The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LII
No. 1340

SATURDAY, APRIL 14, 1945
REGISTERED AS A NEWSPAPER

6D. PER COPY
POST FREE 8D.

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THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers Limited

VOL. LII
No. 1346.

April 14, 1945

Annual Subscription 21s.
Overseas 26s.

The Tools of Industry

BRITISH industry, as we pointed out last week in these columns, has delivered the goods. It is not basically inefficient, but is it adequately equipped to compete against foreign competition in the markets of the world? We have indicated the difficulties under which British industry has operated these five and a half years; the shortage of manpower, of supplies, and of raw materials, and the need for concentrating on production have brought other handicaps which will embarrass us after the war. The first of these is maintenance. Our plant has not had that maintenance that as skilled engineers we know it should have. In every branch of industry the loss of skilled men to the Forces and to purely production work has told its tale. A great deal has been done; plant and machinery have not been allowed to work to a standstill; but the fact remains that the repairs and maintenance programme is already years behind schedule. Replacements on a vast scale will be needed, and that immediately. On so huge a scale will those replacements and extensions be demanded that the allocation of materials for them in orderly priority will be one reason for retaining controls of raw materials, of steel and so forth. Europe will require to be re-equipped. It is necessary that the peoples of Europe who have lost everything shall be put into a position to earn their own living, to feed and clothe themselves and to rebuild their countries. That is right and we do not for an instant dispute that we must do our part to help. But let us be quite sure that in re-equipping others we do not leave ourselves with old-fashioned, worn-out plant.

Industry demands a fair share of the nation's productivity to supply its own needs. We need industrial re-equipment and we need personal re-equipment. Unless both of these are forthcoming, industry will not become efficient and whatever efficiency we now possess will decrease. While we were fighting for our lives we put up with much that we are not willing to put up with under conditions of peace. But we have still a heavy task to fulfil, and industry must demand of the Government that the British shall have some precedence in food, in raw materials, and in the amenities of life that will enable those worn out by the long struggle to recover their energies.

The physical reconstruction, difficult as

On Other Pages

it is, requires for its fulfilment *finance*. We have insisted, on more than one occasion, that the Chancellor of the Exchequer has been demanding too much return from the taxation of industrial profits. The principles of sound business finance have been abandoned in order that the Treasury shall have something to crow about. We have, however, admitted that the new Income Tax Bill has removed some of the worst features of industrial taxation. The aim of policy from now on should be to make such tax concessions to industry as will restore real capital and provide funds for re-equipment. The position of many firms is not markedly different from that given by Lord Davidson in his address to the Engineering Industries Association, of which body he is president, from the experience of 100 specimen engineering firms. These companies in their last financial year retained £775,000 of their profits and handed over to the Government no less than £9,125,000; a staggering ratio of profits retained to moneys demanded by the Exchequer. It might be said that these were companies that had been making excess profits. Let us see. At their balance sheet dates their ordinary current assets were £11,748,000 and their ordinary current liabilities were £4,966,000; but there was owing to the insatiable maw of the Inland Revenue no less than £4,501,000. The net result is that they are only barely solvent. In point of fact the retainable profits of these 100 industrial guinea-pigs amounted to but 3 per cent. on turnover. A writer in *The Times* justly remarks that "this is hardly a financial basis on which to expand operations (as these companies have) to more than double the pre-war level and then to convert the expanded businesses to peaceful purposes."

Huge amounts of capital are needed by British industry for re-equipment. It is fresh in mind that the coal industry needs enormous sums. The textile industry is said to need over £100,000,000. Other industries seem likely to require sums of a similar magnitude. In addition to the normal re-equipment and the renewal of worn-out or obsolete plant, there is another expense that must be incurred. Our inventiveness and our resource are equal to those of any other nation. But our works are old. Many of them have been established a great many years. They have grown with the growth of the business. They have often grown in cramped quarters, and comparatively few have been planned from the outset to meet the full production so that the flow of material through the works is really the best that can be devised. Our costs and our ability to produce *en masse* (where mass-production is desirable) are handicapped by that "admired disorder" that seems to the foreigner the very embodiment of "muddling through." We need not only to re-equip ourselves with new plant and machinery, but in many instances to rebuild our works completely on new and more commodious sites. Finance is essential if this is to be done.

Another essential is the limitation of control. Mr. Churchill, in his speech to the Conservative Party on March 15, declared: "Control for control's sake is senseless. At the head of our mainmast we fly the flag of free enterprise"; and again: "No restriction upon well-established British liberties that has not proved indispensable to the prosecution of the war and the transition from war to peace can be tolerated." We shall hold the Prime Minister to that promise, as he undoubtedly expects to be so held. There are too many Ministries trying to establish a claim to retention after the war by seeking to impose restrictions on our liberties which they must remain in being to enforce. The powers sought by the Civil Service in planning the location of industry are regarded with considerable disquiet by many business men. The Socialist Party has declared itself for nationalisation.

Unless British industry is allowed to do so, it cannot prove to the nation that it can do its job. Unless its hands are unfettered it cannot demonstrate that private enterprise is still the most businesslike method of organising production. At this moment, when British industry is threatened by what Mr. Churchill has described as "the creation and enforcement of another system or systems borrowed from foreign lands and alien minds," it is least able to meet the threat in the only sound way, namely, by actually doing the job. To the Government, industry says: Give us the tools and we will do the job.

NOTES AND COMMENTS

Indian Industrial Mission

At the invitation of the Government of India, a group of Indian industrialists and business men will shortly visit the United Kingdom and, afterwards, the United States of America to study the present industrial organisation of Britain and America, the technical advances made in the past few years, and British and American post-war industrial plans. The mission will be unofficial in character, and its members, all Indians of independent views and position, will be free to arrange their programme and discuss any matter, unfettered by terms of reference or any form of control by Government. They will be accompanied by their own technical advisers and will bear their own expenses throughout the trip. It is believed that the mission's study on the spot of the latest developments in the industrial sphere, and the knowledge and ideas which they will bring back with them, will be of great value in the further industrialisation of India after the war. Among the ten members of the delegation who are expected, Mr. J. R. D. Tata, who is chairman of Tata Sons, Ltd., and chairman or director of all Tata and Associated companies, is probably best known in England, especially in chemical and metallurgical circles. Mr. G. D. Birla, founder of Birla Brothers, Ltd., includes sugar, paper, textile machinery, pharmaceuticals, starch, and plastics among his industrial interests; Mr. K. Lalbhai is a member of the Scientific and Industrial Research Board, and director of a starch factory; and Mir Laik Ali has been associated on the engineering side with the development of a large power alcohol plant and paper mills in Hyderabad State.

An American View

We are fairly well informed in this country on the attitude of American politicians towards affairs in general; but we are, most of us, vastly ignorant of the point of view on foreign affairs (which includes ourselves) of the average American business man, who is often a good deal less insular than we are sometimes inclined to think. In this connection, the conclusions of Mr. Maury Maverick, chairman of the U.S. Smaller War Plants Corporation, arrived at after two recent trips to Europe (including Britain), are of considerable interest. He is not optimistic about the future; he considers that after military victory, the "battle of ideas, and probably minor wars and disorders" will go on indefinitely. The Nazis, though beaten, will, he thinks, continue to make trouble, and will try to have anyone with fairly progressive ideas branded as a Communist. They have already, as we know, branished the Bolshevist bogy. One of the conclusions which Mr. Maverick reached concerning Britain is that the small business men here "have a bigger share and more influence in the matter of foreign trade" than do their counterparts in the U.S.A. He also considers that British newspapers give fewer prejudiced stories on the subject of foreign affairs. So far, so good; these are characteristics which will be of great avail to us in the coming struggle for the liberty of man.

The Secrecy Bug

There is another characteristic, however, developed since the war, which is going to be less helpful; and though Mr. Maverick does not accuse us of it, he castigates his own countrymen roundly for this defect—what he describes as "a hysteria of secrecy." He realises that this secrecy has gone too far, and now, with military victory over Germany nearer than ever before, he says, "we should certainly get rid of our secrecy complex." In America, he claims, there are thousands of "little undergrounds and secret cells"; and who shall say there are none here? *The Times*, referring last week to the "security black-out" on the movements of Montgomery's men after their Rhine crossing, remarked how this policy had led to an anti-climax. Many of us had pictured armoured columns wandering half over Germany; the truth, when it came out, magnificent though it was, showed simply the orderly progress of a victorious army. We frankly do not believe that its concealment from the British public bamboozled the Germans one atom. The trouble is, our officials

are "security minded"; they just cannot bear to think of sharing their exclusive knowledge. We believe we are playing a straight game. Let us therefore, come into the open and say so. Is it just force of habit that makes the B.B.C. speak of "a town 14 miles S.W. of Hanover"? Or is it because they believe we couldn't locate it on the map if they did name it? Why has there been no official statement about the future controllers of German industry? Their names have leaked out in an undignified way into the gossip columns, it is true; but that is no way to deal with a subject of international importance. If we are going to fight for the liberty of Europe and of mankind—or, to put it at its lowest, for our own well-being—there is surely no need to be so bashful about it. There are plenty of new insecticides: one is now needed that will suppress the secrecy bug. We would suggest a more liberal supply of a well-known cellulose product—ordinarily known as Paper.

A Study of Vibration

WE have recently received a booklet containing information of a nature rather out of the usual, but none the less of interest to chemists and chemical engineers, especially if they happen to be of a mathematical turn of mind. The enormous advances in the technique of aircraft engineering have naturally been accompanied by studies of what might be called the by-products of that science. One of the most awkward problems resulting from aircraft construction, and one of far-reaching importance, is the question of vibration; and the booklet to which we have referred is entitled *A Study in Vibration.* The author is Mr. R. G. Manley, B.Sc., vibration engineer to Silentbloc, Ltd., makers of anti-vibration mountings, who have specially devoted their attention to aircraft construction difficulties. It is not possible here to go into the mathematical development of vibration problems, nor even to outline the steps taken to deal with them. But it seems clear that the co-operation between mathematician and practical engineer which has proved so useful in the aircraft-construction industry might well be of advantage to other industries where machine parts moving at high speeds may be involved. Silentbloc, Ltd., inform us that they will post a copy of the booklet to any of our readers who may write to them at Victoria Gardens, London, W.11. Mr. Manley says that "the vibration engineer thrives on trouble"; his trouble will be well worth the effort if, through his specialised knowledge, he can assist in solving some of the more abstruse problems of chemical engineering.

A CHEMIST'S BOOKSHELF

Organic Reagents for Organic Analysis. By the Staff of the Research Laboratory of Hopkin & Williams, Ltd. London: Hopkin & Williams. Pp. 172. 5s. 6d., post free.

This practical and inexpensive volume is a companion to *Organic Reagents for Metals,* produced in the same laboratory, which reached its fourth edition last year. It was found that there was lacking in the literature an up-to-date review of the application of well-known reagents to organic analysis, and the present volume goes far to fill the gap. As in the companion volume, emphasis is laid primarily on the reagent and its capabilities, but in the present instance a preliminary general survey is included giving particulars of "selected reagents" for various types of organic materials. All the selected reagents are available from Hopkin & Williams, as well as a number of the "other reagents" which are listed.

The selection of the reagents described has been made as the outcome of practical investigation, such considerations as accessibility (*i.e.,* reasonable cost of production), stability, and convenience in the preparation of derivatives, being borne in mind. Tables of melting-points contain the result of practical work in the laboratory; some of the published melting-points have been checked and some new ones determined, literature and reference books having been found inaccurate or contradictory in a disturbing number of cases. The authors will welcome further amendments to the figures published. We are glad to note that the importance of clarity of printing and setting-out in a work of this kind has not been forgotten.

Production of industrial alcohol in Canada rose from 175,000,000 gallons in 1941 to 625,000,000 last year, according to Mr. Brian Daville, Quebec representative of United Distillers, Ltd. In 1941 the bulk of industrial alcohol was made from molasses, and to meet the shortage of that material, due to curtailed shipping, industrial plants had had to re-equip for a change to the use of grains.

Industrial Alcohol

Some Notes on its Modern Production

by A. E. WILLIAMS, F.C.S.

FOR some years before the present war industrial alcohol had become an important commodity in this country, largely because it is a cheap solvent for the numerous new resins used in the varnish industry, and because research has shown that alcohol is beneficial when used in the internal combustion engine in admixture with petrol or other hydrocarbon fuel. To compete effectively with other solvents or fuels the cost of industrial alcohol must be kept low, and to this end research is constantly going on, seeking increased yield from the available materials and creating higher efficiency in the processes. In general it may be said that cheap alcohol depends on: (1) cheap raw material; (2) efficient fermentation; and (3) recovery of all valuable by-products.

Raw Materials: 1. Potato Haulm

There is, naturally, a lower limit to the price at which any raw material for alcohol-making can be purchased, but when this limit has been reached cost may still further be reduced by obtaining a higher yield from any given amount of raw material, and in the case of crops this is being done. For example, a ton of potatoes, grown in this country, and having a starch content of 18 per cent., will yield approximately 25 gallons of 95 per cent. alcohol; but by utilising the potato haulms for alcohol-making a further yield may be obtained. The proportion of haulm, when dried down, will form approximately 20 per cent. by weight of the tubers, or a ton of potatoes will yield 448 lb. of haulm. Assuming we get only 40 per cent. of fermentation sugars from the haulm, we have 179 lb. of sugar, from which is obtained 20-22 per cent. of 95 per cent. alcohol, or about 4½ gallons of spirit. Thus, a distillery handling 100 tons of potatoes per day gains an extra 450 gallons of alcohol per day from the haulms. For several years before the present war paper was being made from potato haulms, also cellulose pulp for rayon manufacture. In this connection it had been found convenient, to facilitate transport of the haulms, to give them a preliminary drying and then compress them into briquettes, a procedure which may with advantage be adopted when the haulms are destined for alcohol production. Before drying, the haulms are treated with dilute sulphuric acid, and the acidified haulms, on drying, become quite brittle and may easily be broken down into the necessary fine particle size for quick action by the hydrolysing acid. By obtaining the haulms as a fine powder in this way the amount of hydrolysing acid is reduced considerably. When this powder is treated with about 40 per cent. by weight of sulphuric acid the yield of reducing sugar is usually 40-45 per cent., from which may be obtained, on fermentation and distillation, from 20-22 per cent. of strong spirit.

2. Straw

Another additional source of alcohol is the straw, such as wheat or oat straw, many tons of which are used as manure in this country each year. The straw of an oat or wheat plant before it is fully ripened may contain 4-6 per cent. of sugars, but at the stage when the corn is ripe and ready for harvesting the sugar content of the straw has been reduced. On saccharification of such materials by mineral acid it may safely be assumed that not all of the resulting sugar has come from the cellulose but that some proportion was already present or has come from the hexosan content. Materials such as potato haulms and straw are normally used as manure, and when these materials are utilised for the production of alcohol they permit nitrogenous fertiliser to be manufactured to replace this manure, so that no loss occurs in this direction. This is because the excess of concentrated sulphuric acid remaining from the saccharification of the material may be recovered in the form of ammonium sulphate. The sulphuric acid, therefore, is made to perform a double duty, that of saccharifying the cellulosic material and later creating a valuable fertiliser. As is well known, the starch in potatoes, grain, etc., may be effectively hydrolysed by the use of dilute acids only, but the cellulosic material in straw and potato haulms requires sterner treatment, and concentrated acid must ordinarily be used. In an alternative method embodying the use of hydrochloric acid in place of sulphuric acid, the straw is first treated with steam to soften it, whereupon it is converted to pulp, which is then soaked in hydrochloric acid to hydrolyse the cellulosic constituents.

3. Wood

In the timber-growing countries wood is successfully utilised, in the form of sawdust or wood meal, from which is obtained an average of 45 gallons of 95 per cent. alcohol per ton of wood. Wood as a raw material, however, is of less interest in this country, owing to its comparative scarcity. A modern method of treating wood is described by H. C. E. Johnson (*Chem. Ind.*, 1944, *55*, 226) in which dry wood in the form of shav-

ings or sawdust is heated with dilute sulphuric acid at an elevated temperature and pressure, which results in the formation of a sugar-containing wort through the hydrolysis of the cellulose. The acid remaining in the wort is then neutralised and filtered, after which it is acted on by a yeast containing urea and phosphates, and the resulting weak alcoholic wash distilled. By this method woods such as Douglas fir and white spruce yield from 50 to 60 gallons of alcohol per ton of wood, such coniferous woods giving a higher yield than hardwoods.

4. Peat

Peat, of which there are many millions of tons in this country in addition to the huge deposits in Ireland, is an interesting and cheap raw material for alcohol production. Its one big disadvantage has hitherto been its high initial water content—often as high as 85 per cent.—which necessitates some form of drying, generally sun drying, before it can be used. Because of this, and the general lack of sun in this country, peat has not been greatly exploited for spirit production. However, a recent American process apparently overcomes this difficulty of high moisture content. According to this method (U.S.P. 2,312,196/1943) wet peat and weak sulphuric acid are heated together under a pressure of 3-4 atmospheres to saccharify the cellulose without decomposing other ingredients. The weak acid used is adjusted so that it contains 1.0-1.2 per cent. of sulphuric acid, and the total volume of the weak acid is about 90 per cent. of the total autoclave contents. After pressure treatment the mixture is cooled and the acid content brought down, by adding chalk, to between 0.2 and 0.4 per cent. acid, when it is ready for fermentation by yeast. In an example given 1000 kg. of wet peat gave 12.1 kg. of alcohol.

5. Sulphite Liquor

Waste sulphite liquor from wood pulp processes, thousands of tons of which are annually thrown away in this country, is another cheap source of alcohol. Up to now British manufacturers have not taken much interest in this idea, partly because it does not solve the problem of disposing of the huge volumes of waste liquor from the mills; for after the alcohol is extracted there is still, more or less, the same volume of waste liquor to be got rid of, sometimes into the river, or, if the local authority permits it, into the sewer. Waste sulphite liquor contains from 2 to about 5 per cent. of carbohydrates, so that the proportion of potential alcohol-making material to unwanted liquor is relatively low. Nevertheless, in some countries alcohol has for some years been successfully produced from these waste liquors.

One of these processes is described by J. R. Callaham (*Chem. Met. Eng.*, 1943, *50*, 12, 104) in which the liquors are cooled before aerating to remove free sulphuric dioxide; they are then neutralised with hydrated lime to the correct *p*H, about 6.0, for fermentation. The sludge is next separated and the liquor pumped to fermenting vats, where yeast containing appropriate nutritive salts is added. Yeast is separated by centrifugal machines, giving a liquor containing about 1 per cent. alcohol, which is recovered by distillation, while the yeast from the fermenting vats is reused in the next batch. At his factory the conclusion was reached that best results would be obtained by using molasses in conjunction with the sulphite liquor.

Sankey and Rosten (*Pulp and Paper Mag. Canada*, 1944, *45*, 3) describe a process for the production of alcohol from sulphite liquor in which the liquor is screened, stored hot to maintain sterility, then passed in batches through a heat exchanger, and neutralised in 11,000-gallon batches with quicklime to a *p*H slightly under 6.0. The liquor is next allowed to settle and the clear portion mixed with urea, or other nutrient substance, when yeast is added, circulation being maintained to prevent settlement. On completion of fermentation the heavy sludge is separated and the bulk of the liquor centrifuged. The slurry of the yeast so obtained is removed and treated with sulphuric acid before re-using in a subsequent batch. The yield on distillation is 1 gallon of spirit per 106 gallons of concentrated sulphite liquor.

A process dealing specially with fermentation efficiency in handling sulphite liquors, operated by the Ontario Paper Co., Ltd., Thorold, Ontario, is described by C. A. Sankey (*Canad. Chem.*, 1944, *28*, 464). The main feature of this process is the centrifugal separation of the yeast from the fermented wort, and the re-use of this yeast in a subsequent fermentation in the operating cycle, the object being to establish without delay in each new batch the state of "crowded" yeast cells which obtained at the end of the previous fermentation. This method of working is said to give increased yields of alcohol, while simultaneously reducing the danger of infection by micro-organisms, since the latter are lighter than yeast, and so are separated from it in the centrifuge. The yield of products is 1 gallon of 96.3 per cent. alcohol for 118 gallons of concentrated liquor.

Fermentation Efficiency

In order to increase the efficiency of the fermentation process and to secure a higher yield of spirit, use is made of various agents which have been found suitable for this purpose. Sodium fluoride is used to reduce the increase in acidity of the yeast mass, and in the case of potato washes the fluoride

also substantially reduces the number of undesirable organisms. As a consequence the amylase is preserved and the yield of alcohol increased. In most cases the proportion of sodium fluoride used is very small and often does not exceed 0.10 per cent. of the weight of the wash. To remove inhibitors of yeast, multiplication steam treatment and neutralisation of the wash has been tried with great success.

The advantages of having phosphate present in mashes have been known for some years, and where phosphate is absent in the normal constituents of the mash it may with advantage be added in the form of a cheap phosphate fertiliser, such as superphosphate. In general the presence of phosphate induces a marked acceleration of the rate of fermentation and produces an increased yield of alcohol. In preparing alcohol from maize, investigations show that the highest yield of alcohol is obtained from maize mashes diluted with very weak hydrochloric acid, which latter has been adjusted to *p*H 5.0 by the addition of soda ash; the mash is then saccharified by mould bran.

U.S.P. 2,272,982/1942 protects a method for increasing fermentation efficiency in which use is made of a solvent. Sedimentary yeast from a previous batch is autolysed in the presence of chloroform at a temperature around 60° C. for 24 hours. The entire resultant autolysate, which provides enzymes, nutrients, and buffers, is added to a subsequent fermentation, preferably with the seed yeast. By this means the alcohol yield is increased, the lag phase reduced, and the passage of sedimentary material to the stills avoided without loss of alcohol.

According to R. T. Andrew (*Chem. Ind.*, 1943, *53*, 350) an increased yield of alcohol can be obtained from wheat flour in the granular condition, the raw material being ground to about 60 per cent. recovery, the remaining 40 per cent. being disposed of for cattle feeding. He also discusses the conditions necessary for the trouble-free operation of the plant with a view to obtaining the maximum yield of both alcohol and by-products. It is generally supposed that salts of heavy metals, including iron salts, have an injurious effect on the conversion of starch by malt amylase. However, R. S. Potter (*J.S.C.I.*, 1940, *3*, 45) does not share this view, for he finds the presence of iron salts to be without influence even in a concentration of 850 p.p.m.

In distillery operations much valuable time, and therefore money, is constantly lost in waiting for the yeast to act upon the fermentation sugars so as to produce the alcoholic wash for distillation. Because of this relatively slow action of yeast a large proportion of the distillery space has to be set aside for batches in various stages of fermentation. This delay, however, can be shortened, according to U.S.P. 2,311,418/1943, which claims that the initial rate of fermentation can be accelerated by the use of a medium containing maltose or galactose, in conjunction with nutrient, buffer salts, etc. The mixture is fermented, while being agitated, with yeast, the fermentation being conducted during the initial stages in the presence of oxygen, which gas may displace the air above the medium, or oxygen may be bubbled through the liquor.

Efficient Recovery

The efficient recovery of the ethyl alcohol and of the several by-product alcohols is the job both of the chemist and of the chemical engineer. Some of these by-product constituents on a weight-for-weight basis are worth more than the ethyl alcohol itself, their value being in the neighbourhood of £100 per ton at pre-war prices. Purification of the "heads" which normally contain ethyl, propyl, and butyl alcohols, may be accomplished by the selective decomposition of the impurities which are oxidisable through the agency of a manganic salt, such as permanganate, in the presence of acid. The mixture is next aerated to separate impurities which are more volatile than the alcohols; and it is then treated with strong alkali, which converts the normally volatile impurities to the non-volatile form. The mixture is then distilled, precautions being taken to avoid entrainment of residual impurities.

According to U.S.P. 2,227,485, neutral spirits of high quality are obtained from "heads" alcohol by adjusting the *p*H to about 7.5, then oxidising the mixture at a temperature of 14°-16° C. by a solution of potassium permanganate, or manganate, to destroy oxidisable impurities, removing manganese dioxide and afterwards treating with an alcohol-soluble inorganic salt of an aromatic amine, such as nitro-anilines, toluidines, aminophenols, etc. The product is next distilled, the distillate being digested with NaOH and finally redistilled.

A method of enhancing the value of the heads fraction is dealt with by U.S.P. 2,302,346/1942, in which before the usual recovery distillation, and with the temperature maintained at 60°-63° C. an alkali, such as sodium hydroxide, is added to raise the *p*H to between $x + 1$ and $x + 4$, where x is the *p*H of a saturated solution of sodium acetate in alcohol of the same strength as the heads. Additional quantities of sodium hydroxide are added as required until the *p*H is within the same range. Sulphuric acid, or other non-volatile acid, may then be added to give a *p*H of $x \pm 1$. The recovered material is either separated as a second-quality spirit of enhanced purity, or may be fed back into the aldehyde column.

In some types of distillation plant the

separation of fusel oil is facilitated by introducing into the concentration tower a weak solution of sodium chloride. A new method for purifying fusel oil is protected by U.S.P. 2,294,346/1942, in which the crude fusel oil is added to a high-boiling amyl ester, such as stearate, phthalate, sebacate, borate, or phosphate, and distilling with about 1 per cent. of either sulphuric acid or phosphoric acid to give amyl alcohol. A new method for the removal of impurities in the continuous distillation of alcohol is covered by U.S.P. 2,207,111/1940. In this procedure the ester impurities are saponified and the organic acids neutralised by introducing a base, which may be alkali hydroxide or carbonate, into the upper half of the aldehyde column, in order to maintain the bottom product at *p*H 6.4 or 6.5.

Plant Improvements

Engineers have kept pace with the modern requirements of the distillery, and it will be realised that their task is not so simple when we remember that what has to be distilled is not merely a mixture of ethyl alcohol and water, but these two in admixture with volatile by-products of the fermentation, consisting of higher alcohols, esters, and acetaldehyde, with traces of volatile fatty acids, etc. For the purpose of motor fuel it is necessary that the alcohol should not contain more than about 0.4 per cent. water, so that a distillation plant of high efficiency must be employed. As is well known, it is not possible to remove the last few per cent. of moisture from alcohol by ordinary distillation methods, and some chemical method of dehydrating has to be employed for this purpose.

The Hiag System

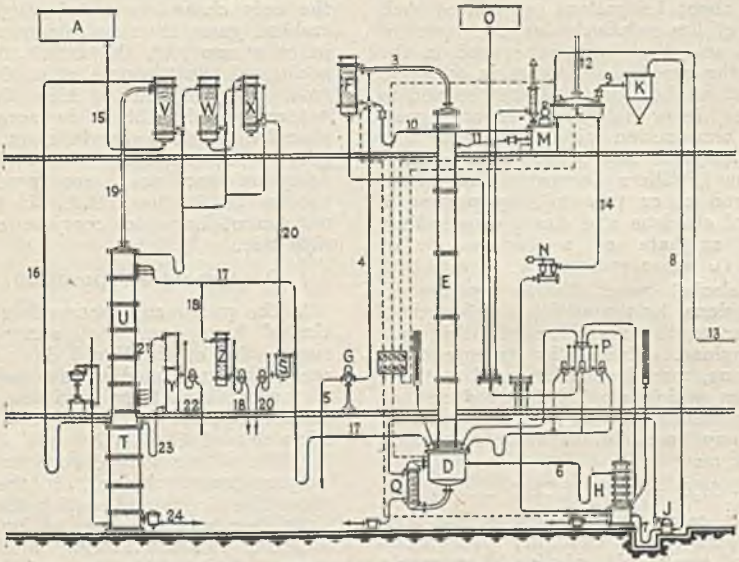
Among the most efficient and economical processes for dehydrating alcohol probably the best known in recent years is the Hiag method, the plant for which is built by Blairs, Ltd., Glasgow. In the Hiag plant the consumption of steam, water, power, and dehydrating chemicals is found from experience to be extremely low, and another big advantage of this plant is that either rectified spirit (about 95-96 per cent. alcohol) or absolute alcohol (practically 100 per cent.) may be produced, and both strengths of spirit can be made at the same time. The dehydrating chemicals used consist chiefly of the anhydrous acetates of sodium and potassium. This mixture, which has the capacity to take up all the water in the spirit, is soluble in both water and alcohol, so that it remains always in the liquid state, does not block up the stills, and may be easily circulated from point to point in the plant. As these acetates are non-volatile at the temperature of distillation they do not pass into the distilled spirit and so contaminate it. The alcohol leaving the dehydrating plant is of at least 99.8 per cent. strength.

The Blairs plant on the Hiag system is illustrated in the accompanying diagram, the left portion of the plant extracting from the weak fermented wash a spirit up to about 96 per cent. strength. When stronger spirit is required it is passed into the dehydrating plant on the right. The weak alcoholic wash runs from tank *A*, in the diagram, to the heat exchanger *V*, in which it is preheated by the spirit vapour from the distilling column *U*, when it passes through the pipe 16 to column *T*, where the spirit is separated, the spent wash being discharged through the pipe 24. The spirit distils upwards into the concentration and rectification column *U*, while the fusel oil runs off from the lower plates of the column through the pipe 21, and is freed from spirit in the separator *Y*. Fusel oil then passes through the pipe 22 to storage, while the separated spirit returns through the pipe 23 to the stripping column *T*. The head products are condensed in the condensers *W* and *X*, then cooled in cooler *S*, and led to storage tanks through pipe 20. Rectified spirit, of 95-96 per cent. strength, is drawn off from one of the upper plates of column *U*, whence it may pass to storage through pipe 18 and cooler *Z*.

If absolute alcohol is required, the spirit leaving the column *U*, instead of going to storage, is passed through pipe 17 to the dehydrating plant, on the right of the diagram, where it runs to kettle *D*, with circulation heater *Q*, in which it is evaporated and passed to the dehydrating column *E*. The dehydrating agent, dissolved in absolute alcohol, enters the upper part of the column *E*, through pipe 11, and moves down the column to meet the rising spirit vapour, from which it completely removes the water. Anhydrous alcohol vapour traverses the pipe 3 and is condensed in the condenser, *F*. Liquid absolute alcohol flows through pipe 4 to the spirit safe *G* and thence through pipe 5 to the spirit storage vessel. The dehydrating solution, containing the water extracted from the spirit, collects in the kettle *D*, and then flows continuously through pipe 6 to the stripping column *H*, where small amounts of alcohol still present are expelled and returned through cooler *P* to the kettle *D*. From *H* the alcohol-free dehydrating solution is transferred through pipe 7 to the montejus *J*, from which it is forced into the storage tank *K*. This aqueous dehydrating solution then flows to the regenerator *L*, where it is heated to about 300°C. to evaporate all the water, which latter escapes through pipe 12. The steam from *L* is passed through pipe 14 to the steam regulator *N* and thence to *D* and *H*, where its heat is completely utilised. The anhydrous dehydrating salts flow, in the liquid state, into the mixer *M*, which is

provided with a stirrer, and are fed also through pipe 10 with absolute alcohol from the condenser *F*.

By means of pipe 11 the column is again supplied with the regenerated dehydrating agent, so that the dehydrating chemicals remain always within the plant, and are in constant movement within the plant in the form of liquid, either in the dissolved or the molten state. Cooling water is supplied to the plant through the tank *O*. The loss of alcohol in the dehydrating plant is very low, averaging about 0.1 per cent.; the average loss of alcohol on the rectifying plant being only about 0.2 per cent. alcohol.



Plant for the production of absolute alcohol from mash.

Plate efficiency in the distillation of alcohol-water mixtures has been investigated by Byman and Keyes (*Chem. Met. Eng.*, 1941, *48*, 7, 85), who carried out tests with a four-plate bubble-cap column. The plate efficiency may be computed from the composition of vapour and liquid samples. While the overall and local plate efficiencies vary with the composition of the liquid, being low at both high and low alcohol contents, they show little or no change with variations in rate of distillation or in reflux ratio.

Synthetic Alcohol

Over a century ago the investigator Hennell made ethyl alcohol synthetically by passing ethylene into sulphuric acid and then adding water before distilling the mixture to recover the alcohol:

$$C_2H_4 + H_2SO_4 = C_2H_5HSO_4 \quad \ldots\ldots \quad (1)$$

$$C_2H_5HSO_4 + H_2O = C_2H_5OH + H_2SO_4 \quad (2)$$

For some years this method of making alcohol remained little more than a laboratory curiosity, until, with the large-scale production of coal gas and coke-oven gas, which contain several per cent. of ethylene, efforts were made to establish the method on a commercial basis. But headway in this direction was not easy, for it was found that the relatively small proportion of ethylene in these commercial gases was absorbed only very slowly by the sulphuric acid, which made the process cumbersome.

Progress was made when, in 1920 (B.P. 146,332), it was discovered that the use of carbon enabled the low concentration of ethylene in coal gas and coke-oven gas to be absorbed by the carbon and released from the latter with a concentration of around 60 per cent. ethylene, so that the absorption by sulphuric acid could be speeded up. In this process for manufacturing alcohol from ethylene, a continuous current of the latter is passed upwards through a series of lead-lined towers, which contain suitable inert packing material, and over which concentrated sulphuric acid trickles downwards. The ethyl sulphuric acid from the towers is then distilled through the use of an open steam jet, which supplies the heat for distilling and also the necessary water to hydrolyse the ethyl sulphuric acid to alcohol, the spirit being recovered by distillation and rectification at a strength of 95 per cent. More recently it has been found that the rate of absorption of ethylene by sulphuric acid can be appreciably accelerated by the use of catalysts, such as cuprous sulphate or silica. With silica as catalyst this can form the tower-packing material.

Nowadays, the cheapest source of ethylene

is the cracked gases from petroleum refining, and coke-oven gases. From these latter gases it is estimated that approximately one gallon of alcohol can be obtained for every ton of coal carbonised, although this is much below the theoretical yield of alcohol, which is about 1.6 gallons per ton of coal. Because of the relatively large amount of sulphuric acid that has to be used in the process, the modern tendency is to avoid the use of sulphuric acid altogether and to substitute higher temperatures and pressures, in conjunction with a catalyst. For example, ethylene may be hydrated, according to the Distillers Company, Ltd. (B.P. 360,492 and other patents), by passing a mixture of ethylene and steam over sodium hydrogen sulphate at a temperature of 150°-160° C. under pressure.

Ethyl alcohol may also be synthesised from acetylene, by the addition of hydrogen and water to the acetylene. In this synthesis ethylene, obtained by hydrogenation of acetylene, may be an intermediate product, from which alcohol is produced as previously described. Or the intermediate product may be acetaldehyde, obtained by the reaction:

$$C_2H_2 + H_2O = CH_3CHO \quad \ldots\ldots\ (3)$$

which is a catalytic hydrating action, and may be operated, for example, through the medium of weak acid solution of mercuric salts on acetylene.

Acetaldehyde

The production of acetaldehyde from acetylene is a well-known process much used in producing organic chemicals other than ethyl alcohol. The reduction of acetaldehyde to ethyl alcohol may be accomplished by passing the acetaldehyde in admixture with hydrogen over a nickel catalyst at a temperature of about 140°C. The catalyst may be prepared by mixing nickel nitrate with pumice so that the mixture contains 30 per cent. nickel, and heating for several hours at a temperature of the order of 500°C., in a current of hydrogen. With such a catalyst and using a sevenfold excess of hydrogen for the reduction of the acetaldehyde, a yield of alcohol better than 90 per cent. may be obtained. By means of synthesis we may also obtain a mixture of ethyl and butyl alcohols, and so simulate to a certain extent the products from the older fermentation process. Aliphatic hydroxyaldehyde or unsaturated aldehydes may be hydrogenated, using a copper catalyst, and when employing a simple aliphatic aldehyde, as for example, acetaldehyde, the catalyst may be used in conjunction with a substance which will bring about condensation of the acetaldehyde to aldol. From aldol a mixture of ethyl and butyl alcohol is obtained through the action of hydrogen at a temperature of about 200°C. Acetaldehyde may also be converted to alcohol by electrolytic reduction.

In the U.S.A. the synthesis of ethyl alcohol from ethylene by the hydration of ethylene has advanced considerably in the past few years. Unlike this country, in which the only cheap source of ethylene lies in cracked gases from petroleum refining and in coke-oven gas, the U.S.A. has a large additional cheap source, that of natural gas from the oilfields. Also through this natural gas the U.S.A. is more favourably placed to produce acetylene, and at the present time something like 50,000 tons of acetylene per year are produced from natural gas in the U.S.A. In this country we cannot hope to compete economically with this.

Decreasing Evaporation Losses

In the past many thousands of gallons of alcohol have been lost annually through evaporation of the liquid during bulk storage. Various remedies have been proposed to prevent such losses and one of the best of these appears to be that recommended by Dietrich and Stoss (*Oel und Kohle*, 1940, *36*, 363). Their method consists in avoiding temperature fluctuations in the air space above the alcohol by coating the tank with aluminium-bronze paint, or by completely enclosing the tank. They also avoid exchange of air within the tank by means of special valves, while alcohol vapour entrained in any air which does escape from the tank is collected by passing the air through a water scrubber.

To sum up the present position of the alcohol industry in this country, it may be said that synthetic alcohol production would not be of great commercial interest, except possibly in wartime, owing to the relative cost and scarcity of the materials used in the process. The future of the industry in this country, apart from the molasses, would appear to be more conveniently based on crops, which can be grown here, and the wholesale utilisation of the cellulosic material accompanying the crops. Converting such cellulosic material as straw and potato haulms to alcohol would be a big advance in the right direction—and would enable mineral acid to be dispensed with—if a biological process for the conversion could be perfected. Much work has already been done on the use of bacterial cultures in the conversion of cellulose to alcohol, but as yet none of these methods seem to be widely used commercially. In this sphere, sooner or later, it will probably come to pass that subsances which we at present regard as an extravagant nuisance—such as the species of fungi which induce rotting of timber by the process of hydrolysing the cellulosic constituents—will be harnessed and made to perform useful work under controlled conditions.

Association of Tar Distillers

Annual Report : New Officers Elected

THE report of the Association of Tar Distillers for the year ended December 31, 1944, marks the sixtieth year of the Association's existence. Although the demand for tar products was well maintained in general, there was ample evidence that major changes were in store for the immediate and more distant future and that no time should be lost in appropriate preparations. In its deliberations on such matters the Association has had from the Coal Tar Controller in particular and the Ministry of Fuel and Power in general that measure of co-operation and support which was called for by the importance of the issues at stake.

British Tar Confederation

The year saw the completion of the work entailed in establishing the British Tar Confederation of the producers and distillers of tar. The Confederation so constituted of the National Gas Council, the British Association of Coke-Oven Tar Producers, and the Association of Tar Distillers, promises to be of first importance and value in the future of the tar distilling industry and its development on a nationally co-ordinated basis. During the year the Association completed, as far as it could in the circumstances, a report on the future policy and organisation of the industry.

Tar Products

Special importance attaches to the report of the Research Sub-committee, in view of the immediate and unanimous support it secured throughout the Association for its recommendation of the setting up of a research association for the industry. The Association must deal by more immediately effective measures with the problem of radically changing demand arising with the progress and ultimate conclusion of hostilities, but it has emphasised also the present need for thinking much further ahead. To deal with the immediate re-orientation of the demand for tar products, the Association presented to the Controller, for consideration by the joint post-war planning comittee of the Ministry of Fuel and Power and the Association, a memorandum dealing with the post-war distribution of the main products—creosote and pitch and their admixtures such as refined tar and coal-tar fuel. This memorandum was well received by the Ministry and, although it was not to be expected that the Government could make immediate pronouncements on all the points raised, an early assurance was obtained of the Ministry's support in certain directions of pressing importance. As a result, valuable progress has been made in planning for the immediate post-war period.

Anticipating as far as possible the difficulties of supply, for post-war needs, of labour, plant, etc., the Association co-operated with the Ministry in the collection of data on the industry's requirements. The information is in the hands of the Ministry in ensuring that supplies, which will for some time be inadequate to meet all needs, are most appriately apportioned throughout industry generally.

Toluene: Apart from departmental reorganisation in the control of toluene, the Association's interest in this product centred during the year on securing a greater measure of correlation between cost of production and price; its efforts in this direction resulted in a satisfactory revision.

Benzol and Coal Spirit: The Control of Benzol and Coal Spirit Order, 1944, replaced the Control of Coal Tar Naphtha and Xylol Order, 1943, and introduced provisions necessitated by the transfer, to the Ministry of Fuel and Power, of control of materials containing less than 40 per cent. of toluene. The Advisory Committee provided by the Association and Allied interests has continued to assist the Ministry of Fuel and Power in its operation of the control of these products.

Hydrocarbon Oils: The Association submitted written evidence to the Hydrocarbon Oil Duties Committee (set up to inquire into the effect of the duties on the supplying and chemical consumer industries) and its representatives gave oral evidence before the Committee.

Naphthalene: The Coal Tar Products Prices (No. 2) Order, 1944, provided increased prices for various grades of naphthalene, granted as the result of representations by the Association. Recognition should be expressed of the expeditious manner in which the Coal Tar Control dealt with and acted on the Association's representations in this case.

Coal Tar Fuels: The supply of tar fuel oil, in particular creosote-pitch mixture, in substitution for imported oils was maintained satisfactorily, the management continuing in the hands of the National Creosote Committee. The book "Coal Tar Fuels", prepared by the Tar Fuels Technical Sub-committee, was published, and, besides substantial sales, there was a large complimentary issue to fuel engineers. The Sub-committee prepared up-to-date specifications for certain coal-tar fuels (creosote and creosote/pitch mixture), with a view to submission of agreed drafts to the British Standards Institution.

Pitch: The replacement of bitumen by

pitch has opened up many new uses in constructional work and the Coal Tar Bituminous Products Sub-committee has accordingly collaborated with the British Standards Institution in the preparation of a British Standard for pitch binders for use in building construction. In addition, the Sub-committee continued its activities on investigations to establish and extend new uses for pitch, with the object of obtaining new permanent markets.

Tar Acids: The extraction of tar acids and the production of phenol has been so developed by the Control that the supply of phenol exceeded war requirements.

Prices for Basic Tar Products

The main concern of the industry in regard to prices was to secure a revision of the Controller's price structure to a level which reflected the heavy increases in costs since the price structure was fixed in 1940. To that end, the Price Structure Sub-committee, in conjunction with the National Gas Council and the British Association of Coke-Oven Tar Producers, established a basis on which prices for the basic tar products could be related to the principal cost factors (*i.e.*, coal and labour). This formed the substance of negotiation with the Controller towards the end of the year, on behalf of the whole body of crude tar producers and distillers, and the discussions have recently concluded with success.

New Committee

The following officers and executive committee were elected for the ensuing year:—*President*, Mr. S. Billbrough (Yorkshire Tar Distillers, Ltd.); *vice-president*, Mr. W. A. Walmsley (Thomas Ness, Ltd.); *hon. treasurer*, Capt. C. W. Harriss (Burt, Boulton & Haywood, Ltd.); *hon. auditor*, Mr. E. Hardman (E. Hardman, Son & Co., Ltd.). *Executive committee* (subject to confirmation or amendment of their representation by certain of the regional groups): Mr. H. H. Bates (South-Western Tar Distilleries), Mr. A. Bradbury (Staveley Coal & Iron Co., Ltd.), Col. W. A. Bristow (Low Temperature Carbonisation, Ltd.), Dr. T. H. Butler (William Butler & Co. (Bristol), Ltd.), Mr. C. E. Carey (South Metropolitan Gas Co.), Mr. J. Colligon (Dorman Long & Co., Ltd.), Mr. C. F. Dutton (Powell Duffryn, Ltd.), Mr. E. Hardman, Mr. L. Hilton (Scottish Tar Distillers, Ltd.), Mr. C. Lord (Lancashire Tar Distillers, Ltd.), Mr. C. A. Murray (British Tar Products, Ltd.), Mr. J. H. Olliver (The Gas Light & Coke Company), Mr. W. H. Phillips (Staffordshire Chemical Co., Ltd.), Mr. R. B. Robinson (Midland Tar Distillers, Ltd.), Maj. A. G. Saunders (Burt, Boulton & Haywood, Ltd.), Mr. J. Simpson (Shettleston Oil & Chemical Co., Ltd.).

New Control Orders

Export Licensing

THE Export of Goods (Control) (No. 3) Order (S. R. & O. 1945, No. 357), operative April 9, makes relaxations in the control of exports. The following items (among others) have been removed from the Schedule to the Export of Goods (Control) (No. 10) Order, 1943, and consequently require licences only when exported to those destinations to which the export of all goods is controlled: Magnesium and manganese; thermite; vacuum flasks, vacuum jars and similar vacuum vessels and parts thereof; scientific silica ware; liquid metal polishes.

The following amendments have been made to the Schedule to the Order. The item "Refractory blocks, bricks and tiles of chromite, chromite-magnesite, dolomite, magnesite and silica" has been deleted and the following substituted: Refractory blocks, bricks and tiles of silica. The item relating to aluminium and alloys mainly thereof has been deleted and replaced by: Aluminium and alloys mainly thereof in the form of billets, blocks, blooms, cakes, grains, granules, ingots, leaf and foil in all forms (whether or not backed with other materials), lumps, notch bars, pellets, powder (other than flake), shot, slabs, sticks and wirebars. The heading relating to non-ferrous metals and alloys thereof has been amended to exclude alloys mainly of aluminium, magnesium, manganese and mercury.

Certain iron and steel goods have been released from export licensing requirements when exported to British Colonial destinations.

The following countries have been removed from the list of destinations to which the export of *all* goods is controlled: U.S.S.R.; Turkey, including the Hatay; Rio de Oro.

DIBASIC ACID FOR RESINS

Development of a new dibasic acid, of interest to chemists working with alkyl and other resins and drying oils, has been announced by the Heyden Chemical Corp., New York City. Known as M.D.A., the new product is a technical grade of methylene disalicylic acid, and consists of a mixture of isomers, principally the para-para. A significant property of the acid is the combination of the reactive carboxylic acid groups with the phenolic groups in the same molecule. By this combination it would be expected that the versatility of the alkyd resins would be combined with the chemical resistance of the phenolic types, and such an expectation is said to have been borne out in experiments at the Heyden laboratories. —*Rubber Age* (N.Y.), February, 1945.

Electrode Measurement*

Types Used in *p*H Determination

TWO types of cell are employed for electrometric work: (1) cells *with* transport, (2) cells *without* transport. These latter have much wider fields of application as they are used for investigations into the formation and composition of complex ions in solution, determination of solubility products, mode of ionisation of acids, *p*H values, standardisation of indicators used for colorimetric methods of finding *p*H values, measurement of normal electrode and Redox potentials, standardisation of the new Redox indicators, and potentiometric titrations. The sources of potential in cells without transport are located at the electrode/solution interfaces and may be interpreted in terms of the Nernst equation.

The Normal Electrode Potential, e, is preferred to that of the hydrogen electrode, supplied with hydrogen at 1 atm. pressure, immersed in a solution containing 1 gr. mol. of the H-ions per litre. The so-called Standard Electrode Potential, ϵ, is ideally a hydrogen electrode with hydrogen at 1 atm., but immersed in a solution containing hydrogen ions at unit activity. This state is unrealisable, and a solution of HCl is chosen so that anion activity $(a\pm)=1$. These two arbitrary hydrogen electrodes may differ at any given temperature by as much as 4 millivolts.

Cells with Transport

In cells with transport an additional source of potential difference exists between the solutions surrounding the two electrodes at their point of contact, and this difference varies according to whether the liquid junctions are moving, stationary or barriered by sand, sintered glass, asbestos, etc. Instead of attempting to evaluate the junction potential it is usual to interpose a saturated solution of KCl or KNO_3, thereby reducing it to negligible dimensions.

The various electrodes employed in *p*H determinations using cells with transport are as follows:

(i) *The Hydrogen Electrode* consists of platinum or gold covered with an adherent coating of black, exposed to an atmosphere of pure hydrogen and partly immersed in the test solution. A trace of lead acetate when platinising renders the "black" much more adherent, but the layer formed should be as thin as possible and the glint of the basis metal should be visible. This electrode cannot be used in solutions containing reducible ions and ions of metals more noble than hydrogen. To prevent the possibility of obtaining erroneous E.M.F.s two hydrogen electrodes should be present in the same solution and readings in close agreement should be obtained from each.

(ii) *The Quinhydrone Electrode* forms a "Redox" system when dissolved in water in which a bright platinum electrode is immersed, from the presence of quinone and the double charged anion of hydroquinone. A steady potential difference results provided that the *p*H of the solution is not higher than 7-8. The quinhydrone must be pure and no more than is sufficient to cover a silver threepenny-piece should be used for a *p*H determination.

(iii) *The Oxygen Electrode* does not provide reproducible results owing to the irreversibility of the platinised platinum-oxygen electrode due to formation of some oxide. Air free from CO_2 may be used instead of an oxygen stream, and the system is useful in titration work.

(iv) *The Antimony Electrode* is an example of a metal/metal-oxide system. The electrode usually is a rod of cast antimony having a layer of adherent oxide at one end. This may be produced chemically or by allowing the electrode to stand in water for a few days, or the oxide may be suspended in water. It is necessary to calibrate the system daily according to the manner in which the electrode is employed, because of irreversibility. For this purpose standard buffer solutions are used. The presence of hydroxy acids introduces calibration difficulties.

(v) *The Glass Electrode* provides the greatest advance in recent times, though its potentialities were first observed by Haber and Klemensiewicz in 1909. The glass eminently useful corresponds with the molecular proportion: 1 Na_2O, 0.3 CaO, 3.3 SiO_2. The electrode takes the form of an extremely thin glass membrane, consistent with the desired mechanical strength, on one side of which is placed a solution of fixed *p*H, and on the other the solution of unknown *p*H. If it is assumed that at each interface there exists a silicic acid/NaOH buffer system, it follows that such a system would be affected by the H-ions in the solution, and above *p*H 9 by Na-ions as well. In effect, below *p*H 9 each glass interfacial system will tend to establish its own H-ion concentration which will be opposed by the concentration of H-ions in the solution. It is of paramount importance that the lead from a glass electrode to the grid of the triode or tetrode valve of the electrometer system should be well insulated.

* Summary of a Lecture given by Professor H. T. S. Britton, D.Sc., F.R.I.C., at a joint meeting of the Institute of Physics and the Royal Institute of Chemistry, at the Royal Institution on March 21.

Personal Notes

MR. S. N. TURNER has been appointed a director of the Staveley Coal & Iron Co., Ltd.

MR. G. P. WILLOUGHBY has been elected first president of the newly-formed East African Association of Engineers.

MR. A. E. BATTYE, M.Sc., chemist in the research department of Tootal Broadhurst Lee Co., Ltd., Manchester, has been elected a Fellow of the Textile Institute.

DR. P. K. BOSE has been selected by the Indian Lac Cess Committee for the post of Director of the Lac Research Institute, Namkum.

MR. G. WADSWORTH, of Halifax, has been adopted prospective Liberal candidate for the Buckrose Division of Yorkshire. He is a managing director of Wadsworth White Lead Co., Ltd.

MR. T. P. TROMP, a manager of the Philips works at Eindhoven, who took a prominent part in the Dutch resistance movement, has been added to Dr. Gerbrandy's cabinet as Minister of Public Works.

MR. J. R. MENZIES-WILSON, who has been appointed head of the metallurgical branch of the British section of the Allied Control Commission in Germany, is a director of Stewarts & Lloyds, Ltd., and chairman of Stewarts & Lloyds of South Africa, Ltd. He also occupies a seat on the board of many other iron and steel and iron-mining companies.

DR. WILLIAM CULLEN, MR. M. B. DONALD (vice-chairman), MR. G. W. RILEY, and MR. STANLEY ROBSON are retiring this year from the committee of the Chemical Engineering Group, Society of Chemical Industry. Nominations in accordance with the rules of the Group, to fill the four vacancies, should reach the Group's offices not later than April 27.

MR. HAROLD WRIGHT, chief metallurgist to Dorman Long & Co., Middlesbrough, has been awarded the Bessemer Gold Medal by the Iron and Steel Institute in recognition of his "valuable contributions made over many years to improve the technique of iron and steel manufacture." The medal, representing the Institute's highest award, will be presented at the annual meeting in London on May 9.

MR. JOHN W. THOMAS, chairman of the Firestone Tire & Rubber Company, has been awarded the Gold Medal of the American Institute of Chemistry for 1945, in recognition of his leadership in rubber research for four decades and for his director of achievements in the development of synthetic rubber. The formal presentation will take place at Columbus, Ohio, on May 11 at the Institute's annual meeting.

Obituary

MR. THOMAS BORLAND, who died in Edinburgh on April 2, aged 73, had been mining manager for Scottish Oils, Ltd., in the West Calder district, for 20 years until his retirement some six years ago. His activities included the sinking of the Valleyfield Colliery, West Fife.

New Coating Material

Outlet for Surplus Starch and Sugar

A NOVEL resinous coating material that looks like varnish, withstands high temperatures and the action of most chemicals and solvents, and can be made from sugars and starches of farm crops, has been developed by the Research Administration of the U.S. Department of Agriculture, according to the *Journal of the Franklin Institute* (February, 1945).

The product, known as "allyl starch," is prepared by treating starch with either allyl chloride or allyl bromide and is quite different from the carbohydrate compounds previously made by this method. When freshly prepared, allyl starch and other allyl carbohydrates are soluble in most paint and varnish solvents, which makes possible their ready application to wood, metal, paper, glass, textile and other surfaces. Upon curing, in contact with air or by application of heat, they undergo complex chemical changes that produce a hard, smooth surface which is extremely resistant to organic solvents, acids, alkalis, and other corrosive agents, as well as to climatic changes. Properly cured coatings are stated to have withstood temperatures of 200°C. Alcohol, petrol, acetone and other liquids spilt on a coated surface left no mark.

Allyl starch and other allyl carbohydrates, which were developed by Dr. P. L. Nichols, Jr., and Mr. R. M. Hamilton in the Eastern Regional Laboratory at Philadelphia, should be especially valuable in the preparation of lacquers, varnishes, cements, and impregnating compounds. The coating is easily applied, and possesses transparency, high gloss, hardness, and adequate flexibility. The materials used in making this product are thermosetting. Indications are that the new coating will find wide application as a protective coating —particularly for interior use and in the plastic field. Development is now in the pilot-plant stage.

"This new discovery," says Dr. O. E. May, chief of the Bureau of Agricultural and Industrial Chemistry, "promises to open a whole new field for the industrial utilisation of surplus starches and sugars."

General News—From Week to Week

The Merchant Navy Comforts Service has received a donation of five guineas from the employees of I.C.I., Ltd., Plastics Division, Croydon.

"Solvent Extraction of Solids" was the title of a lecture given by Mr. W. C. Peck before the British Association of Chemists on April 11.

The Patents Committee appointed last year by the Board of Trade has issued an interim report which will be available to the public in the course of the next few days.

Cornish tin workers are to receive an increase in wages of 6d. per shift, in accordance with an award of the National Arbitration Tribunal. The workers had applied for an advance of 1s. 6d.

Recommendations from H.M. Consul-General, Reykjavik, and H.M. Consul, Thorshavn, are no longer required for any exports to Iceland or the Faroe Islands, and exporters are requested not to ask their clients in these countries to apply for them.

A demand for a peace-time organisation to continue and co-ordinate the work of the Industrial Salvage Groups, but in a much wider field, has been made by Mr. J. F. Ahearne, chairman of the Cheltenham and Gloucester Group.

Complaining of a proposed drop in rates, 500 workers at the I.C.I. Works, Witton, Birmingham, staged a brief sit-down strike last week-end. On Tuesday morning, however, they decided to resume work, and negotiations are to take place between the men's representatives and the company.

A factory has been acquired at Heathhall, Dumfries, by the North British Rubber Co., Ltd., for increased post-war production. With 300,000 sq. ft. of floor space, it was built for the Arrol-Johnston Aster Engineering Company since the last war. Equipment will be installed after the war.

William Briggs and Sons, Ltd., tar distillers, of Dundee, celebrate this year their 80th year of continuous trading. The present directorate includes two sons and one grandson of William Briggs, who founded the firm in 1865. To mark the occasion the firm has distributed a bonus based purely on length of service.

Following complaints by buyers that damage was being done to wool by the use of chemically-compounded sheep-dips containing colouring matter, the directors of the Highland and Agricultural Society appointed Mr. J. W. Alexander, chairman of the Science Committee, to represent the Society at a conference held on April 11 to discuss the use of dips containing colouring matter.

Weekly courses on tropical packaging are now being held in London. They deal with the effects on stores of tropical humidity, heat, fungi, and ants, and show approved methods of cleaning, preservation, and packing. Vacancies exist for contractors' representatives. Inquiries should be sent to the Commandant, Tropical Packaging School, The Boltons, Old Brompton Road, London, S.W.10 (FLAxman 0410).

With the approval of the University Court, the Imperial College of Science and Technology has accepted the benefaction from Courtaulds, Ltd. (recorded in our issue of March 24), which will yield an annual income of £3000. The fund will be administered for the present by a small body of trustees; it will permit the endowment of a Courtaulds Chair of Chemical Engineering as well as providing for other needs in the Department of Chemical Technology.

Foreign News

A dozen small bone-meal factories are helping to increase fertiliser supplies in Travancore State, India.

The American By-Product Coke Institute has recently been formed in Washington, D.C.

Merck and Co., Ltd., the Canadian subsidiary of the U.S. Merck concern, have purchased an area of 210 acres at Valleyfield, Quebec, for post-war expansion.

President Roosevelt has sent a request to the House to appropriate $4,480,000 for the preparation of plans for a Missouri River Valley Authority.

Production of synthetic rubber in the United States, which reached 763,000 tons in 1944, will be raised to about 1,000,000 tons this year, and to about 1.2 million in 1946.

In Belgium, several blast furnaces are being re-started in the Liége basin and in the Province of Hainault, where a glass factory is also resuming production.

Acetanilide, both pure and technical, is being made in Canada for the first time. Production is expected to cover the Dominion requirements and to leave an export surplus.

Canadian Copper Refineries, Ltd., plan to erect a copper sulphate plant at a cost of $500,000. In 1943, the Dominion imported about 8,000,000 lb. from this country and 2,000,000 lb. from the United States.

Highly accurate measurements of the freezing points of nickel and cobalt have just been made by the U.S. National Bureau of Standards. Calculated on the International Temperature Scale, these freezing points are: nickel, 1455° C.; cobalt, 1495° C.

The Argentine State Oilfields will sell 300,000 tons of linseed oil and by-products for fuel purposes in order to replace mineral oil products which are very scarce. Twenty per cent. of linseed oil will be mixed with mineral oils.

The Hebrew University on Mount Scopus, Jerusalem, commemorated the twentieth anniversary of its opening by Lord Balfour, on April 1, 1925. Three small original departments have grown into complete faculties of the humanities and of the sciences, with a library of about 500,000 volumes.

The weight-per cent. solubilities of pure DDT in common organic solvents, for certain temperatures between 0° and 48° C., have been determined by F. A. Gunther (*J. Amer. Chem. Soc.*, 1945, *67*, 189). It is concluded that benzene is the most efficient "stripping" agent for this material at room temperature.

The Midwest Research Institute has been organised at Kansas City, U.S.A. The Institute's laboratories are being equipped to cover many research activities, including the fields of chemistry, physics, metallurgy, mineralogy, biology, bacteriology, chemical, civil, electrical and mechanical engineering, and other fields of science and science application.

The Mexican Ministry of Finance has granted concessions for the following new industries: Quimica Industrial Marineda, S. A., Gante, production of nitrate and arsenate of sodium, arsenates of copper and lead, yellow sulphide of arsenic, stearate of zinc, methylarsenate of sodium, and sulphate of monohydrated copper; Salico, S. A., Balderas, production of salicylates, phenol, and acetic acid.

That certain fractions of petroleum, especially asphalt, may become a valuable source of vanadium, is indicated in a paper recently presented to the Russian Academy of Sciences, it is reported. The paper discloses for the first time that a Soviet plant is producing ferro-vanadium from asphalt derived from Ural crude oil, the ash of which may contain as much as 43 per cent. of vanadium. Asphalt from certain American crudes, notably some produced in California and Oklahoma, also contains vanadium.

Tunisian mineral production has fallen considerably, but since exports have ceased almost completely, stocks have increased. Output of phosphate rock in the last quarter of 1944 amounted to one-fifth of the pre-war output of over 1,800,000 tons; stocks at hand total 2,000,000 tons. Iron ore production was only 15 per cent. of normal, with stocks of 200,000 tons, reports *Foreign Commerce Weekly*. Owing to the coal shortage, lignite deposits in the Cape Bon area are being worked, yielding some 5000 tons monthly.

To study industrial developments in Canada and the United States, four officials of I.C.I., Ltd., Messrs. W. A. Duncan, J. C. A. Glenn, L. Donaldson, and S. E. McWright, have arrived in Montreal.

A vitamin research institute has been organised by 40 American companies which either make or use vitamins. The institute is to study nutrition problems, and to make recommendations as regards standards and terminology.

Research on the development of food products "in which the high protein content and vitamins of spent brewers' yeast can be used to advantage" is to be carried out by the Brewing Corporation of America, through their subsidiary, Carling's, Inc. Provision is made for the expenditure of $250,000 in 1945.

Forthcoming Events

April 16. Royal Society of Arts. John Adam Street, Adelphi, W.C.2, 1.45 p.m. Cantor Lecture. Sir Frank Smith: "Synthetic Chemicals from Petroleum.—I."

April 16. Association of Austrian Engineers, Chemists & Scientific Workers in Great Britain. Austrian Centre, 69 Eton Avenue, London, N.W.3, 7.30 p.m. Mr. E. Chilton: "Present-day Problems of Industrial Photography."

April 17. The Institute of Physics (London and Home Counties Branch). Rooms of the Royal Society, Burlington House, Piccadilly, London, W.1, 5.30 p.m. Dr. S. Tolansky: "Some New Contributions to Interferometry with Applications to Crystal Studies."

April 18. The Institute of Fuel (North Western Section). Engineers' Club, Manchester. 2.30 p.m. Annual general meeting.

April 18. Royal Institute of Chemistry. Lecture Theatre, The Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1. 6 p.m. Mr. G. T. Bray: "Some Empire Vegetable Oils."

April 18. Royal Society of Arts. John Adam Street, Adelphi, London, W.C.2. 1.45 p.m. Sir Edward Appleton, F.R.S.: "The Work of the Department of Scientific and Industrial Research."

April 18. A.B.C.M. Fuel Efficiency Technical Discussions (second series). Meeting room No. 1, Gas Industry House, 1 Grosvenor Place, London, S.W.1. 2.30 p.m. Mr. Oliver Lyle: "Simultaneous Generation of Power and Process Steam."

April 19. The Chemical Society. Society's Rooms, Burlington House, Piccadilly, London, W.1. Annual general meeting, 11.30 a.m.; private business meeting, 2.30

p.m. Presentation of Longstaff Medal for 1945 to Professor N. V. Sidgwick, F.R.S., and of Harrison Memorial Prize to Dr. L. F. Wiggins. Presidential address: Professor W. N. Haworth, F.R.S.: "Starch."

April 21. North of England Institute of Mining and Mechanical Engineers (Associates' and Students' Section). Tea dance. Institute's Wood Memorial Hall, Newcastle-on-Tyne. 4.30-8.30 p.m.

April 21. The Association for Scientific Photography. Caxton Hall, Westminster, London, S.W. 2.30 p.m. Mr. E. Mackie: "A Consideration of the Requirements for Micrography and Cinemicrography Apparatus."

April 21. International Society of the Leather Trades' Chemists (British Section, Manchester Group). Engineers' Club, 17a Albert Square, Manchester. Mr. W. R. Atkin: "Some Aspects of 'Wet Work Procedure' for Heavy and Light Leather Manufacture," and "The International Society of Leather Trades' Chemists—Its Past and Its Future."

April 21. Society of Instrument Technology. London School of Tropical Medicine, Keppel Street, London, W.C.1. Morning session, 11 a.m.; afternoon session, 2.30 p.m. Mr. E. B. Moss: "Electrical Tachometers"; Messrs. G. R. Polgreen and G. M. Tomlin: "Electrical Non-Destructive Testing of Materials"; Mr. G. K. Burkitt: "The Determination of Steam Wetness."

April 23. Royal Society of Arts. John Adam Street, Adelphi, W.C.2, 1.45 p.m. Cantor Lecture. Sir Frank Smith: "Synthetic Chemicals from Petroleum.—II."

April 23. Association of Austrian Engineers, Chemists & Scientific Workers in Great Britain. Austrian Centre, 69 Eton Avenue, London, N.W.3, 7.30 p.m. Mr. P. Motz: "Some Interesting Facts on Sex-determining Compounds."

New Companies Registered

Vaculi, Ltd. (394,096).—Private company. Capital, £1500 in £1 shares. Manufacturers of and dealers in vacuum lids, forgings, castings, chemicals, etc. Subscribers: P. F. Money; R. Harris. Solicitors: Buckeridge & Braune, 3-4 Clement's Inn, W.C.2.

British & Continental Yeast & Plastics Corporation, Ltd. (394,168).—Public company. Capital, £10,000 in £1 shares. Manufacturers of, dealers in, and agents for yeast, bakers' spirit, press, dried, food and medical yeast, carbonic acid, molasses and waste products of fermentation and distillation; makers and moulders of plastics, casein, cellulose and other substances, etc. Subscribers: E. G. M. Fletcher; W. H. Mugford. Solicitors: Denton Hall & Burgin, 3 Gray's Inn Place, W.C.1.

Beecham Research Laboratories, Ltd. (394,167).—Private company. Capital, £100 in £1 shares. To carry out research work in connection with medicinal, pharmaceutical, and chemical products and processes, materials and processes for containers or packings, etc. Directors: Sir Joseph S. Holmes, M.P.; Walter McGeorge, B.Sc., A.R.I.C., A.R.T.C. (director Macleans, Ltd.); R. H. Marriott, chemist; F. H. Milner, B.Sc., Ph.D., F.R.I.C.; E. A. J. Koch, consulting engineer. Registered office: 68 Pall Mall, S.W.

Birmingham Electric Furnaces, Ltd. (394,048).—Private company. Capital, £100 in £1 shares. Designers and manufacturers of and dealers in electric and other furnaces and heating appliances for melting, smelting, annealing, heat treatment, nitriding, carburising, normalising, etc. So long as Birlec, Ltd., of Erdington, Birmingham, and Grosvenor House, Park Lane, London, W.1, or any nominee or subsidiary thereof holds three-fourths of the issued shares, that company shall be the sole director and manager. Delegate Director: David O. Evans, vice-president of the International Nickel Co. of Canada, Ltd. Registered office: Grosvenor House, Park Lane, W.1.

Company News

Pinchin, Johnson & Co., Ltd., report a net profit for the year of £526,661 (£573,237); the ordinary dividend is maintained at 10 per cent.

The United Glass Bottle Manufacturers' Co., Ltd., reports a net profit, for last year, of £209,026 (£203,276). The dividend announcement was reported on March 31.

Chemical and Allied Stocks and Shares

WITH the war news dominating sentiment, stock markets continued cheerful. British Funds making further gains, leading industrial shares again favoured, while Far Eastern securities showed general improvement. The good tone of markets was attributed partly to hopeful views in regard to post-war prospects. The yield structure of markets centres on the return on gilt-edged stocks; nevertheless, the small yields on industrial shares are due partly to the current belief that, in most cases, post-war dividends are likely to be at least maintained.

Imperial Chemical remained steady at 39s. 6d. in front of the dividend announcement, while Dunlop Rubber moved higher at 50s. 6d. on the company's Far East interests, and Levers

and Levers N.V. both at 48s. 3d. showed firmness on the forthcoming complete liberation of Holland. Turner & Newall at 87s. were higher on balance, United Molasses improved to 38s. 9d., and the units of the Distillers Co. were firmer at 112s. 3d. British Match at 43s. 6d. recorded a further rise, while Wall Paper Manufacturers deferred strengthened to 44s. 3d. Pending the dividend, British Oxygen showed firmness at 90s. Amalgamated Metal were 19s., but Borax Consolidated deferred eased to 38s. 9d. British Aluminium were little changed at 44s. 10½d. Radiation rallied further to 60s. 3d., and Nairn & Greenwich remained at 77s. 6d. Barry & Staines firmed up to 54s. The market is hopeful that results of the last-named company for 1944 may show a further improvement in dividend (7½ per cent. was paid for 1943) and that later the 12½ per cent. basis of pre-war years will be restored with prospects of higher payments as time proceeds. United Glass Bottle were steady at 75s. on the results, which show that the maintained 12 per cent. dividend is again a very conservative payment. Canning Town Glass 5s. shares were 9s. 9d. Key Glassworks changed hands up to 72s. and Forster's Glass 10s. shares held their recent rise to 38s. 9d.

B. Laporte were firm at 87s. 6d. W. J. Bush shares, which are tightly held and rarely change hands, have marked 75s. 6d. British Drug Houses were dealt in up to 31s., Burt Boulton at 27s. 3d., British Thermostat at 21s., while De La Rue were around £11 9/16 on market hopes of a higher dividend. British Industrial Plastics 2s. shares transferred around 6s. 9d., and Erinoid were firm at 12s. 4½d. Morgan Crucible first preference marked 26s. 9d. Goodlass Wall 10s. shares have been favoured on post-war considerations, rising further to 20s. 3d. on hopes that increased dividends may be in prospect. Other paint shares were inclined to strengthen, with International Paint 121s. 10½d. and, awaiting the dividend, Pinchin Johnson 10s. ordinary firmed up to 41s. 4½d.

Greeff-Chemicals Holdings 5s. shares attracted a fair amount of attention, changing hands up to 9s. 9d. Boots Drug 5s. ordinary moved higher at 57s., Timothy Whites were 41s. 6d., Sangers 31s. 7½d., and Beechams deferred 19s. 4½d. British Plaster Board were 39s. 6d., and Associated Cement 61s. 6d. Iron and steels showed a rising tendency with Guest Keen 39s. 9d., United Steel 26s. 9d., Dorman Long 27s. 7½d., while Stewarts & Lloyds strengthend to 58s. pending the dividend announcement. Consett Iron were 9s., Babcock & Wilcox 56s., and Thomas & Baldwins 6s. 8d. shares strengthened to 13s. Textiles developed a number of good features, particularly Courtaulds at 57s. 6d., and Fine Spinners and Bradford Dyers which both rose to 27s. 3d. Oil shares lost earlier strength, but V.O.C. were better at 47s. 6d.

British Chemical Prices

Market Reports

QUIET conditions are in evidence in some sections of the London general chemicals market, chiefly owing to the recent holiday, and there is little of importance on which to report. In the soda products section a moderate weight of new business has been placed in hyposulphite of soda and industrial refined nitrate of soda. A brisk inquiry is reported for Glauber salt and salt cake, while chlorate of soda is a steady market. There is a good demand for bichromate and for yellow prussiate of soda which continues in short supply. Most of the potash products are available in restricted quantities and prices remain firm. Acid phosphate of potash is a good market and an active inquiry is reported for both the B.P. and the commercial grade of permanganate of potash. Supplies of caustic potash and of bichromate and yellow prussiate of potash are quickly absorbed for priority needs. In other directions peroxide of hydrogen and formaldehyde are meeting with a steady demand, and a good inquiry is reported for crude and refined glycerine. Conditions in the coal-tar products section remain steady, with carbolic and cresylic acid in good request, while a fair home trade is reported in pitch. The xylols and naphthas are firm and a moderate trade is passing in the pyridines.

MANCHESTER.—There has been a fairly brisk resumption of trading on the Manchester chemical market during the past week, with the textile and allied trades and other leading industrial consumers of "heavies" calling for reasonably steady deliveries under contracts. Fresh inquiries since last report have led to a moderate weight of new business being placed in the alkalis and in the ammonia and magnesia products, as well as in the acids. Sulphate of ammonia and many other fertiliser materials are now being taken up in good quantities. In the tar products section, creosote oil, carbolic acid, and toluol and benzol are in good demand.

GLASGOW.—In the Scottish heavy chemical trade the improvement shown last week has been fully maintained during the past week. Export business also is becoming more active. Prices remain very firm at previous levels.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

SITUATIONS VACANT

APPLICATIONS are invited for the position of Purchasing Officer of the Chemical Branch of Newton, Chambers & Co., Ltd., Thorncliffe, Nr. Sheffield. Purchases include a wide range of chemical products, such as tar oils and acids; organic and inorganic compounds; packaging materials for bulk and retail supplies; soaps; paper bulk and printed; machinery and maintenance equipment. Position is permanent and superannuable. The successful applicant will have to have the modern approach to buying. Applications in writing stating age, experience and salary required to Personnel Officer.

SOUTH London Firm (E.W.O.) requires an Intelligence Officer, M. or F. attached to Research Department. Fluent knowledge German essential, knowledge of other languages, especially Russian, an advantage. Duties include Library and Patent Research, Translation recording, Abstracting, Indexing, etc. Apply stating age, sex, qualifications, previous experience, salary, to Box No. 2207, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

SOUTH London Firm (E.W.O.) requires a young British Physical Chemist or Physicist-Chemist with Honours Degree or equivalent, as Research Assistant for research under direction. Previous electro-chemical experience an advantage. Must be fully conversant with modern Physico-Chemical technique relating particularly to Potentiometric and Conductiometric analysis, Determination of pH and Electrode Potentials, etc. Apply stating age, sex, qualifications, previous experience, salary, to Box No. 2208, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

SERVICING

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, Bochurch, London." Telephone: 3285 East

GRINDING, Drying, Screening and Grading of materials undertaken for the trade. Also Suppliers of Ground Silica and Fillers, etc. James Kent, Ltd. Millers, Fenton, Staffordshire. Telegrams: Kenmil, Stoke-on-Trent. Telephone: 4253 and 4254, Stoke-on-Trent (2 lines).

WANTED

WANTED regularly, Residues, Sludge, Slag, etc., containing Antimony, Cadmium, Copper, Lead, Nickel and Zinc. Oakland Metal Company Ltd., Willington, Derby.

WANTED.—Supplies of Nitre Cake in ten-ton lots, Box No. 2126, THE CHEMICAL AGE, 154, Fleet Street, E.C.4.

WORKING NOTICE

THE PROPRIETOR of Patent No. 504,543 for "Improvements in or relating to Hard Metal Alloys," is desirous of negotiating with interested parties with a view to promoting the full commercial development of this invention in the United Kingdom by way of the grant of licences or otherwise on reasonable terms. Please address communications to Blackburn & Pollett, 12, Vernon Walk, Tadworth, Surrey.

Printed in Great Britain by THE PRESS AT COOMBELANDS, London and Addlestone, and published by BENN BROTHERS, LTD., at Bouverie House, 154, Fleet Street, E.C.4, April 14th, 1945. Entered as Second Class Matter at the New York, U.S.A., Post Office.