., Fairfield Road Works, Droylsden, Manchester. January 14, 1933.

Transpet. 538,901. Class 1. Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. Blundell, Spence & Co., Ltd., Bankside Works, Sculcoates Lane, Hull; and 9 Upper Thames Street, London, E.C.4. February 8, 1933.

Casephrin. 537,902. Class 3. Chemical substances prepared for use in medicine and pharmacy. May & Baker, Ltd., Garden Wharf, Church Road, Battersea, London, S.W.11. December 31, 1932.

British Standard. 532,684. Class 2. Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. British Standards Institution, 28 Victoria Street, Westminster, London.

ADVERTISERS please note that the latest hour at which we can accept advertisements for insertion in these columns each week is 12 o'clock on Thursday morning.

APPOINTMENTS WANTED

(Prepaid—Twenty-seven words 1s. 6d.; every additional nine words 6d.) Replies can be received "Box , Office of this Journal," in which case our address is included in cost of advertisement, and charged as nine words.

BOYS of good character, well-trained and eager to work, will be gladly recommended by the Warden of the John Benn Hostel, Bower Street, E.1.

YOUNG MAN, 21, desires an opening in industrial chemistry, now working as laboratory assistant. National certificate in chemistry, willing to start at low wage, energetic, keen and willing. Advertiser, 21 Ravenscraig Road, N.11.

EDUCATIONAL

(1s. per line; minimum charge 8s.)

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY.

FELLOWSHIPS.

Applications are invited for a limited number of Fellowships available for chemists of post-graduate standing. The object of the Fellowships is to afford additional and special training at home or abroad preparatory to a career in industrial chemistry. The course to be followed will in each case be decided by the Director in consultation with the Fellow. The value of a Fellowship is normally from £250 to £300, but the Institute is prepared to consider applications which might justify the award of Fellowships of higher value.

Applications should be received by the Director of the Institute, Salters' Hall, St. Swithin's Lane, London, E.C.4, on or before

1st MAY, 1933.

Further particulars and forms of application may be had on request.

ARTHUR SMITHELLS,
Director.

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY.

GRANTS-IN-AID.

The Committee will in July allocate a limited number of Grants-in-Aid to young men and women employed in chemical works in, or near, London who desire to extend their education for a career in chemical industry. Applicants must not be under 17 years of age. Applications, with particulars of age, nature of employment and manner in which the grant would be used, and giving the name of some person to whom reference may be made, should be sent as soon as possible, and in any case not later than 1st May, 1933, to the Director of the Institute, Salters' Hall, St. Swithin's Lane, London, E.C.4.

ARTHUR SMITHELLS,
Director.

FOR SALE

(1s. per line; minimum charge 8s. Sixpence extra is charged when replies are addressed to Box Numbers.)

AVERY Weighbridge, six tons; cheap for quick sale. Can be seen in working order at Walter P. Edmunds, Ltd., King's Hill, Wednesbury.

BROUGH'S Patent Indestructible Drums and Kegs, also Plain Welded, Double-seamed or Corrugated Drums and Kegs, of every description, from 1 to 80 gallon.—4 Upper Parliament Street, Liverpool. Telephone: Royal 2685. Telegrams: Superdrum, Liverpool.

CHARCOAL, ANIMAL and VEGETABLE, horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Hill Jones Pop., London." Telephone: 3633 East.

HYDRAULIC PRESSES AND PUMPS. Large stock in London. Price quoted for adapting and erecting.—THOMPSON AND SON, Maria Street, Millwall.

MIXERS by Werner and other makers, jacketed pans, disintegrators, grinders, good stock.—C. F. DAVIS, LTD., Hatcham Road, Old Kent Road, London, S.E.15.

TO DYERS and Artificial Silk Manufacturers.—Special Yarn Poles for Cotton, Wool and Silk Dyers, also Stove Poles, Dye Boxes, Bobbins, Rollers, Bogies, Yarn Barrows, etc. Special Lancewood Poles and Canes, superfine finish for Mercerisers. Prices on application. CRAWFORD'S TURNING MILLS, Paisley, Scotland.

'Phone 98 Staines.

"Z" BLADE MIXER, Pan 20 in. square; 100 Gallon Fixed Copper Jacketed Pan; 35 Gallon Tilting type; 30 in. Disintegrator; Johnson Filter Press 27-chamber, 27 in. dia.; 4 ft. Edge Runner.
HARRY H. GARDAM AND CO., LTD., STAINES.

WANTED

(1s. per line; minimum charge 8s. Sixpence extra is charged when replies are addressed to Box Numbers.)

GRINDING of every description of chemical and other materials for the trade with improved mills.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Hill-Jones, Pop., London." Telephone: 3633 East.