THE Chemical Age

VOL. LXXI 10 JULY 1954 No. 1826

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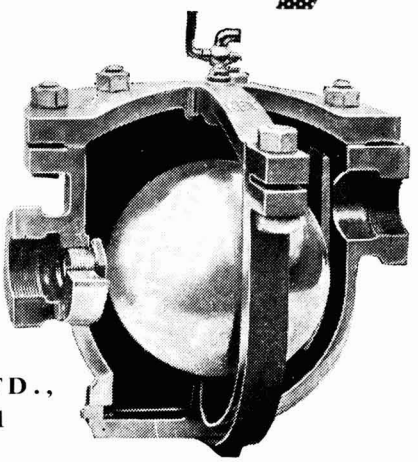

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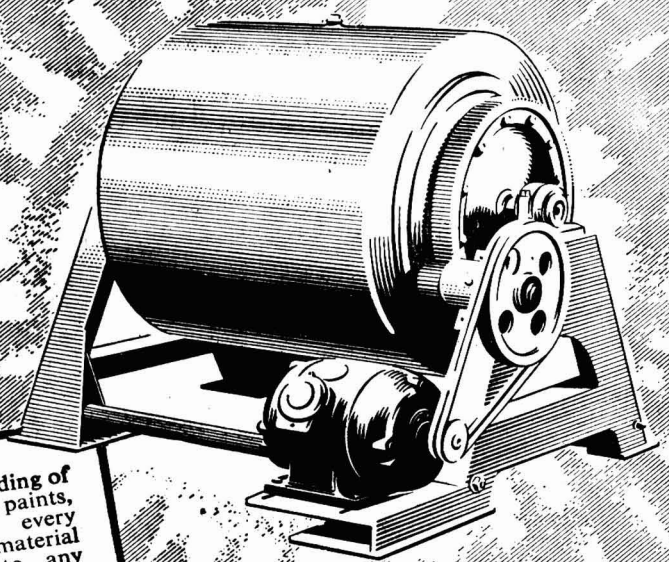

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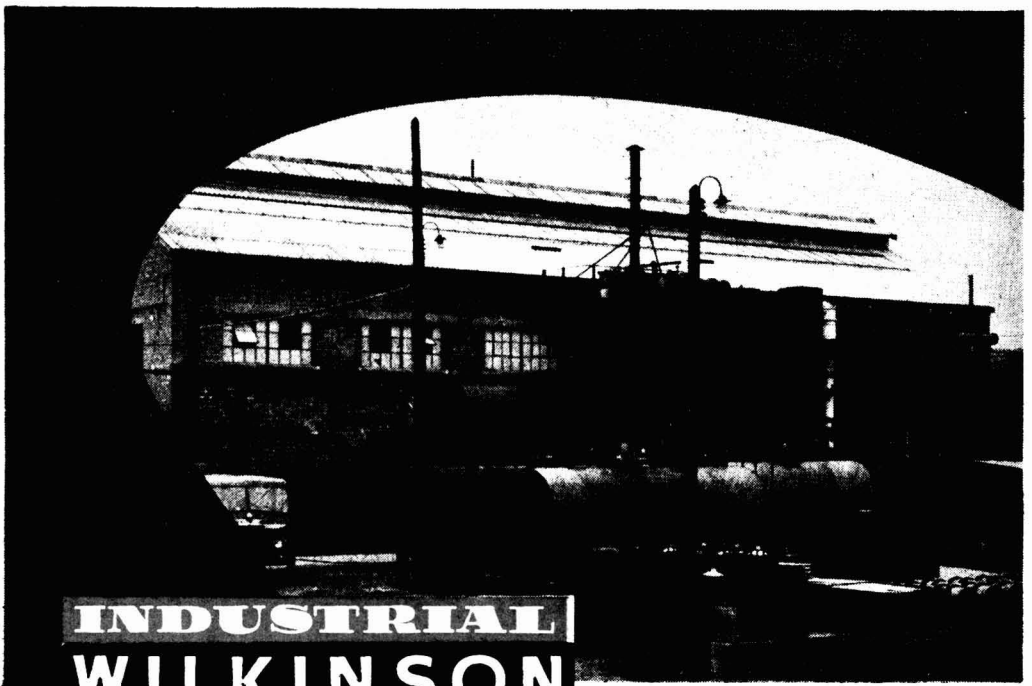

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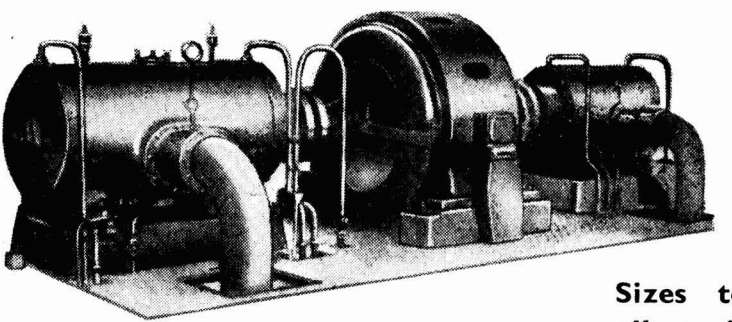

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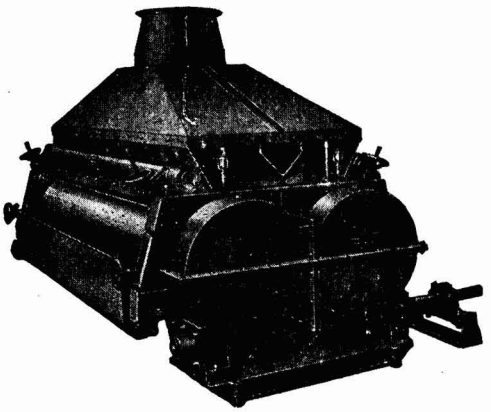

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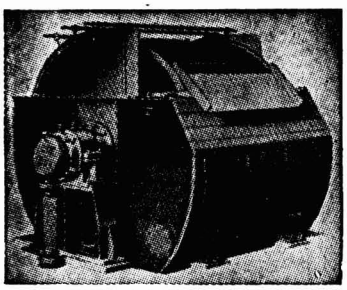

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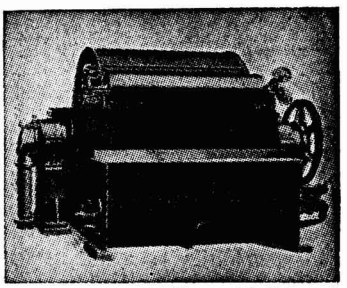

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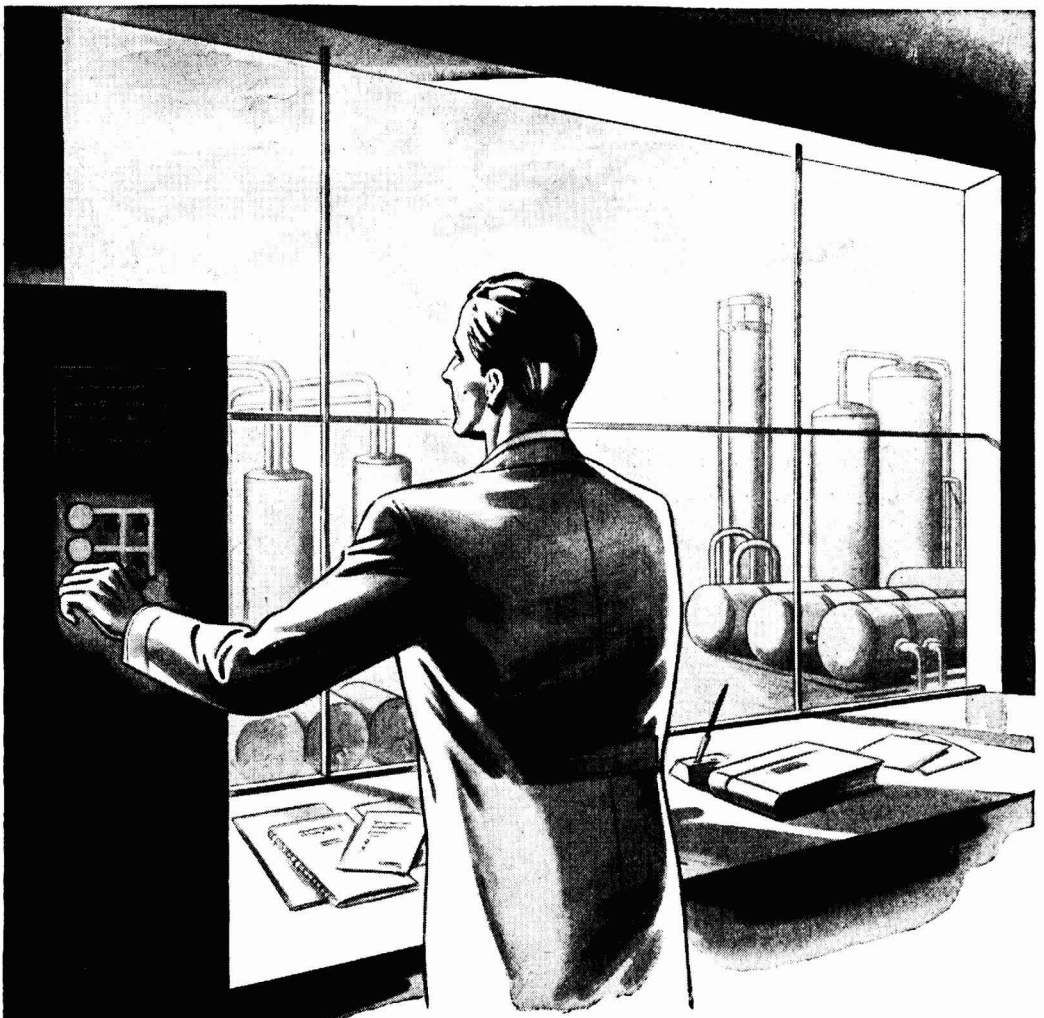

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Research in Perspective

INDUSTRIAL research, its costs and its rewards, is hardly a new subject for debate and controversy. But attention was once again focused upon it in a recent issue of *The Economist* (1954, **171,** 5782) with a substantial supplement on the general topic, 'Research for Industry.' It is natural for the businessman to want to know within fairly close limits what the returns upon any investment are likely to be, and in this field of prediction economists have become the modern soothsayers. Large-scale statistical surveys or smaller-scale statistical samplings can be applied to almost any relationship between industrial effort and its consequent reward, but research, because by its very nature it must deal with what is initially unknown, is not so easily measured. 'Few statistics are shakier than those dealing with research and development,' begins one of the articles in *The Economist* supplement. It is a fair observation. But does it reflect an imperfection in our knowledge or is it merely the expression of inevitable uncertainties?

There are constant efforts in American trade and technical journals to 'formulate' research, to measure its costs in capital and man-power, to relate these costs to total capital expenditure and sales turnover, and then to set against these estimates of debit the profits of technological progress. The research scientist may well regard this assembling of figures as a much simpler operation than most of the research work that is assigned to him; and he may rightly carry cynical realism further by reflecting that his own research results would be of little value if his experimental data were associated with statistical errors of the same order. The basic desire to measure research, though humanly understandable, is fundamentally fallacious. It cannot be otherwise, for the variables are numerous and their range of variation is wide. Research projects differ in their complexity. Research workers differ in their quality and it is almost ludicrous to suppose that this aspect of research can be measured in equivalent man-salary units. The financial returns from successful projects differ enormously—from one the return may be direct and swift, from another indirect and slow.

The old saying that the man who pays the piper calls the tune is inapplicable here. Nor should the industrialist expect to enjoy a position of certainty. Research is better looked upon as the prerogative of enterprise; indeed, as the best example of speculative risk that private enterprise must face and take. If industrial research could be so accurately measured by cost-accountancy that it became non-speculative, the argument that industry is more efficiently conducted as private enterprise would be much less tenable. One of the articles in *The Economist* quotes an old 'rule of thumb' that 'a company should spend about 2 per cent of turnover to equal the average . . .'; admittedly, this is quoted as an out-of-date example, and preference for the current idea of relating research expenditure to sales turnover is expressed. But should such relationships be sought? We prefer the view of a research director which is also quoted: 'You only find out in the long run. If you are doing too little research, you eventually notice that the company is falling behind in competition. If you notice that there are more proposals to manufacture piling up than you have resources to invest, you might—perhaps—be doing too much.' We feel tempted to re-interpret this point of view and say that a truly enterprising company should conduct at all times a volume of research whose cost has reached the point where it actually hurts.

No doubt any suggestion that research costs should be less subject to budgetary accounting than most others tends to

create a reaction of administrative resistance. Modern industrial management is built upon the bed-rock of central control and it is disconcerting if any peripheral sector fails to fit tidily into an ordered place. But to advocate spending money, whether allocated out of capital or current income, upon research 'until it hurts' is not giving research a free rein. It remains for management to ensure that the money is converted into good value, that the resultant research effort is not conducted wastefully. This function of control by accountancy and management seems far more sensible than control to some formulated rule based upon the average research costs of industry in general or of a branch of industry in particular. There is no equation of universal validity for converting £X0,000 research expenditure into £Y0,000 result-value. Nor is the disposition to regard annual research expenditure as adequate so long as it is up to the standard of competitors of much significance save, perhaps, for the company whose trade is entirely in home markets. A standard of X per cent of sales turnover or capital may be suitably competitive at home but much less competitive when set against the research expenditures of American or German companies. There are no yardsticks that do not melt away when subjected to analysis.

Our contemporary has tried to compare research expenditures of British and US industry, but British data are so much scarcer that reasonably accurate comparison is impossible. In any case, the abundance of US data should not be regarded as a sign of truly reliable estimation. It is nevertheless quite easy to conclude that US companies, by any *pro rata* method of measurement, spend more upon research than British companies. How big the differential actually is cannot be estimated with precision. But current comparisons cannot hope to tell the entire story; the past, with its long period of under-attention to research and application in Britain, still extracts its price. One summing-up in *The Economist* seems particularly appropriate: 'Considering the natural resources and the present economic circumstances of the two countries, it may be permissible to guess that Britain should be devoting a much greater effort to research, in proportion, than the US.'

Within the Anglo-American comparison, imprecise though it must be, there is nevertheless a qualitative paradox. There is plenty of evidence that the impressive-sized US research effort is unbalanced, with 'superb technique for turning fundamental ideas into prodigious ironmongery' but 'insufficient fundamental research to generate those new ideas.' By contrast, the British effort is in better balance, though the hard truth probably is that the relatively higher proportion of fundamental research is mainly a reflection of our backwardness in developing applications. It has even been suggested that America has gained greater economic benefits from British fundamental research than Britain herself; antibiotics and the silicones are two examples that will readily occur to chemical minds. This paradox is not unimportant. If we could increase our total research effort without disturbing the better balance between fundamental and applied research that now exists, the return of results might be superior to the *pro rata* return of the total US effort.

The difficulty is that fundamental scientific communication, except in the atomic field, is universally available. A country whose industries possess well-developed resources for rapidly harnessing new ideas can market the results more speedily than a country with superior resources for fundamental research. An idea is not patentable until it is expressed in applied form. In short, technological leadership can easily be far more profitable than scientific leadership. As a hard economic fact, therefore, facilities for technological development should be somewhat in advance of facilities for purer research; and it is somewhat idealistic to think otherwise.

It does not appear from the figures produced that there is an appreciable difference in research inputs between the British and US chemical industries. For America the figure given is just over 2.5 per cent of sales turnover; for Britain it is just under 2.5 per cent. Even if these figures are only approximate estimations, there is not a notable difference in the two proportionate efforts.

Notes & Comments

Ni & Co Analysis

A COMMUNICATION in the Indian journal, *Science and Culture* (1954, **19**, 573) describes a new method for determining cobalt and nickel by a colorimetric technique. It has developed out of studies of the gravimetric possibilities of the methyl mercaptide precipitates obtained when S-methyl thiourea sulphate is added to alkaline Ni or Co solutions, a method previously described in the same journal (1954, **19**, 506). Brown precipitates are formed for both nickel and cobalt, but with cobalt, if not perhaps with nickel, the precipitate has a constant composition, $Co(MeS)_2$, only if less than the required quantity of reagent is added. If an excess is added, the precipitate is contaminated with oily oxidation products of methyl mercaptide and the amount of cobalt may be from 2 to 4 per cent less than the amount present in the solution. However, if very dilute Ni or Co solutions are used, the colour changes in the presence of ammonia follow Beer's Law and colorimetric determination is possible with appropriate colour filters. The ageing period is satisfactory—for nickel determinations about one hour, for cobalt two hours. The dilutions required in the solutions tested are very low, and especially so for cobalt; the method seems well worth examining for micro-analytical work in plant nutritional research, in which, of course, trace amounts of these two elements are of considerable interest.

The Wood & the Trees

EVEN random page-opening in the latest report from the Forest Products Research Board (for 1953, HMSO, 62 pp., 3s.) will provide a variety of items of chemical interest. The breakdown of timber in water-cooling towers is being specially studied; in addition to the more common soft rot that develops, decay by *Basidiomycetes* has been diagnosed; in warmer climates there is considerable evidence of bacterial forms of decay, an unusual trend when the natural field is mainly dominated by fungal organisms. It is possible that higher operating temperatures in warmer climates discourage fungal growth and in consequence bacteria can invade with less antibiotic deterrence. The decay of cut logs in open store—a development that obviously causes considerable losses to this useful fuel and waste disposal industry—can be substantially prevented by spraying the logs with creosote or with 5 per cent sodium pentachlorophenate. How far this represents an opportunity for the chemical trade depends perhaps on the variable economics of the log industry; currently gloomy predictions about coal stocks suggest that firms who cut or sell logs may anticipate a fairly good 1954/55 winter. Stacks of oak boards are liable to be attacked by the lyctus beetle, but preliminary research results have shown that various treatments with BHC at 0.5 per cent concentration give complete protection, and a large measure of protection is given by 0.325 per cent strength applications. A particularly interesting item concerns the historic naval vessel, HMS *Victory*, whose continued preservation may well depend upon defeating a non-maritime enemy, the death-watch beetle. The fumigation of the ship with methyl bromide has been considered a means of at least reducing the serious population of these beetles now established.

Trouble at the Root

FUNDAMENTAL wood chemistry has its own section in the report. New attention is being given to the polysaccharides other than cellulose as it is suspected that these hemi-celluloses may be influential in determining the susceptibility of timber to attacks by insects, fungi, and chemicals. The application of modern partition chromatographic techniques may make these lesser-studied components of wood easier to isolate. Two hemi-celluloses, at present merely named A and B, have been isolated from beech wood. The Report contains the plea, now all too

familiar in post-war DSIR research centre reports, for scientific staff augmentation and for no further postponement of the basic research programme. The demand for advisory services has steadily expanded until it now absorbs far too large a proportion of the staff's time. Malnutrition seems to be the customary fate of official research.

A Volt from the Blue

IN recent weeks two methods of converting sunlight into battery-stored electricity have been announced in the United States. A research team of Bell Telephone Laboratories has developed a silicon battery which achieves a 6 per cent efficient conversion, a rate which compares promisingly with the 1 per cent efficiency of most photoelectric devices. This new use for silicon depends initially upon the growth of highly pure single crystal silicon; minute impurities whose nature is at present unspecified are then diffused into the crystalline silicon so that they take up positions just below the surface. As a result innumerable positive and negative junctions are created, and wafer-thin strips of this crystalline silicon are then extremely light sensitive. If a number of these wafer-strips, each about razor blade size, are linked together, the production of electricity is about 50 watts per square yard of surface exposed to sunlight. An experimental silicon battery has already been used to operate a small mobile radio transmitter. The Bell Telephone organisation anticipates using these solar batteries at amplifying points along rural telephone lines. The second method is based upon cadmium sulphide, and was reported in THE CHEMICAL AGE on 19 June (1954, **70**, 1364). Terminals attached to either side of the crystalline wafer are made of silver and indium respectively; but the amount of power is considerably determined by the area of terminal contacts. With a crystal of about sugar cube size, a contact area $\frac{1}{8}$ in. square produced $\frac{1}{3}$ V. This development is being pioneered by the US Air Research and Development Command. It would seem to have been announced at a much earlier stage of progress than the telephone company's silicon battery.

IN THE EDITOR'S POST

American Chemical Progress Week

SIR,—Our friends at the American Chemical Society have called our attention to your comments on our Chemical Progress Week, which appeared on page 1186 of your issue of 29 May, 1954

You may be interested in some of our thinking behind this programme. The survey you mention illustrated some of the public relations problems we face. Of course, there are others. Among these is the fact that during times of national emergency members of our state and national legislative bodies and executive branches of our Government seem to have less understanding of the problems of the chemical industry than they do of other industries such as steel, petroleum or the railroads.

Chemical Progress Week is simply a device for meeting these problems. It is designed to reach as many people as possible in their own communities. It has the big advantage that they learn the significant facts of our industry from their own neighbours and this tends to put the subject in context with their own community life. One of our main objectives in this programme was to tell about the importance of the industry in terms of their everyday individual self-interest.

There are a number of important additional benefits resulting from this programme. The most important was that on this occasion a great many members and a great many employees of the chemical industry participated, and there is substantial evidence to show that this did a great deal to enhance their concept of the industry and their feeling of unity within the industry.

We are now in the process of making a detailed study of the results of our first Chemical Progress Week. We do not know whether such a programme would be practical for the chemical industry of the United Kingdom. However, we will be happy to make our study available to the proper people in England if they should be interested in considering such activity—Yours, etc.,

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THE bulk of the world supplies of thorium and the rare earths are derived from monazite, which consists of phosphates of cerium and yttrium earths with thoria. For many years the world's largest consumer, the United States, was able to import its requirements of monazite from India and Brazil more cheaply than they could be produced from domestic ores. In view of the possible use of thorium for atomic fission purposes the right to prospect for, mine and process minerals containing the element is now reserved by the Governments of most producing countries. As a result of these embargoes the price of monazite in the United States soared from $60 to $300 per ton, old domestic deposits were reopened, and strenuous efforts were made to discover new sources of supply.

Monazite & Bastnasite

The drive for self-sufficiency in rare earth minerals has yielded spectacular results. Substantial deposits of monazite are being exploited in Idaho and production from this source is expected to average from 3,000 to 5,000 short tons between 1952 and 1955. In addition, deposits of bastnasite containing 10-20 per cent of rare earth oxides have been discovered in New Mexico and California. Several million tons of bastnasite are available and it is considered that these deposits should be capable of supplying the United States demand for rare earths for more than 70 years. The recovery of thorium from bastnasite is out of the question, however, except possibly at prices at least ten times those at present paid for thorium compounds. The outlook for thorium is further handicapped by reserves costly to work for monazite alone.

Most of the uses of the rare earths were developed because of their unique properties and substitution is not easy. Research is further extending the potential applications of both thorium and the rare earths, while it is possible that thorium may become an important raw material for atomic power.

That the rare earths have not hitherto been more extensively exploited is attributed largely to separation difficulties. The purification and separation of individual rare earths is usually carried out by multiple fractional crystallisation, hundreds of recrystallisations being required. These methods are now being replaced by chromatographic techniques, using adsorptive alumina. Much work has also been done on the development of methods based on ion exchange.

According to the Office of Technical Services, Washington, there are at present no commercial uses for the separated rare earth metals or their oxides which cannot be accomplished at lower cost by mixed rare earth material[1]. On the other hand, the authors of the Paley Report[2] consider that there may be waste in using a group of rare earth metals in the form of mischmetal, where only one or two constituents are doing the work actually required. In their view the future tendency will be to split the rare earths into individual components and use each where it does the most good.

Research on problems associated with the extraction of thorium and the rare earths from domestic ores and with the separation of rare earths is being very actively prosecuted. Kinetic and thermodynamic studies of rare earth acetyl acetonates are being undertaken at the University of Arkansas. The Iowa State College and the Polytechnic Institute of Brooklyn are studying separation problems, while the extraction of rare earths from monazite sands is being investigated by the Mining Experiment Station, State College of Washington.

The University of Illinois has a long association with the rare earths, going back to the discovery of 'illinium' (promethium) by which Moseley's theory of atomic numbers was confirmed. Since the war a comprehensive investigation embracing a variety of problems in the fields of rare earth and thorium chemistry has been carried out. Many of the results have been made available to British industry in a series of reports received by the Technical Information and Documents Unit of the Department of Scientific and Industrial Research[3].

Rare Earths in Non-Aqueous Solvents

Considerable attention has been given in the past to the problem of plating out the rare earth metals from solutions of their compounds. All metals of the group are

highly electropositive in nature and are therefore difficult to obtain in an elemental state. The approximate values range from + 2.4 V for lanthanum to + 2.1 V for lutecium. Whenever electrolysis of aqueous solutions of rare earths is attempted, water is reduced preferentially and insoluble basic salts of the rare earths are formed.

This problem prompted an investigation of the properties of compounds of the rare earths in non-aqueous solvents. Many years ago Kettember studied the solubility of salts of thorium, cerium, yttrium and didymium in pyridine and in absolute alcohol. He found that the compounds investigated were either not appreciably soluble in the solvents employed or the solution possessed extremely high electrical resistance. Late in 1928, Broughall issued a British patent for the electrodeposition of metals such as beryllium, tungsten, tantalum and members of the rare earth group from liquid ammonia, using stainless steel electrodes. In the period 1930-1934, a study was made of the solution of various rare earth compounds in methyl alcohol, ethyl alcohol, the higher alcohols, acetic acid, liquid ammonia, acetone, aniline, and other media. The most satisfactory results were obtained from absolute ethyl alcohol.

Other Solvents Considered

In 1934, Ananasis and Babor reported that they had deposited traces of metallic cerium from an *iso*-amyl alcohol solution. This work seemed to indicate the desirability of extending the search for suitable solvents to other compounds. In 1936, Kube and Putman, working with the alkali metals and alkaline earths, published a study of ethylenediamine as an ionising solvent. Their work confirmed the supposition that, because of its properties as an alkyl amine as well as of its great complexing power, this compound should be a solvent of great ionising power. Of particular interest was the fact that the investigators were able to deposit electrolytically metals of the alkali and alkaline earth families from solutions of their salts in ethylenediamine.

In view of the similarity of the alkyl amines to alcohols and the success attending the work of previous investigators, it seemed desirable to undertake a study of the properties of anhydrous rare earth compounds in anhydrous ethylenediamine. The objective was to obtain knowledge of the approximate solubility of representative rare earth compounds in the solvent, the conductance of such solutions, and their behaviour upon electrolysis.

Experiments showed that anhydrous ethylenediamine acts as an ionising solvent for certain salts of neodymium, lanthanum and yttrium. However, a salt which ionises well in the solvent and at the same time is fairly soluble still remains to be found. The bromine and acetate compounds examined exist in the ethylenediamine as complexes. It appears that neodymium bromide forms an addition compound which is only slightly soluble in ethylenediamine. This is analogous to the behaviour of neodymium chloride in liquid ammonia.

It may be possible to form amalgams of the rare earths by electrolysing solutions of their salts with ethylenediamine. It appears that neodymium and yttrium can be plated on to platinum from ethylenediamine.

Ion Exchange Studies

The use of ion exchange materials to effect separations of the rare earths from each other is well established. In an investigation carried out at Illinois University, a cation exchange resin was used to determine if thorium and neodymium ions could be separated from each other by this means.

The charge and hydrated radius of an ion determine its rate of exchange and conversely its rate of elution from the resin bed. Thorium ion would be expected to be strongly bound to the resin by virtue of its quadrivalent charge. Although the hydrated radius of the thorium is not known, its crystalline ionic radius is slightly less than that of neodymium. On the basis of size alone, the neodymium ion would be expected to exchange in preference to the thorium ion, since larger ions are more readily exchanged. However, experimental observations showed that the thorium ion is the more readily exchanged ion in mixed solutions of thorium and neodymium. However, thorium is less basic than the rare earths and the less basic materials will form more stable complexes with materials like citric acid. This property might facilitate the removal of thorium with a complex-forming eluent.

Since difficulties were encountered in precipitating thorium oxalate from solutions containing nitric acid, the pyrophosphate method was used to recover thorium in certain experiments. This method consists in

precipitating thorium with sodium pyrophosphate from boiling solutions containing 0.3N hydrochloric acid. The rare earths present are not precipitated in the acidic solution. The precipitate is filtered from the solution and the filter paper containing the pyrophosphatic precipitate is digested with a mixture of sulphuric and nitric acids. The thorium is then recovered by precipitation as the hydroxide, using sodium hydroxide as the precipitating agent. The thorium hydroxide precipitate is dissolved in acid and a second pyrophosphate precipitation followed by digestion is made. A final precipitation as thorium oxalate and subsequent ignition yields an essentially pure thorium dioxide, which can be weighed. After this method had been widely used for thorium analysis, it was supplemented by a volumetric iodate method, developed at Illinois, which compares favourably in accuracy with pyrophosphate and hexamine procedures and is more rapid.

In order to avoid the difficulties encountered in precipitating thorium ions in the presence of complexing media, a series of experiments was performed to ascertain if precipitation of thorium as the fluoride would be qualitative in a citrate medium.

Ion Exchange Separation

Experiments proved that thorium ions can be separated from neodymium ions by ion exchange. Various substances are capable of effecting this separation, namely 0.5 per cent and 5 per cent hydrochloric acid solutions in the *p*H range 2.60-2.88; saturated ammonium carbonate solution, *p*H 8.56; and saturated ammonium oxalate solutions, *p*H 5.15, 5.28 and 8.70. Ten per cent hydrochloric acid and 5 per cent or 10 per cent citric acid solutions will elute both neodymium and thorium from the resin but will not effect a separation. The efficiency of eluting agents for the removal of thorium from the resin decreases in the following order: 10 per cent HCl, 5 per cent HCl, 0.5 per cent HCl, saturated ammonium carbonate, 10 per cent nitric acid, 5 per cent citric acid, and saturated ammonium oxalate solutions.

Regardless of the eluting agent employed, all the thorium was not recovered and some of the ions were always retained within the resin, due possibly to a co-ordinated linkage being established between thorium and the resin particles. The thorium ions retained within the resin may be recovered by washing the resin and subsequent solubilising of the thorium dioxide.

Radioactivity of Monazite Ores

Another investigation was concerned with the development of methods for analysis of thorium, which make use of the natural radioactivity, as recorded by a Geiger counter, of monazite ores and solutions of thorium salts. Several variables which affect determination of the activity of radioactive materials were examined. It was found that the radioactive count increases with layer thickness to a practically constant value. It also varies with the percentage by weight of ore when the ore is mixed with sand ground to the same particle size. This generalisation holds good where magnesite having approximately the same density as that of the ore is used as a diluent. This suggests that bulk density has no great effect where the diluent and ore are ground to a uniform particle size. A reduction in particle size does not, however, cause a definite increase in activity.

The radioactivity of thorium nitrate solutions prepared from one source varies with the concentration of thorium. The use of a calibration curve permits of rapid analysis of unknown solutions from the same source with an error not exceeding plus or minus 2 per cent.

An attempt was made to apply these findings to solutions of rare earth thorium salts obtained by opening up various samples of monazite ores. These were ground and screened to pass through 200 mesh and were put into solution by the following methods:

A 10-20 g. sample was added to concentrated sulphuric acid which had been boiled to white fumes. Boiling was continued till the mixture formed a pasty mass and the sample was allowed to cool to room temperature. The acid solution was then poured into nearly a litre of crushed ice to effect solution. When the ice had melted the solution was filtered in a Buckner funnel, using an acid-distilled-water-filter paper mixture. The filtrate was then diluted to 1,000 ml. in a volumetric flask.

The dilute solutions so obtained did not yield a high enough activity to provide satisfactory accuracy for the determination of thorium. The procedure was therefore modified by adding crushed ice directly to the acid ore mixture, and by this means the filtering volume was kept within the

desired limits. The activity of 25 ml. portions of filtrates was determined and the concentration of thorium in these solutions was calculated from a calibration curve previously prepared.

The agreement between chemical and activity determination proved far from satisfactory. It was considered that this might be due to the loss of some of the radioactive material on the filter paper, since the insoluble residue removed during filtration might contain the sulphates of thorium B and mesothorium I, the former being an isotope of lead and the latter of radium. That this idea was valid seemed to be indicated by the fact that the insoluble residue was highly radioactive. Further work on this phase of the problem is being undertaken.

Other Investigations

An investigation is being conducted into the phosphoric acid derivatives of the rare earths in order to effect an improvement in the existing processes for opening up rare earth ores. The equation

$$La^{+++} + H_2PO_4^- \quad LaPO_4 + 2H^+$$

represents a possible reaction occurring on the addition of an aqueous solution of sodium dihydrogen phosphate to one of lanthanum. It is believed that titrations of the liberated hydrogen ion with a standard base could result in a method for a rare earth determination, as well as the average atomic weight of the rare earths.

Laboratory work on the separation of rare earths from thorium by liquid-liquid extraction indicates that very good separations can be obtained when aqueous solutions containing ammonium thiocyanate and mixtures of thorium and rare earth salts are extracted by an organic solvent such as butyl or amyl alcohol. Thorium passes into the solvent phase preferentially.

Methods of spectrophotometric estimation are described. It has been shown that solutions used as standards have their band intensities altered over prolonged periods. A remarkable resolution of the broad band originally reported for gadolinium in the region 270-280μ has been effected by a revised technique of slit width adjustment. The absorption peaks as revealed correspond closely with those reported for photographic measurement.

Other subjects reviewed in the reports include the feasibility of counter current migration as a means of separating or concentrating rare earth ions; the reduction of rare earths to the divalent state, and the separation of rare earths by thermal diffusion. Analytical results are given for volumetric and 8-hydroxyquinoline procedures for thorium. Work has also been undertaken on the separation of lanthanum and praseodymium, on the effect of added anions on the absorption spectra of neodymium and praseodymium anions, and on stabilisation of the higher valency states of praseodymium.

REFERENCES

1 Office of Technical Services, Washington (PB111101)
2 *Resources of Freedom*, Vol. IV, p.113.
3 PB 108041, PB 108206, PB 108207, PB 108211 and PB 107701.

Ammonia Production

JUST a few months ago Sherritt Gordon Mines Limited started its mill at Lynn Lake for treatment of nickel and is now completing a construction programme at Fort Saskatchewan, which will produce a substantial tonnage of ammonia.

Mr. Eldon L. Brown, president and managing director, announced that the ammonia plant at Fort Saskatchewan has been in full operation and making shipments of ammonia for the past few weeks. 'We have a very good market for all the surplus ammonia we can produce and at current prices ammonia production appears to be a very profitable business,' he stated. He added that 'in the design and construction of our ammonia plant provision was made for doubling the capacity with a minimum of capital expenditure. It is obvious that we should take advantage of this provision at the earliest opportunity.'

Sherritt Gordon's Fort Saskatchewan plant comprises an ammonia plant and a metallurgical plant, with utilities to serve both sections. The ammonia plant is a more or less standard type of plant, and the original estimate of the cost of this section of the plant was reasonably close, said Mr. Brown in discussing differences between November 1953 estimate of cost of the Fort Saskatchewan plant and the original estimate given in 1951 annual report. The metallurgical plant, first one of its kind to be built, was well over the original estimate.

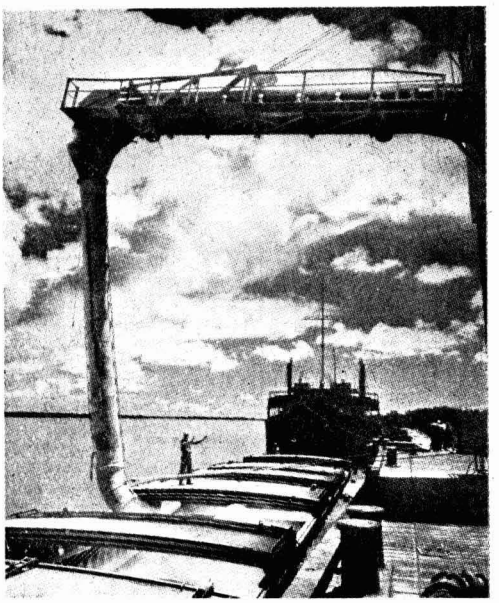
Searching for Sulphur

Two Films Tell the Story of Freeport Company

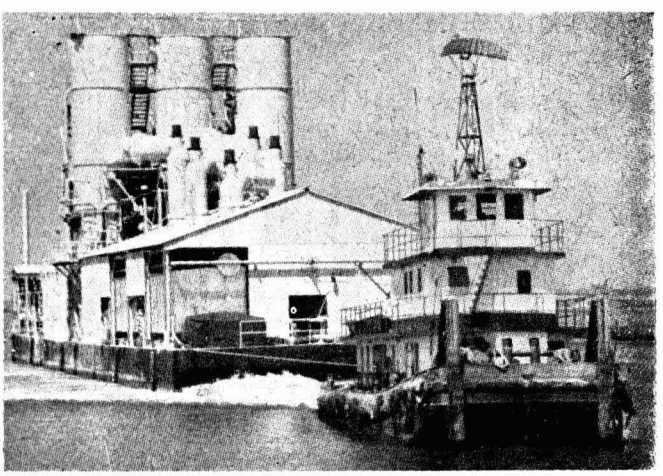
ONLY by drilling a complete well, with its attendant pipelines and hot water plant, can one determine whether a likely salt dome will give an economic yield of sulphur by the Frasch process. This was one of the many interesting and at times surprising pieces of information in two films with which the Freeport Sulphur Co., under the auspices of F. W. Berk & Co. Ltd., entertained sulphur users, members of the technical press and others on 6 July.

This complete erection is necessary because, even though the location of the salt domes is known accurately through the prospecting of the oil companies, and exploratory drilling has shown that the rock is sulphur-bearing, it is still not certain that the well will yield. Not until molten sulphur is actually pouring from the outlet pipe can the engineers be sure.

Entitled 'Yellow Magic' and 'Report from the Field,' the two films, which were in colour, gave an enthralling account of the Freeport Sulphur Co.'s mines in Texas and Louisiana, and of the very many difficulties involved in prospecting, sinking wells, and transporting the won sulphur. While the first film was of more general interest, describing the history of the Frasch process, and its development by the company during the first half of the century, the second was concerned with the four most recent projects,



Molten sulphur is transported in insulated barges to Port Sulphur, where it is pumped into giant storage vats to solidify. It is then broken down and fed to conveyor belts which lead to rail trucks, barges and freighters



For Bay Ste. Elaine, the power plant was built on a barge about 200 yards long, and towed 65 miles through bayous, lakes and canals to the site, where it was partially sunk in place. Auxiliary buildings were also erected on barges. The absence of fresh water was overcome by the development of a new process making possible the use of salt water

at Garden Island Bay, Bay Ste. Elaine, Nash and Chacahoula.

Of these four sites, only Nash is on dry land, and perversely this mine has the poorest sulphur yield. At Bay Ste. Elaine, where the mine-site is under water, the yield is richest. The other two are on land described as 'too thin to plough and too thick to drink'; Garden Island Bay is at the mouth of the Mississippi River, and Chacahoula is in the midst of a 100,000-acre swamp infested with alligators and water moccasins.

Each new assignment, indeed, as Mr. Charles White, president of the company, told his audience, is more difficult than the last. Nevertheless, projected new production of sulphur in the free world is an additional 5,000,000 tons per year over the figure of 12,800,000 tons for 1953, about 45 per cent of this being obtained by the Frasch process. But although deposits become leaner and less accessible, so that already salt domes out below the waters of the Mexican Gulf are being exploited, the growing world demand will continue to justify the Freeport Sulphur Co.'s motto that 'sulphur is where you find it.'

Nylon Yarn Patents

Judgment Reserved in High Court Action

JUDGMENT was reserved by Mr. Justice Danckwerts, in the Chancery Division on 24 June, in the resumed hearing of the action by British Nylon Spinners against Imperial Chemical Industries Ltd., claiming a declaration that it was entitled to exclusive licences in respect of patents vested in I.C.I. for the manufacture of nylon yarn within an area defined by an agreement of 5 January, 1940.

I.C.I. said it could not or should not be ordered to grant the exclusive licence to the plaintiff because, if it did so, it would be in breach of an order made by the court in the United States under the Sherman anti-trust legislation in that country.

Mr. M. K. Skadden, a member of the American Bar, said that according to United States law if I.C.I. complied with an order of the court in this country for the grant of exclusive licences to the plaintiff that would not constitute contempt of the judgment in the American court.

For I.C.I., Sir Andrew Clark, Q.C., said it found itself in a most unfortunate dilemma. It was an old-established company of the highest possible repute and it was its desire to honour and implement to the full all contractual obligations into which it had entered.

On the other hand, it carried on business in America and was amendable to the jurisdiction of the United States court. It was equally its desire to pay due respect to the decrees of the United States court and to honour every obligation placed upon it by the British court. Unfortunately, those two objects were incompatible.

The American court, said Sir Andrew, appeared to have held first, that there was an illegal conspiracy between the du Pont company and I.C.I. to violate the Sherman anti-trust laws in the United States which rendered invalid the original agreement of 1939. Secondly, it appeared to have held that the 1946 du Pont agreement was entered into for the express purpose of defeating the anti-trust laws and with a view to placing the British patents beyond the reach of the American courts in order to stultify an order which was then pending in a suit there.

The American court held that the plaintiff was fully aware of, if not an actual party to, the original conspiracy which was alleged and of the objects of the 1946 agreement as determined by the American court.

I.C.I. denied strenuously that that was the object. It entirely denied that there was ever any such conspiracy. It said the original agreements were entered into perfectly *bona fide*, but it was bound by the finding that they were illegal. As to the 1946 agreement, it was endeavouring to regularise and make legal what it realised was an agreement which might well be held by the American court to be illegal under the Sherman Act.

Sir Andrew said I.C.I. was only bound to give the plaintiff such licences as it was able to grant without infringing any order made against it by the American court.

Mr. Charles Russell, Q.C., for British Nylon Spinners, submitted that it was not a party to any conspiracy to violate US laws.

Duke to Visit Fort Dunlop

The Duke of Edinburgh will fly to Fort Dunlop on 17 November and spend the day there.

A New Industrial Tool

NPL-Industry Co-operation Results in Cheaper Spectrometer

INFRA-red spectrometry has in recent years assumed increasing importance as an industrial and scientific tool. The high cost of the equipment currently available, which was developed for research purposes, has, however, tended to limit the use of this technique in industry, and there has arisen a demand for a high resolution dispersing instrument covering a specific range of wavelengths, at a price which would enable it to be used for routine analysis or process control.

The latest report of the National Physical Laboratory announced considerable progress in the diffraction grating research programme founded on the new techniques suggested by Sir Thomas Merton, and said that simple grating monochromators were being designed which, together with inexpensive receivers of infra-red energy also under development, were likely to have extensive uses in chemical process control. The culmination of this work was to be seen at a luncheon held in London last week to announce the production of the Mervyn-NPL spectrometer, the result of collaboration between the optical experts of NPL and the electronic engineers of Mervyn Instruments.

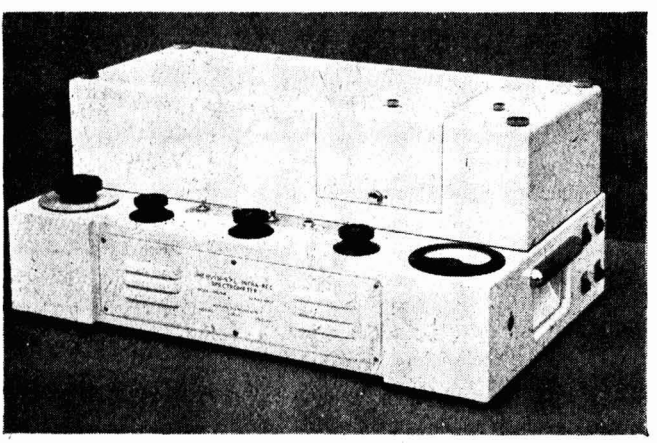
The present instrument, covering the important 2.8-3.8 μ region, is the first of a series of such instruments designed to operate each in one specific region of the infra-red spectrum. It is hoped that it will prove possible to adapt it to other regions by the addition of small relatively inexpensive components to the basic design.

The spectrometer source is a Nernst filament, the light output of which is interrupted 800 times per sec. The monochromator is a Merton-NPL grating with a filter to absorb unwanted orders; the resolving power is comparable with that of prism instruments, but is achieved with unfigured optics and simple slits. The detector is a lead selenide cell.

A high gain amplifier followed by a special correlation detector and an adjustable integrator network combines adequate sensitivity with a control of signal-to-noise ratio at the output.

A very high order of overall long term and short term stability for quantitative measurement, comparable with that of a null method balanced double beam spectrometer, is obtained by a novel and patented system of compensation developed by Mervyn Instruments. By this system the light output from the source is continuously monitored through the detector and the gain of the amplifier is automatically adjusted so that variations in output of the source, the sensitivity of the detector, or drifts in the amplifier characteristics, appear as negligible variations in the output.

Another novel and patented feature of the instrument is a continuously adjustable cam, by means of which the compensated gain level of the amplifier is automatically corrected to allow for the wavelength characteristics of the source, the filter and the detec-



Showing the simple construction and few controls of the new instrument

tor. If desired, it may be set to allow for any non-linear absorption in the cell.

The main control is a dial calibrated directly in wavelengths, which may be operated manually, set to a fixed setting, or rotated by a synchronous motor to give a continuous scan. The scan is unidirectional and the output is reduced to zero during the flyback in order to remove ambiguity. The output is presented on a meter calibrated directly in percentage transmission, and a pen recorder may be connected if desired.

There are three additional controls: one for band-width, one for meter zero-ing and one as a fine output control. Large changes of gain, which may be needed to cope with abnormally opaque samples, are obtained by varying the light attenuator in the reference light path.

Facilities are provided for evacuating the monochromator or for filling it with a suitable gas. The sample compartment can be adopted to take absorption cells of any kind with which the user may be familiar.

The instrument may be used for analysis or control of any compound having absorbtion bands within its range, in such industries as: petroleum refining; production of lubricating oils; manufacture of plastics, paints and resins; production of detergents; explosives manufacture; preparation of pharmaceutical products and cosmetics; and analysis of heavy water.

Rating Assessment Appeal

I.C.I.'s Works at Runcorn

AN appeal by Imperial Chemical Industries Ltd. against a rating assessment for their Castner-Kellner works at Runcorn came before the Lands Tribunal in London last week. The respondents were Runcorn Urban District Council and Mr. Robert Pickering Owen, Valuation Officer.

The tribunal's decision will be announced later.

Mr. Michael Rowe, Q.C. (for I.C.I.) told the tribunal that the Castner-Kellner works had been assessed at a net annual value of £39,333. On March 21, 1952, the valuation officer proposed to increase the assessment to a net annual value of £56,600 and rateable value £14,150.

I.C.I. had subsequently objected but the Cheshire West Valuation Court had determined that the valuation list should be altered in the manner proposed.

That increase, said Mr. Rowe, was largely due to additional plant and machinery—additional, but not different in kind or function—which had been installed.

Within the works there was what was known as the Weston Point power station, at which electricity was generated. The question really at issue was whether the electricity generated was power within the meaning of the Plant and Machinery (Valuation for Rating) Order. I.C.I. claimed that it was not.

Ninety-three per cent of it was, in fact, used for trade processes, and the balance only for motive power, lighting and heating.

Mr. Maurice Lyell, Q.C. (for Runcorn Council and the valuation officer) said that, broadly, his case was, first, that when one generated electricity, one generated power; and secondly, that the actual process which took place in electrolysis (as at Castner-Kellner) was a use of power within the meaning of the order.

In reply to Mr. Lyell, Professor E. N. da C. Andrade (a witness for the respondents), agreed that the dictionary regarded electricity as power only as motive power when it moved machinery. In moving matter from one place to another in the Castner-Kellner process 'you do work.'

Mr. Rowe said that there were fifteen definitions of power and he submitted that the one used by Professor Andrade 'did not make sense' when read into the order. There was no dictionary definition, so far as he knew, that simply said power was steam, water or electricity; yet Mr. Lyell had suggested that the generation of electricity must be a generation of power. Mr. Rowe submitted this could not be so.

Mr. Rowe submitted that as the electricity generated at the works was for the electrolytic process, the generating plant should be exempt from rating, and he asked the tribunal to uphold the appeal.

Fibreglass Contract

Fibreglass Ltd., a subsidiary of Pilkington Brothers Ltd., have secured a contract to supply 10,000,000 sq. ft. of fibreglass tissue pipe for the Sui to Karachi natural gas pipeline project in Pakistan.

Research Progress in Canada

Talk by Past-President of National Research Council

AT a meeting of the General Committee of the Parliamentary and Scientific Committee on 3 June, Dr. C. J. Mackenzie, president of the Atomic Energy Control Board and member and past-president of the National Research Council of Canada, spoke on the progress of scientific research in Canada during recent years, and its effect on the Canadian economy.

Dr. Mackenzie said that Canada was a very different country, both politically and economically, in 1954 from what she was in 1918. Science and technology had made fundamental changes.

In the first war, one of the largest and most successful acetone plants was put up in Toronto; and a scientific industry was introduced into Canada for the first time. After the first war the Government, with the unanimous approval of the people, shut down the factory as soon as they could after 11 November, 1918. The United States acetone plants went on and became the centre of a large nitro-cellulose industry. With the motorcar coming along a large and economically important industry was built up in the United States. The fact was that in 1918, although the opportunities were there, scientifically Canada was not ready.

An Efficient Factory

In 1940, Canada co-operated with the Allies and built, in about a year, a very large artificial rubber plant, which became one of the most efficient factories. After the last war a research organisation was built up round this rubber plant, and today it was one of the single units of a rapidly growing industrial set-up in Canada.

With regard to the present situation, Dr. Mackenzie said they were quite embarrassed by the flattering things said in this country and elsewhere. Very favourable comments have been made on their prospects and prosperity.

Since 1939 the population of Canada had increased by 35 per cent, from 11,000,000 to 15,000,000. Their net income had doubled: Government expenditure had increased fourfold. Their foreign trade had also increased fourfold: that was a very significant point. It must not be forgotten that Canada was a trading nation: 24 per cent of her national products were for export. Since the war they had got along very well; they had balanced the budget every year, and reduced the debt by 15 per cent.

A very large capital investment had been made in Canada, which meant more resources, more facilities and more wealth. A great deal of capital came from Great Britain, and much from the United States: but only 14 per cent of Canada's capital had come from outside: 86 per cent was provided from the savings of the Canadian people.

No Longer Raw

In 1918 Canada was a rural country. They produced fighting men and much raw material, but generally speaking they were raw: that was not true today. One of the reasons for this change was the development of natural resources, such as oil in Alberta and iron in Labrador. The Alberta oil was going to be as great as Texas. But these natural resources did not compare with the value of their agricultural crop, and the exports of their pulp and paper.

Between 1919 and 1939 branch factories were established in Canada. But the great scientific research organisations in American companies were not worth anything to Canada. Canada had no support from the large American research organisations that were located in the United States. Only branch factories were established in Canada.

Fortunately Great Britain had a similar experience in the first war. The British Government suggested to the Canadian Government that it would be a good idea to set up an organisation, and in 1916 the National Research Council was formed for the purpose of co-ordinating research work in Canada: but there was nothing to co-ordinate. The Council started by giving scholarships, and stipulated that these scholarships must be held in Canada. At that time it was a very wise course, because they needed to build up their internal universities. They gave scholarships to individuals and money to universities. The Council started with about $50-60,000 per annum: today they had £2,000,000.

In 1939, when war broke out, the National Research laboratories had just been completed. There were 300 people in the National Research Council at that time, and there was a large reserve of well-trained research scientists. In a short time the number expanded from 300 to 2,000. After the war the organisation was divided up, and they undertook military research and atomic energy research. There were now 6,000 employees.

The Tizard Mission

At the beginning of the war the British Government sent over the Tizard Mission to the American continent, not to help Canada but to help the United States. But Sir Henry Tizard went to Canada first, and Canada started working on a UK programme. By 1940 they had built a radar establishment in Halifax. After the Japanese attacked the United States, radar equipment was supplied by Canadian firms to protect the Panama Canal and the west coast of the United States. Canada built optical glass factories, chemical, aircraft and metallurgical industries, and destroyers. The Canadian shipbuilding industry was fundamentally a development of science and technology.

Canada was and would remain an industrial nation of front rank. The hope of the world depended upon good sound international trade and co-operation, and industrial economy must be founded on applied science.

A short discussion followed. In reply to Mr. A. L. Bacharach, Dr. Mackenzie said that expenditure on Government research in Canada far outstretched that of private research. But he did not know if that was true on a percentage basis. One was impressed by the magnitude of Government research as compared with that of industry: but that was a false impression. There were many industries today which were starting research in a cautious way. There were a number of British industries operating in Canada which were starting research and scientific development in Canadian factories. The hydroelectric, chemical and rubber companies were doing a great deal of research.

Dr. H. R. Lang referred to an article dealing with the drift of Canadian research scientists to the United States because of the greater economic rewards to be earned there, and Dr. Mackenzie said that since 1939 they lost only one senior man from the Research Council, and he knew of none who had left to go to the United States since 1946. Canada had a surplus of research scientists and was turning out more people than they had jobs for. There were more people coming from England to Canada, than there were going from Canada to the United States.

In reply to Dr. R. Lessing, Dr. Mackenzie said that very little was known in Canada of the research which was taking place in the United States. Canada was much closer to England: atomic energy brought the two countries together. They were one group until after the war. They felt far closer today to research in Great Britain than to research in the United States: that was something that should be encouraged.

Replying to Dr. F. H. Cotton, Dr. Mackenzie said that the Polymer Synthetic Rubber Corporation was now completely independent of American direction of research and finance. When it started there was a committee that pooled knowledge. About 1944 the Government was forced into research in order to get this exchange. At the end of the war the United States closed down some plants, but the Canadian plant was not shut down and the Research Council organised research for it.

Sir Henry Tizard inquired if there was in Canada an organisation comparable to the National Research Development Corporation in Great Britain, or if such matters fell within the normal terms of reference of the Canadian Research Council. In reply Dr. Mackenzie said that there was a Patent Corporation, which was a subsidiary company of the Research Council. They had made $200-300,000 on patents.

Gas by Train to Villages

Hungary has decided to supply natural gas to provincial villages and towns by train. Experts of the Ministry of Town Management who have been working out how to make better use of the country's considerable fields of natural gas will at the beginning of next year start the new service with 12 tanker wagons each holding 7,500 cu. metres. Instead of a gas works, all that a selected town will require is a storage plant into which the gas will be pumped. It is stated that each wagon will make possible an annual saving of 8,300 tons of coal.

Styrene Oxide — A Commercial Reality

by PETER W. SHERWOOD

A NEW member promises to join the small family of commercially available epoxides. Styrene oxide, now produced on a semi-commercial scale at Dow Chemical Company's Freeport, Texas, plant shows every sign of early graduation to large-scale production.

Quoted at $1.00 per lb., the material was produced at the rate of 10,000 lb. per month in late 1953. Unquestionably, the price will come down (to an estimated 56-60 c. per lb.) if commercial acceptance can stimulate the large-scale production of styrene oxide.

An immediate outlet exists for the material in the manufacture of phenyl ethyl alcohol, an important intermediate in the perfume industry. Other applications, which are already proving their worth, include use of styrene oxide as modifier for resins in varnishes, paper coatings, electrical insulation, and sealing compounds. Other potential markets may take advantage of this epoxide's excellent reactivity.

Thus, immediate interest will be directed at applications which parallel the uses for commercially established internal ethers, among which ethylene oxide is, of course, the most important.

Growing Importance of Epoxides

While the lion's share of ethylene oxide is converted to glycol, it also finds other applications of growing importance. Among the more important, one must include the production of polyoxyethylene derivatives of ethylene oxide which serve as non-ionic detergents, emulsifiers, dispersants, and in other rôles of surface-active agents. Polyoxyethylene diesters are finding growing use as plasticisers and solvents. The synthetic textile and rubber industries look to ethylene oxide as one of the raw materials in the production of the important monomer acrylonitrile. Promising properties are exhibited by ethylene oxide-terephthalic acid copolymer films.

These are the major established applications for epoxides. Use of styrene oxide in conjunction with or in lieu of ethylene oxide in some of these fields may well become justified by special properties of the product.

Illustrative of the wide range of reactions which may be entered by epoxides are the addition of water to form glycols, hydrogenation to alcohols, addition of hydrogen halides, hydrogen cyanide, and hydrogen sulphide. Ammonia or organic amines will yield the corresponding alkanolamine. Self-condensation will lead to cyclic ethers (e.g. dioxane may be formed from ethylene oxide in this manner). Reaction of ethylene oxide with glycol will yield diethylene glycols (the use of styrene oxide in lieu of ethylene oxide will lead to a coresponding phenyl-substituted condensation product). Polyesters of interest to the plastics industry may be obtained by the reaction of epoxides with polybasic organic acids. Copolymerisation reactions are possible between epoxides and phenol or vinyl chloride.

Direct Oxidation Unlikely

There is no indication that direct oxidation methods, which have latterly assumed considerable commercial importance in the manufacture of ethylene and propylene oxides, may be employed for production of the phenyl-substituted homologue. It is evident that the very pronounced polymerisation tendency of the raw material, styrene, limits both the type and conditions of reaction which may be employed for its conversion to styrene oxide.

Either chlorine or bromine may be used for the first step of styrene oxide synthesis via the halohydrination route. The choice of halogen determines the conditions which must be selected for the subsequent hydrolysis of styrene halohydrin to styrene oxide.

Conversion of styrene to its chlorhydrin is effected by contacting the hydrocarbon with an aqueous solution of chlorine. Contact with elemental chlorine is to be avoided since it leads to the formation of styrene dichloride.

Nevertheless, occurrence of this side reaction to a significant extent is unavoidable. In aqueous solution, chlorine is in equilibrium with its hydrolysis products, hypochlorous and hydrochloric acids. It thus becomes possible to suppress the amount of elemental chlorine by the presence of a weak alkali which will remove hydrochloric acid as soon as it is formed. For this reason, styrene chlorhydrin formation is improved

by the choice of dilute aqueous sodium bicarbonate solution as reaction medium.

Allowance must be made for the polymerisation tendency of styrene, and by-products from this source may be held below 10 per cent by operating at temperatures not exceeding 10°. Additional benefits may be gained by the use of a suitable polymerisation inhibitor.

Normally, olefine chlorhydrins are converted to the corresponding epoxide by the action of hot alkali solutions. It is in this step that the presence of styrene dichloride becomes objectionable. Under drastic conditions it is converted to ω-chlorostyrene which can be separated from styrene oxide only with much difficulty.

Difficulty of Separation

Styrene chlorhydrin boils at 114° at 14 mm., and styrene dichloride boils at 115° at 15 mm. Conditions of chlorination must therefore be chosen with a view to minimum dichloride formation. It is furthermore possible to guide the dehydrochlorination of the dichloride to yield predominantly styrene chlorhydrin which may then be converted to styrene oxide.

The second reaction may be achieved in good yield by using calcium acetate as dehydrohalogenation agent (USP. 2,582,114). Conditions may be chosen so that styrene dichloride as well as the chlorhydrin is simultaneously converted to styrene oxide, making purification of crude chlorinated product unnecessary.

In the course of dehydrohalogenation, acetic acid is set free. To prevent the occurrence of acid conditions, which would lead to α-phenyl alcohol production, the reaction phase is maintained in contact with a neutralising agent, such as calcium carbonate. Use of a stronger alkali is vitiated by its tendency to promote formation of phenyl glycol and ω-chlorostyrene.

Permissible operating temperature is between 70 and 90°. At lower levels, conversion rate is too slow, while an increase in temperature above 90° will lead to hydrolysis of the dichloride's terminal chlorine at the cost of desired epoxide formation.

A homogeneous reaction system in contact with insoluble limestone is made possible by the use of ethyl alcohol as solvent. Excess calcium acetate may be provided in solid form, thus assuring constant saturation of the alcohol phase with the dehydrohalogenating agent (solubility of calcium acetate in ethyl alcohol is about 4 per cent w/w).

Illustrative of this process is the conversion of a crude chlorination mixture containing 45 per cent styrene chlorhydrin, 45 per cent styrene dichloride, and about 10 per cent polystyrene. This product is formed by passing gaseous chlorine into a mixture of equimolar amounts styrene and sodium bicarbonate with water at 10°.

Upon completion of the reaction, the organic phase is separated and dissolved in 90 per cent ethanol. To this solution are added calcium acetate monohydrate and calcium carbonate. The mixture is refluxed (the boiling point is approximately 80° and proper operating temperature is thereby established). The reaction product is purified by vacuum fractionation. Frisch (USP. 2,582,114) reports overall styrene oxide yield at 83 per cent of theory.

Use of bromine in lieu of chlorine reportedly leads to much less extensive dihalogenation and the crude product may therefore be converted to the epoxide at more drastic conditions in aqueous suspension. This method has the disadvantage of calling for the use of more costly bromine which may, however, be largely recovered in the form of sodium bromide.

Alquist and Guss (USP. 2,237,284) suspended styrene in a large volume of water and introduced bromine into the thoroughly agitated mixture. Operating temperature was held at 90-100°. The crude organic product was separated and contacted with an aqueous solution of caustic soda at 50-70°. Styrene oxide was recovered from the organic product by fractionation *in vacuo*. Yields as high as 73 per cent theory (based on styrene) are reported.

Craftsman Welders

A PRESTIGE film, 'Craftsman Welders,' has just been prepared by Babcock & Wilcox Ltd., Farringdon Street, London, E.C.4, for showing to clients, engineers, insurance companies and similar bodies throughout the world. The purpose of the film is to stress the extremely rigorous training through which the company's welders are put, in order to ensure the maintenance of high-quality welding on site as well as during manufacture. The whole is convincing evidence of the care which goes into the erection of Babcock & Wilcox plant.

Indian Ceramic Society Silver Jubilee

Professor W. E. S. Turner Welcomed

THE Silver Jubilee celebrations of the Indian Ceramic Society were held before a large and distinguished gathering of scientists, industrialists and public men in the early part of this year, under the presidency of Dr. Atma Ram, Director, Central Glass & Ceramic Research Institute, Calcutta, and President of the society. A special feature of the meeting was the attendance of a very large number of delegates from all over the country. Professor W. E. S. Turner was the chief guest at the celebrations.

In welcoming the guests on this occasion, the Vice-Chancellor of the University, Acharya Narendra Deva, said that as the society was founded in the University it was in the fitness of things that the Silver Jubilee celebration was being held there. He earnestly hoped that as a result of the deliberations of the eminent technologists and industrialists gathered at the occasion from all over India, an intimate co-operation between industry and institutes of technology would be established which was indispensable for the growth of industry and technical institutions.

Of Considerable Importance

Inaugurating the session, Pandit G. B. Pant said that the ceramic industry had assumed a considerable importance in recent years. While appreciating the work done by the society for the promotion of the ceramic industries in the country, he hoped that in the interest of the country and the average worker the society would pay more attention to the problem of the cottage workers.

In his presidential address, Dr. Atma Ram gave a comprehensive review of the efforts leading to the establishment of the society, its struggle for existence during the period of 12 years and the expansion in its activities in the last decade. He also narrated the developments that had taken place in the various ceramic industries in the country as also in the field of educational and research activities. While discussing the future policy and programme of the society he gave a comprehensive review of the developments that had taken place in other countries in these fields.

Commenting on the phenomenal progress made during the last 30 years particularly due to two events—introduction of automatic machines in the industry and the application of scientific knowledge to industrial operations—Dr. Atma Ram said that not only had the new developments been spectacular but outlook on matters of organisation, planning, personnel, scope and size of operations and methods of production had very materially changed.

Society's Future Work

Making observations on the future scope of the work of the society, the President further remarked:

'The spectacular progress made by other countries need not overawe us and in an attempt to bridge the wide gulf we should not start simply copying the measures adopted by them without reference to the conditions available in our country. One such instance is the employment of automatic machines in the glass industry which has often been recommended. These machines are no doubt good and helpful but viewed in the context of our present low consumption of individual items, their indiscreet use may lead to difficulties. This is one of the aspects in which the Indian Ceramic Society by an objective analysis of our circumstances can help to give guidance to the industries and also educate the public in general.

'Our immediate problem is to produce quality articles at low cost so as to bring them within the easy reach of the common man. The Ceramic Society can be of assistance by writing short notes and informative articles, in emphasising the importance of control by comparative examples and even giving information on the methods of control.'

Summing up the President said:

'I therefore visualise that in future the Indian Ceramic Society should take upon itself the task of providing a sort of brain trust for educating and guiding the public not only in matters of immediate interest but also in the future planning of development of our resources. I appeal to the members of the society to feel conscious that they

serve industries which occupy a key position and their responsibility is very great. With determination, devotion and faith in the spirit of science, I am sure, we shall succeed in discharging the responsibility placed on us.'

Introducing Professor W. E. S. Turner. the chief guest, the President said:

'In the East, the West is usually looked upon as associated with materialism, but here is one W.E.S.T. who after christening the subject of glass technology has nursed it to its present stature with the spirit of a missionary, and after conventional retirement from the duties of teaching has become much more active and is undertaking hazardous journeys to the remote parts of the world preaching the gospel of science.

An Illustrious Pioneer

'Ever since he initiated the study of glass technology in 1915 he has been the central figure and has dominated many of the developments in the scientific and industrial fields. He has been the person whom people have approached for advice which has been freely given and by which they have immensely benefited. Illustrious as a pioneer in a field of research dominated by a sense of secrecy and empiricism, he has been instrumental in bringing about international co-operation . . . among the different countries which has led to two most important organisations—the International Glass Congress and the International Commission on Glass. It is therefore a very rare privilege for the Society to have such an outstanding personality as the chief guest and I feel honoured to request him to address the Silver Jubilee Celebrations.'

In his address Professor Turner said:

'I seem to find my text in the urgency of the times in India, as seen by every thinking, sympathetic visitor from abroad. the urgency of finding work and a dignified human place for all individuals in the huge population of India. In this country the need to apply science to industry was never so apparent.

'I am very glad to know that the founder of this University (Mahamana Madan Mohan Malaviya) recognised significance of all knowledge no less in those branches which cater for man's physical than for his spiritual labours and existence; and the President (Dr. Atma Ram) has rightly paid tributes to his memory.

'In India today the injunction to apply science must insistently be borne in mind. The Indian Ceramic Society is a technological society and the future growth of the industries to which it owes responsibility is dependent on science and invention.'

He added further that in directing the future efforts of the society, the picture of modern world progress in glass and ceramics which had been very lucidly presented by Dr. Atma Ram must be borne in mind.

On this occasion the offices of the society which have been constructed within the the premises of the Glass and Ceramics departments of the University were declared open by Pandit G. B. Pant, the chief minister, and in requesting him to declare the buildings open, the President said:

'The Society has been able to build up a small building for housing its offices, library and museum. It represents the devotion of ceramists and ceramic manufacturers of the country for the future advancement of these technologies and industries. It is therefore a particular privilege that an elderly statesman, and a great national leader of the eminence of Pt. Govind Ballabh Pant should honour them by agreeing to declare the buildings open.'

Special Exhibition

A special exhibition represented a cross-section of the various products produced by these industries, and also research institutions including the Bengal Ceramic Institute and the Central Glass & Ceramic Research Institute and the departments of the glass and ceramics of the University.

As part of the celebrations, a symposium was organised by the Central Glass & Ceramic Research Institute jointly with the Indian Ceramic Society.

In his opening address to the symposium, Dr. Atma Ram said that the application of science to industrial operations and the development of new products to meet the increasing scientific requirements of industries had resulted in the utilisation of new raw materials, new methods of production and beneficiation and new tools of studying them. Dr. Atma Ram hoped that the symposium would help in finding out what was available, what more was needed and what steps should be taken to achieve those ends.

Forty-eight papers relating to (a) occurrences including geology of the deposits; (b) method of studying raw materials and (c) methods of beneficiation were read.

Solvent Extraction for Characterising Tar Creosotes & Petroleum Derivatives*

IT is well known to the wood-preserving industry that the American Wood-Preservers' Association (AWPA) requires coal tar creosote to conform to certain 'specific gravity of the fractions' requirements; viz., that the specific gravity of the distillation fraction between 235° and 315° be not less than 1.025 and the fraction between 315° and 355° be not less than 1.085. However, this requirement does not adequately provide the desired differentiation between and classification of coal tar creosotes and petroleum derivatives. It is particularly well known here in England that creosotes derived from vertical retort coal tar cannot pass the specific gravity of the fractions requirement; however, vertical retort coal tar creosotes have a long, successful history in England as wood preservatives. Furthermore, relatively large amounts of certain petroleum derivatives can be added to some creosote oils and the mixture will still meet the specific gravity of the fractions requirement.

The Research Approach

It is the purpose of this paper to describe briefly the research approach which led to the development of a method which appears to have considerable promise for characterising and classifying the coal tar and petroleum oils of interest to the wood-preserving industry.

At the beginning of this project, it was considered mandatory to determine, as fundamentally as feasible, the essential differences between oils derived from coal tar and from petroleum. It was also considered important to determine the factors which the oils derived from coal tar had in common, as well as to determine the factors common among the petroleum derivatives. It was hoped that this information would define the major areas of difference between oils derived from these two different sources and indicate what differences could best be utilised by the wood-preservers for the desired classification of coal tar creosote.

Eighteen creosote oils of widely different origins were collected. Included were creosotes derived from vertical retort, horizontal retort, and coke oven tars. Ten were obtained from the United Kingdom, two from Germany, and six from the United States. These creosote oils were distilled from the various coal tars in plants using many different types of equipment. The petroleum oils and petroleum derivatives chosen were well within the price range of creosote oil and also had physical characteristics similar to those of creosote oil. In general, they were cheap petroleum by-products, having as high an aromatic content as possible and a distillation pattern as close to the AWPA pattern as possible.

Infra-red absorption studies were conducted on the selected creosote and petroleum oils. The object of these studies was to obtain an overall qualitative estimation of the chemical similarities and differences among the creosote and petroleum oils. The infra-red method is particularly useful for this objective, because certain combinations of atoms, recurring frequently in complex molecules, are associated with certain absorption bands in the infra-red spectra of these substances. In actual practice, an infra-red beam of known wavelength is allowed to pass through a sample of oil. The relative intensity of the incident and emergent beam is measured. This is now repeated for other wavelengths in the infra-red spectrum. From these data, one is able to obtain a plot showing the amount of light absorbed as a function of wavelength. The amount of light absorbed may be denoted by the optical density, OD.

The optical density is related to the amount of material present, i.e., the OD for the aliphatic CH bond will be high when much aliphatic carbon is present. An experienced infra-red spectroscopist can, by examination of such data, ascertain the types and amounts of certain combinations of atoms. These studies showed that the creosote oils have a greater predominance of aromatic carbon-hydrogen bonds than the petroleum oils.

The ratio of the optical density of aliphatic and naphthenic (hereafter referred to as aliphatic) carbon-hydrogen bonds to

* From a paper delivered to the Annual Convention of the British Wood Preserving Association at Cambridge 24 June, by R. E. Heiks, S. E. Blum and J. E. Burch, of the Batelle Memorial Institute, Columbus, Ohio.

aromatic carbon-hydrogen bonds varied from 11 to 36 for the petroleum oils and from 0.5 to 6.0 for the creosote oils. The infra-red spectra of the creosote oils exhibited a general similarity which was significantly different from the spectra of the petroleum oils. Many absorption bands found in creosote oils are missing in petroleum oils; whereas, all of the bands found in the petroleum oils studied are also found in creosote oils.

Optical Density & Boiling Point

The optical densities reported in the first paper[1] were values representative of the whole oil. Because the wide variation in the method of distilling and blending creosote oils results in considerable differences in the distillation pattern, it was desirable to know more about the variation of the optical density of the aliphatic carbon-hydrogen bond as a function of boiling point. Through the kindness of Dr. Donald McNeil, Director of the British Coal Tar Research Association, closely cut fractions from the distillations of a vertical retort tar creosote and a coke oven tar creosote were obtained. Dr. McNeil performed the distillations in his laboratory at Gomersal, using a 39 in. by $\frac{3}{4}$ in. column packed with $\frac{1}{8}$ in. by $\frac{1}{8}$ in. stainless steel gauze rings. The column was rated at 50 theoretical plates at atmospheric pressure. The distillation was carried out under reduced pressure. One per cent by volume fractions were collected. In all, 70 fractions were obtained from the vertical retort creosote and 87 from the coke oven creosote. Twenty-three of the vertical retort creosote fractions and 20 of the coke oven creosote fractions were selected to cover the atmospheric boiling range 175-375°. The optical densities of the aliphatic carbon-hydrogen absorption bands were then determined from the infra-red absorption spectra.

The two curves have approximately the same shape, with the exception of a sharp maximum in the vertical retort curve at 283° which does not appear in the coke oven curve. In both oils, the proportion of aliphatic carbon fluctuates widely as the boiling point increases. This behaviour can be accounted for by the types of compounds distilling. In the low boiling range, aliphatically substituted benzenes distil over. This is indicated by the maximum at about 185°. In the region 215-225°, naphthalene is the major distillate. There is a decrease in aliphaticity and the resulting minimum in the optical-density curve. Now, as the boiling point further increases, aliphatically substituted naphthalenes distil, and there is again an increase in the number of aliphatic carbons and a corresponding rise in the optical-density curve. An extension of this distillation pattern to more complex and higher boiling aromatic nuclei and their aliphatically substituted homologues could account for the remaining maxima and minima.

There is not sufficient information available at the present time as to the chemical identities of the major components in these fractions to substantiate extensively this explanation. However, by applying the method described in the second paper[2], wherein 2, 4, 7-trinitrofluorenone complexes were prepared and identified by X-ray diffraction, the major aromatic constituents in certain fractions were identified. It was found that the vertical retort fraction boiling at 264° contained acenaphthene (a compound containing two aliphatic carbons) as a major constituent, while in the fraction boiling at 267°, β-naphthol (containing no aliphatic carbons) was a major constituent. The corresponding drop in the optical density is thus expected.

Presence of Paraffins

The fact that the vertical retort curve lies above the coke oven curve may indicate the presence of a small amount of paraffinic material, which is admixed with the fractions over most of the boiling range. The presence of normal paraffin hydrocarbons in small amounts was demonstrated by extracting the vertical retort creosote oil with urea, according to the method of Zimmershied and co-workers[3]. The urea extraction yielded 4½ per cent straight-chain paraffin hydrocarbons.

A deep minimum in each curve is observed at about 215°. In the case of the coke oven creosote, the minimum is broad, whereas, in the vertical retort creosote, it is quite sharp. This corresponds to the fact that the naphthalene content of the coke oven oil is much higher than that of the vertical retort oil. Naphthalene is found to be present in fractions boiling over a wide range (from 183° to 225°) in spite of the very excellent distillation procedure which was utilised.

The infra-red absorption study also indicated the presence of phenolic compounds

in all of the vertical retort creosote fractions boiling up to 380°, and there was even a trace in the last fraction boiling at 395°, whereas, in the case of coke oven creosote, no significant amount of phenolic compounds was found in any fraction boiling above 203°. It must be pointed out, however, that not each of the 87 fractions available was studied. The study included 21 fractions selected to cover the boiling range 176-365°.

Since the infra-red studies showed the ratio of the aliphatic carbon to aromatic carbon to constitute a major difference between coal tar creosote and petroleum oils, a series of chromatographic studies was initiated to see if this method could be used for characterising the oils. Chromatographic methods frequently are used in petroleum research to elucidate and separate the various types of chemical compounds found in oils. In this study, samples of barren whole creosote oil (creosote oils stripped of tar acids and tar bases) and petroleum oil were adsorbed on a silica gel column and eluted with 1-octanol. The index of refraction of the eluted chromatographic fractions was measured.

The refractive indices of the eluted fractions were plotted against volume of eluate. These curves showed differences between the oils, but the overlap was such that further efforts along these lines did not appear warranted.

Discrepancy Explained

It was concluded that the so-called highly aromatic petroleum derivatives exhibit evidence of high aromaticity by conventional tests such as chromatography and solubility in concentrated sulphuric acid, whereas infra-red optical density evidence shows a much lower content of aromatic carbon than expected. This discrepancy can be explained if it is assumed that the aromatic compounds in the petroleum oil are generally substituted by aliphatic groups. The aromatic portion would tend to dissolve in concentrated sulphuric acid and to adsorb on silica gel columns, and little or no indication of the aliphatic carbon would be evidenced. However, the infra-red absorption will indicate the presence of aliphatic carbons, whether or not they are attached to aromatic nuclei.

In 1951, Saunders[4] and Medcalf, Hill and Vriens[5] demonstrated that β,β'-oxydipropionitrile, hereafter referred to as ODPN, shows unusual selective solvent properties for the extraction of aromatic compounds from hydrocarbon mixtures. Medcalf *et. al.* quantitatively determined how certain aromatic and substituted aromatic compounds distribute themselves when allowed to dissolve in a 50-50 by weight mixture of the two essentially immiscible solvents, ODPN and *n*-heptane. They placed 50 g. each of ODPN and *n*-heptane into a 250-ml. separatory funnel and added 5 to 6 g. accurately weighed solute. The mixture was vigorously shaken and allowed to settle for at least an hour. After separation, each layer was analysed for its solute content. They reported their results in terms of the distribution coefficient.

Aliphatic Side-chains

They found ODPN to be very sensitive to the presence of aliphatic side chains on aromatic nuclei in such a way that the greater the degree of aliphatic substitution on an aromatic nucleus, the less soluble in ODPN is the resulting compound. Using their notation, the distribution coefficient is increased by a factor of 1.6 for each aliphatic carbon atom added to an aromatic nucleus. Since the infra-red study indicated that one of the major differences between coal tar creosote oils and petroleum oils (even those designated as highly aromatic) was the greater aromaticity of the creosotes, it appeared that the highly selective solvent, ODPN, might be used to characterise and classify oils derived from coal tar and petroleum. The possible simplicity of its use was also appealing.

After a considerable amount of laboratory work, during which 44 different oils were studied, it was concluded that a satisfactory and simple method could be developed. The principles upon which the method was developed and a description of the initial work were included in a paper presented to the American Wood-Preservers' Association in 1953[6]. In essence, the distribution of a sample of oil between the two solvents, ODPN and low-boiling petroleum ether, is determined and is reported as ODPN-insoluble (weight per cent). The ODPN-insoluble value rises very sharply as the number of aliphatic carbon atoms on the benzene ring increases. This is in accord with the conclusions reached by Medcalf *et. al.*

Infra-red absorption data indicate the manner in which a vertical retort creosote and aromatic petroleum oil distribute themselves between the petroleum ether and ODPN layers. It can be concluded that only the unsubstituted and slightly substituted aromatics are concentrated in the ODPN phase. It is significant to note that the petroleum ether phase does contain some aromatic carbon, as indicated by the aromatic carbon-hydrogen absorption band. These aromatic compounds are present in the petroleum-ether phase because they contain a sufficient number of substituted aliphatic carbon atoms to decrease greatly their solubility in ODPN.

Some work has been done toward the development of satisfactory equipment and standardised conditions for applying the extraction principles demonstrated thus far. Sufficient work has been done using uniform procedures to demonstrate, beyond any reasonable doubt, that reproducible results are obtainable.

Adaptation to Wood Preserving

This method can be readily adapted to use in the wood-preserving industry. In order to gain information which could be used to guide the development of more refined techniques and equipment, four reference oils were prepared and representative samples of each were sent to a number of other laboratories, with a full description of the procedure which was used in the Columbus laboratories. For a preliminary test, the results indicate a reasonable degree of agreement which could be improved by further practice and development of completely uniform methods.

It is with great pleasure that the authors express their sincere appreciation and thanks to the Bernuth, Lembcke Company Inc., New York City, for their financial support which made this investigation possible and for permission to publish the results. Special thanks are also extended to the British Wood-Preservers' Association.

REFERENCES

[1] Heiks, R. E., *Proc. Amer. Wood-Pres. Assoc.*, 1952, **48**, 53.
[2] Heiks, R. E., Blum, S. E., Burch, J. E., and Austin, A. E., *Proc. Amer. Wood-Pres. Assoc.*, 1953, **49**, 18.
[3] Zimmershied, W. J., Dinnerstein, R. A., Weitkemp, A. W., and Marchner, R. I., *Ind. Eng. Chem.*, 1950, **42**, 1300.
[4] Saunders, K. W., *Ind. Eng. Chem.*, 1951, **43**, 121.
[5] Medcalf, E. C., Hill, A. G., and Vriens, G. N., *Pet. Refiner*, 1951, **30**, 97.
[6] Heiks, R. E., Blum, S. E., and Burch, J. E., *Proc. Amer. Wood-Pres. Assoc.*, 1953, **49**, 26.

Revised Creosote Standards

REVISIONS of BS. 144, 'Coal tar creosote for the preservation of timber,' and BS. 913, 'Pressure creosoting of timber,' have recently been issued.

In the present edition of BS. 144, which replaces that published in 1936, a single type of creosote has been specified. Terminology and methods of test have been brought up to date, the methods being based on those recommended by the Standardisation of Tar Products Tests Committee.

Several changes have also been made to BS. 913, in the light of modern knowledge of wood preservation. The emphasis in this revision has been shifted from gross absorptions of creosote to net retentions, but heartwood penetrations have generally been specified in addition, so as to ensure adequate treatment. The Lowry process has been added and incising requirements for round poles deleted.

Copies of BS. 144 and BS. 913 can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1, price 3s. and 2s. 6d. respectively.

I.C.I. at Baghdad Fair

THE contribution of Imperial Chemical Industries Ltd. to the economy of Iraq will be illustrated at Baghdad British Trade Fair, 25 October-8 November, by exhibits from almost all the company's divisions. The range of products to be shown include liquid ammonia for refrigeration; liquid chlorine for water treatment, and Gammexane insecticides; explosives and accessories for quarrying and seismic prospecting; and dyestuffs for cotton, wool and leather. There will be decorative and transport finishes (Paints Division); pharmaceuticals, among them Mysoline, the new anti-convulsant, Paludrine and Lorexane for use on animals against insect pests; and Plant Protection products. Also displayed will be a number of other British products for which I.C.I. (Export) Ltd., Baghdad, are agents in Iraq. The pavilion has a standard corrugated aluminium roof supplied by the organisers, fitted with corrugated Perspex roof lights, and the wall-cladding is of Corroplast corrugated plastic sheeting supplied by Holoplast Ltd.

FIBRE SCIENCE. 2nd Edition. Edited by J. M. Preston. The Textile Institute, Manchester. Pp. xix + 421. 40s.

The first edition of 'Fibre Science' appeared in 1949 and this second edition is, as it should be, very much the same book, but grown by some 20-25 per cent. All of the chapters in the second edition correspond to those in the first and the only new 'contributor' is Sir Eric Rideal who has contributed a foreword to the Second Edition.

The message in this foreword is twofold: (1) not to forget that economically cotton and wool are still very much more important than any of the synthetics;

(2) that a better understanding of fibre structure has been afforded by the great progress during the last few years in the study of the mode of formation, the thermodynamics and the kinetic properties of macromolecules, and of proteins in particular.

It is significant that the chapter which has been most greatly expanded in the transition from first to second edition is that on 'Protein Fibres' (F. O. Howitt). Elementary analysis, i.e. estimation of so much hydrogen, nitrogen, etc., gives very little information indeed about the structure of very large molecules such as those of proteins. The classical analytical method has been in fact to hydrolyse the protein into amino-acids and to identify and estimate these in the hylrolysate. Simple enough in theory, the method presented great difficulties in practice; as Howitt writes: 'For many years, the methods used were based on colorimetric and gravimetric procedures, which demanded a large amount of the protein under examination, were difficult of manipulation, and generally gave unreliable results.' These have largely been superseded by such methods of ionophoresis, chromatography on ion-exchange resins, and partition chromatography on paper. According to Howitt, this last method 'coupled with the use of electronically operated fraction-cutters, allows accurate analysis of an amino-acid mixture obtained from 3-4 mg. of protein.' This improved technique—and how often advancement in knowledge does await an improvement in technique—has led to rapid advances in our knowledge of protein structure. There are, of course, still many difficulties to be overcome and one of these is that the operation of hydrolysis may cause degradative changes in the sulphur-containing amino-acids such as methionine and cystine, which exercise such an important influence on the properties of the protein.

A most informative summary is given by Howitt of the methods that have of late been used to determine the *disposition* of the different amino-acids in the molecular chain and in particular the location of the repetitive sectional patterns. To assist in the understanding of this investigation which is of importance not only to fibre scientists but to many other disciplines, Howitt has outlined the elegant determination by Sanger and his co-workers of the order of the amino-acids in the phenylalanyl chains that form one half of the insulin molecule. The work carried out by Consden, Gordon, and Martin on the specific order of the amino-acid residues in the molecular chains of wool keratin is also described. Work of this type contributes to our knowledge of the structure of the protein and is a necessary prelude to the synthesis of artificial protein fibres. The work of Pauling and Corey on X-ray reflection characteristics of amino-acids, simple peptides and related substances which led them to propose a helical structure for the polypeptide chain is also described; as Howitt writes: 'The theory of a helical structure for long-chain molecules is, of course, not new, but the work of Pauling and Corey is the first experimental demonstration of its existence that merits serious consideration.' The very considerable increase in the length of this chapter is an indication of the intense activity that is going on in the field of protein fibres; there

is a common agreement on the excellence of natural hair fibres for purposes of apparel, there is a growing appreciation of the shortcomings of the synthetic fibres that have so far been made and there is a determination to synthesise fibres that are more like those that Nature makes. The description of the approaches to such syntheses is very good.

The discussion on the bearing of the stiffness or rigidity of the individual molecular chains on fibre properties has been considerably enlarged in the chapter on 'Synthetic Fibre-Forming Polymers,' by R. J. W. Reynolds. Reference is made particularly to Terylene which is compared with polyethylene phenylene diacetate and with polytrimethylene terephthalate. Examples are given to demonstrate the influence of molecular rigidity on the solubility and especially on the melting point of a fibre. This chapter especially will be valuable to students, in whom it is desirable at an early stage to inculcate the idea that physical properties are determined by chemical composition, and that within reasonable limits a fibre with any required physical properties can be synthesised by suitable choice of intermediates. As Sir Eric Rideal points out in his foreword, 'It is now possible to define the type of monomeric unit which on polymerisation will yield a fibre and, to a certain extent, we can even anticipate some of the properties of the resulting fibre. It has indeed been claimed that industrial economies are the sole limitation to what may be termed "fibre availability."' No one who has engaged in fibre synthesis will be inclined to criticise this statement except perhaps on the ground that it is unduly cautious.

Most of the other chapters of the book have grown a little; some more than others. The chapter on 'Wave Mechanical Considerations Applicable to Fibre-Forming Substances' has been retained, although it cannot be said to be any more at home in the second than it was in the first edition.

An author index has been added but the customary inclusion of initials has not been adopted in it. The book is well printed; the buff canvas cover of the first edition which seemed to have been so aptly chosen has been replaced, perhaps regrettably, by a red cloth cover. The book is bigger and its price has risen from 30s. to 40s.; this is unfortunate from the point of view of the student who, after all, is the person likely to derive the most benefit from reading some of its excellent chapters.—R. W. MONCRIEFF.

FRESH WATER FROM THE OCEAN. By C. B. Ellis (and members of the staff of Nuclear Development Associates Inc.). The Ronald Press Company, New York. 1954. Pp. vl + 217. $5.

The problem of obtaining fresh water from salt water is an interesting one but although a considerable degree of success has attended attempts to do this on the small and even medium scale, the cost is still high. The purpose of this book is said to be to investigate the possibilities of carrying out the separation on a large scale and at a low cost. The scale considered is that of 1,000,000,000 gallons per day. This quantity has been chosen since it is said to be 'appropriate to a public irrigation project of intermediate size.'

The study has been sponsored by the Conservation Foundation (USA) and according to the Foreword to the book, it was considered 'that there would be definite advantages in not having the report written in strictly technical language' and it appears to be intended for the layman.

After dealing with the chemical composition of sea water and the limit to which purification is necessary for water destined for irrigation purposes, the author goes on to consider energy costs and discusses in a general way the laws of thermodynamics. Methods for obtaining fresh water from salt water are then reviewed. Rather too much space is taken up in discussing methods which appear rather unpromising.

It is concluded that 'it seems unlikely that fresh water from the ocean can ever be made economic by any extraction method suggested so far unless most of the cost is borne by other installations and commerce attracted to the irrigated region.' It is suggested that the electric membrane method might be expected to be the cheapest with compression distillation coming next. Other methods which appear to offer promise are multi-effect distillation, super critical distillation and the freezing method.

It is difficult to accept some of the cost figures suggested, for in some cases even pilot plant studies have not been made. The author admits that the cost figures for the electric membrane plant are guesses.

Solar distillation and the sale of by-product chemicals are also discussed.—R.L.

HOME

Maize Starch Imports from Dollar Sources

Maize starch may now be imported from dollar countries under open individual licences instead of under specific licences as hitherto, says a Board of Trade announcement. Notice to Importers No. 663 gives details of how to apply for the licences. Copies can be obtained from the Import Licensing Branch, Board of Trade, of 43 Marsham Street, London, S.W.1.

Fertiliser Subsidy Changes

A new subsidy scheme has been made for fertilisers delivered on or after 1 July. An announcement by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland states that the scheme continues assistance towards the cost of nitrogenous and phosphatic fertilisers, and a subsidy will again be paid on the nitrogen and phosphates in compounds, but because of the various changes in the prices of different kinds of fertilisers since the 1952 scheme was made, contributions are now higher for nitrogenous fertilisers, but lower for most phosphatic fertilisers.

Change of Address

The offices of Fenwood Products Ltd. have moved to 1 Duke's Yard, Mayfair, London, W.1. Telephone: Mayfair 0997. This company are representatives of the Gesellschaft für Teerverwertung mbH, Duisburg, Germany, who are producers of coal tar fractions, and Selectochimica-Lautenberg SA, manufacturers of fine chemical intermediates.

Anglo-Iranian's Lubricating Oil Plant

Distribution has begun of lubricating oils from Anglo-Iranian Oil Company's Kent Refinery. First shipment—18,500 gallons of BP Energol in drums—left the refinery by barge on 29 June for the Royal Albert Docks for loading on to the *Rangitiki* for New Zealand. Other despatches will follow to the UK market and many other parts of the world.

Join International Telex

Johnson, Matthey and Co. Ltd. have joined the International Telex service, at present providing direct foreign teleprinter communication and to be extended later this year to include transmissions within the United Kingdom.

Licences of Right

Under Section 35 of the Patents Act, 1949, the following patents were endorsed 'Licence Right,' on 9 June last: No. 691,266, Institut de Recherches pour les Huiles de Palme et Oleagineux, 'Method of recovering palm oil'; on 17 June last: No. 674,088, Glaxo Laboratories Ltd., 'The preparation of a new unsaturated carbinol.' Any person who claims that the patentee at the time of the endorsement of either of the above patents was precluded by a contract in which the claimant is interested from granting licences under the Patents Act may apply for cancellation of the endorsement on Patents Form No. 45, within two months after the date of the endorsement.

Gas from Oil Carbonisation

A 'great deal of future development' in the production of gas from oil carbonisation was forecast by Mr. L. W. Joynson-Hicks, Parliamentary Secretary to the Ministry of Fuel and Power, speaking at the inauguration of a new carbonising and ancillary plant at the Stockton-on-Tees town gas works recently. 'But,' he added, 'we shall never be able to get away from the conventional methods of gas production from coal and we must use them in the best manner possible.' The plant cost £1,000,000.

Peaceful Uses of Atomic Energy

More than 700 scientists, working on the peaceful uses of atomic energy in 30 different countries, are to meet at Oxford from 19 to 22 July to discuss advances made in the last three years. They are to attend a conference organised by the Atomic Energy Research Establishment, Harwell, on isotope techniques, and will compare notes on their achievements during the last three years. Developments in medical research and treatment, in industrial processes and in agricultural research will be discussed.

Fluoridation of Water Supplies

The fluoridation of water supplies as official policy for Britain is advocated in a report made to the Kesteven (Lincs) Education Committee at Grantham, by the County Medical Officer, Dr. J. H. C. Clarke.

• OVERSEAS •

Europeans Study Pollution in US

On a six week tour to study US methods in solving air and water pollution problems are eleven European engineers and technicians. Travelling under the auspices of the Foreign Operations Administration, they will pay particular attention to pollution control facilities installed in chemical plants, oil refineries, and pulp and paper mills. Of special interest are sampling and analytical methods, prevention measures and regulations, meteorological methods, and co-operation between weather bureau stations and industry. British representative on the mission is Mr. W. A. Damon, of the Ministry of Housing and Local Government.

Northern Rhodesia Mining Research

Mr. H. F. Oppenheimer, of the Anglo-American Corporation of South Africa, opened the new £300,000 research centre of the Research and Development Division of Rho-Anglo Mine Services at Kitwe recently. The centre—comprising research laboratories and a pilot plant—is the only one of its size and scope in the Federation of Rhodesia and Nyasaland, and is the biggest in English-speaking Southern Africa. It will be used mainly for metallurgical research into vanadium, cobalt, copper, zinc and lead.

Titanium in Canada

The Canadian Minister of Mines, Mr. Prudham, has stated that Canada will be producing titanium in considerable volume by 1960. He estimated that by that date Canada would be able to support a titanium industry about one-tenth the size of the US industry.

German Plastics Trade Fair

The date for Plastics 1955, Trade Fair and Production Exhibition of German Industry, has now been definitely fixed for 8 to 16 October, 1955, at Düsseldorf.

India's Soda Ash Imports

The Indian Government has decided to issue supplementary licences valid up to 15 July, 1954, for import of soda ash to established importers equal to 15 per cent of half of their best year's imports for immediate shipment.

Oil from Seabed off Borneo

Oil has been mined in Brunei and Sarawak for a number of years, and the potentialities of North Borneo are now being investigated. Drilling has recently been carried out in the territorial waters of Brunei, and it is proposed that the resources of the seabed beyond the territorial waters of the three territories should also be explored so far as possible. Orders in Council have been made governing the extension of boundaries.

Aden Refinery's First Plant

First plant at the Anglo-Iranian Oil Company's new 5,000,000 tons-a-year Aden refinery is now being brought into commission. This is the SO_2 production plant, which has begun to produce a stock of liquid sulphur dioxide ready for the refinery's coming into operation in August—four month's ahead of schedule. The liquid sulphur dioxide will be used in the SO_2 extraction plant, designed to produce premium and regular grade kerosine at the rate of 300,000 tons a year, as well as about 50,000 tons a year of a high grade blending component for tractor fuel.

Synthetic Oil in India

The Government of India Advisory Committee on synthetic petrol has decided after two days' deliberations in Srinagar to recommend to the Government the setting up of a synthetic oil industry in India as soon as possible. The committee has decided that a survey of coal and water resources should be undertaken immediately as a necessary requirement for the plants.

Medicinal Plant Research

Two research schemes at Dacca and Peshawar Universities, involving a cost of Rs. 50,000 for the survey and study of the medicinal plants of East and West Pakistan respectively, has been sanctioned by the Council of Scientific and Industrial Research on the recommendations of its drugs and pharmaceuticals research committee.

US Tungsten Production

According to the Bureau of Mines, US Department of the Interior, domestic production of tungsten concentrates during the first quarter of 1954 reached a new high for the post-World War II period.

PERSONAL

At the invitation of the Council of the Institution of Gas Engineers, DR. ALEXANDER FLECK, chairman of Imperial Chemical Industries Ltd., has agreed to deliver a Murdoch Memorial Lecture, to mark the bi-centenary of the birth of William Murdoch, in the Lecture Theatre of the Royal Institution, London, on Tuesday, 5 October, at 6.0 p.m.

Consequent upon the resignation of DR. R. F. BOWLES from the post of honorary editor to the Oil & Colour Chemists' Association, MR. M. H. M. ARNOLD has been appointed acting honorary editor. Mr. Arnold is a member of the Midlands Section of the Association and has served as honorary publications secretary and honorary research and liaison officer.

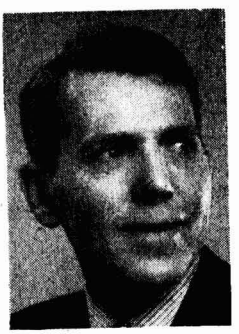
MR. EDWARD A. O'NEAL, JNR., chairman of Monsanto Chemicals Limited, has resigned from the board of Monsanto Chemicals (Australia) Limited, and MR. P. A. SINGLETON, managing director of Monsanto Chemicals Limited, has been elected in his place. As chairman of the British company, of which the Australian company is a subsidiary, Mr. O'Neal will continue to take a close interest in its affairs.

The Anglo-Lautaro Nitrate Corporation has announced the retirement of MR. HORACE R. GRAHAM as president of the company, and the election of MR. JOHN A. PEEBLES, first executive vice-president, as his successor. Mr. Graham will continue in close association with the company affairs as consultant and member of the advisory committee. MR. JORGE VIDAL, formerly second executive vice-president and general manager, has been promoted to first vice-president and general manager. MR. ALBERT VAN DE MAELE has been elected a vice-president in New York, as well as a director of the company.

MR. JOSEPH C. MELLOR, assistant technical manager to Clayton Aniline Co. Ltd., dyestuff manufacturers, of Manchester, who has been re-elected a chairman of Upper Agbrigg Division Education Executive, has completed 25 years as a councillor. He was a member of the former Marsden Urban Council for eight years, being chairman from 1935 to 1937.

MR. J. MURRAY GRAMMER, stores buyer for the North Thames Gas Board, has been elected chairman of the London branch of the Purchasing Officers' Association, largest of the Association's 43 branches.

Chairman of the newly-formed company of Griffin & George Ltd., is MR. R. MCKINNON WOOD, O.B.E. He joined the scientific staff of the Royal Aircraft Establishment from Cambridge in 1914, and was principal officer in charge of aerodynamics research from 1920 to 1934. After serving on the technical and scientific staff of the Ministry of Aircraft Production during the war, he became a member of the LCC in 1946 and was chairman of the Education Commitee in 1950. He joined Griffin & Tatlock Ltd. as chairman in 1947.



The council of the University College of Wales has appointed MR. R. O. DAVIES, independent lecturer and head of the Department of Agricultural Chemistry, to be Professor of Agricultural Chemistry.

DR. T. HARRINGTON and MR. F. N. RIDING, D.F.C., T.D., have been appointed directors of Hickson & Welch (Holdings) Ltd.

A member of the research staff of the Bradford Dyers' Association Ltd., MR. WILLIAM BRAGG, was married at Cowling Methodist Church on 3 July to Miss Molly Cockshott, of Craggside Farm, Cowling.

MR. EDWARD ANGLUM, assistant foreman at Howards of Ilford Ltd., has been awarded the B.E.M. (Civil Division) for gallantry shown when he and others fought a recent fire at their factory.

MR. JACK T. D. CORNWALL has been appointed advertising and sales promotion manager, Chemical Division, Celanese Corporation of America. Mr. Cornwall previously had been with Hazard Advertising Company since 1946.

MR. FRED J. EMMERICH, president of Allied Chemical & Dye Corporation, has been elected chairman of the board of directors of the American Manufacturing Chemists' Association Inc. He succeeds MR. CHARLES S. MUNSON, chairman of the board of Air Reduction Co., who has been elected to the newly-created post of chairman of the executive committee. MR. WILLIAM C. FOSTER, full-time president and a director, has been re-elected. MR. HOWARD S. BUNN and MR. WILLIAM H. WARD have been elected vice-presidents. Mr. Bunn is a vice-president of Union Carbide & Carbon Corp., while Mr. Ward is a vice-president of E.I. du Pont de Nemours & Co. Inc. MR. M. F. CRASS, JR., full-time secretary-treasurer, also was re-elected. Directors elected for the term expiring 31 May, 1957, are MR. LELAND I. DOAN, president, the Dow Chemical Co.; MR. JOHN FENNEBRESQUE, vice-president, Celanese Corporation of America; MR. JOSEPH FISTERE, president, Mallinckrodt Chemical Works; MR. A. E. FORSTER, Hercules Powder Co. Inc.; MR JOHN L. GILLIS, vice-president, Monsanto Chemical Co.; MR. R. K. GOTTSHALL, president, Atlas Powder Co.; MR. R. C. MCCURDY, president, Shell Chemical Corporation; and MR. W. H. WARD, of Du Pont, and MR. W. C. FOSTER, of MCA.

The life and achievements of a famous Wisconsin biochemist, PROFESSOR EDWIN BRET HART, who died last year, received recognition by some of America's outstanding scientists who were his students, at the annual meeting of the Institute of Food Technologists in Los Angeles last week. At the meeting a panel of five scientists and former students of Hart spoke on his work and the name of the Babcock Award was officially changed to bear the names of both Hart and Stephen Moulton Babcock, Wisconsin scientists who devised the butterfat test for milk and conducted pioneer investigations in the field of biochemistry.

Among awards for 1954 recently announced by the Commissioners for the Exhibition of 1851 were overseas scholarships to F. W. EASTWOOD (Sydney) for research in organic chemistry at Oxford; to G. N. MALCOLM (New Zealand) for research in physical chemistry at Manchester; and to K. AGHORAMURTHY (Delhi) for research in organic chemistry at Oxford.

Wills

MR. CHARLES ROWARTH BAKER, former chairman of Joseph Watson's, soap makers, Leeds, and a director of Unilever Ltd., left £96,516 (net £96,364, duty paid £43,520). His bequests included £250 to St. Dunstan's.

MR. WALTER CHARLES HANCOCK, B.A., F.R.I.C., of Woburn Court, London, W.C.1. left £12,567 (duty paid £746).

MR. WILFRID HOLT OXLEY, of Fourwinds, Birkenshaw, a director of Heckmondwike Chemical Co., and J. C. Oxley's Dyes and Chemicals Ltd., Lighthouse Works, Dewsbury Moor, Heckmondwike, left £2,135 (net £1,302).

Obituary

MR. F. L. GOODALL, joint managing director of the Geigy Co. Ltd., of Rhodes, Middleton, Manchester, died on 27 June, at his home in Wilmslow, Cheshire. He had been with the company for over 30 years.

DDT Patent Position

THE Geigy Co. Ltd. have issued the following announcement concerning the patent position of DDT: manufacture of insecticidal aqueous emulsions, solid preparations and solutions containing DDT forms the subject of British Patents Nos. 547,871, 547,874 and 644,895.

Use of DDT for the manufacture of such compositions by the methods claimed in these patents would, if not authorised by the patentee, be an infringement. The sale and use of compositions so manufactured would also be an infringement.

Where insecticidal preparations containing DDT are compounded under a licensing arrangement, no infringement would, of course, be involved but in cases of doubt it is recommended that the undermentioned should be consulted. Licence agreements have in this country been concluded with: the Geigy Co. Ltd., Rhodes, Middleton, Manchester; W. J. Bush & Co. Ltd., Ash Grove, Hackney, London, E.8; Cocker Chemical Co. Ltd., Oswaldtwistle, Lancs; Hickson & Welch Ltd., Ings Lane, Castleford, Yorks; who will all be glad to give every assistance.

Publications & Announcements

EXISTING Praducil tablets, marketed by Evans Medical Supplies Ltd., containing 200,000 units of benzylpenicillin BP (sodium salt) have now been given a suffix '200' to distinguish them from a new strength known as Praducil '400,' containing 400,000 units. The present 10's pack of Praducil '200' will be discontinued when stocks are exhausted and the two new packs have been introduced.

* * *

THE range of chemicals produced by John and E. Sturge Ltd. are described in an 18-page booklet, 'Sturge Products,' recently issued by the company. The publication covers the various grades of Sturge precipitated calcium carbonates and gives their main characteristics and uses. Other products described in the booklet include pure alkaline earth compounds, citric acid, sodium citrate, sodium potassium tartrate, seidlitz powder, potassium bicarbonate and ergosterol Sturge. Each product is analysed and its uses listed. Copies of the booklet are available, free of charge, from the company at Wheeleys Road, Birmingham.

* * *

FROM R. S. Colour Works Ltd., of 22 Kender Street, London, S.E.14, comes an informative leaflet designed to assist users of cadmium sulphide and liquid bright gold, which are produced by that company for many uses in a variety of industries.

* * *

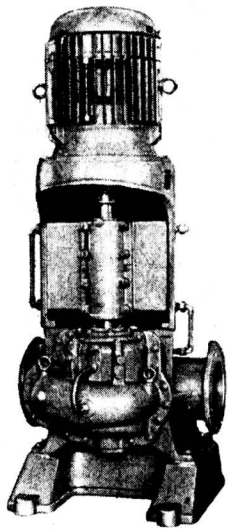
JUST published by the Carbide and Carbon Chemicals Company, a division of the Union Carbide and Carbon Corporation, New York, is a 16-page booklet dealing with synthetic methanol, which has many applications in the production of anti-freezes, pharmaceuticals, dyes, fuels, resins, adhesives, wood stains and plasticisers, etc. Prepared for people engaged in the chemical industry, the booklet contains information on the uses, physical properties, shipping data, specifications, and constant-boiling mixtures of methanol. There are fourteen graphs on vapour pressures, specific gravities, freezing points, viscosities, and other physical properties of methanol. Copies of booklet—'Methanol' (F-8141)—are available from Carbide and Carbon Chemicals Company, of 30 East 42nd Street, New York 17, N.Y.

IN a new 22-page booklet H. J. Elliott Ltd., of 'E-Mil' Works, Terforest Trading Estate, Pontypridd, give details of their well-known and comprehensive range of hydrometers used for testing petroleums, sugar, milk, tanning, tar products, glue and gelatine, etc.

* * *

THE Polarograph Minor is one of the range of Tinsley polarographs now being made by Evershed & Vignoles Ltd., Chiswick, London, W.4. It has been introduced to meet the demand for a less expensive instrument where the volume and scope of the analytical work does not warrant the outlay for the larger recording instrument. Although non-recording, the Minor retains many features of the larger model, including the derivative circuit; this inclusion is made

possible by the use of a motor-driven potentiometer. With this instrument, it is claimed, it is possible to detect changes in current of 100 $\mu\mu$A, this amplification being achieved without the use of any thermionic valves or additional attachments. There are 16 ranges, adjustable damping, and the instrument may be operated from AC mains or internal batteries.



The Jonkopings 'Nobox' centrifugal pump, described in THE CHEMICAL AGE, 1954, 70, 950

THE Baldwin vacuum-cell photometer (Baldwin Instrument Co. Ltd., Dartford, Kent) consists of one or two vacuum photocells and a simple, compact mains operated DC valve amplifier. Attachments include transmission, reflection, and line densitometers. By means of the reflection densitometer, it is claimed, it is possible to measure accurately the difference in colour between almost any material and a standard. A recent successful example was in the matching up of khaki fabric for army uniforms. Another important application is the measurement of fading after exposure.

* * *

AS a result of the visit of Capt. I. R. Maxwell, managing director, to Moscow in January, Lange, Maxwell & Springer Ltd. announce that a project is now under way for the translation of Soviet scientific, technical and medical books into English. Most of the books selected are recent works by leading authorities in the various branches of science, technology and medicine in the USSR, but they also include a number of important standard works. The list of titles to be published will include new contributions in chemistry covering recent Soviet research on isotopes, and the original data on magnesium-organic compounds by S. T. Ioffe and A. N. Nesmeyanov, president of the USSR Academy of Sciences.

TECHNICAL data on new materials and processes arising from the research work of the British Rubber Producers' Research Association at Welwyn will in future be made known by a series of technical bulletins which will supplement the publication of BRPRA researches in technical and scientific journals. Technical Bulletin No. 1, just published, is entitled 'Heveaplus M' and describes the production and properties of a range of self-reinforcing elastomers based on natural rubber and polymethyl methacrylate. All types of Heveaplus M are light in colour and vulcanisates covering the whole range of rubber hardness, it is stated, afford specific advantages over comparable materials reinforced by mineral fillers. Two such advantages are the excellent flex cracking resistance and fatigue resistance of the softer vulcanisates and the exceptionally high tensile strength of the hardest vulcanisates. These new products, which may be utilised in the latex or solid form by conventional methods, are now available for laboratory trial. Copies of the Bulletin may be obtained from the British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3.

* * *

LATEST number of 'Heat Engineering,' published by Foster-Wheeler Corporation, 165 Broadway, New York, contains a feature on the USS *Nautilus*, first atomic submarine. Other articles are on a new plant for ammonia synthesis at Spencer Chemical Co.'s Vicksburg works, some design and economical aspects of supercritical boilers, and sulphur recovery from waste gases.

* * *

MANY important pharmaceutical, veterinary and biological chemicals are in the latest price list of fine products from Burroughs Wellcome & Co., 183-193 Euston Road, London, N.W.1. A valuable feature of the price list is a column indicating any changes which have occurred since the issuing of the last list on 1 September 1953.

* * *

PROBLEMS relating to welding polythene and PVC are dealt with in a useful little 10-page booklet published by the Radio Division of the Edison Swan Electric Co., Ltd., of 155 Charing Cross Road, London, W.C.2. The booklet, which is illustrated, is based on information appearing originally in *Chemical and Process Engineering.*

Law & Company News

Mortgages & Charges

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

O. M. SEMAN LTD., Southall, chemical manufacturers. 31 May, £4,750 (not ex.) charge, to Lloyds Bank Ltd.; charged on land and buildings at Kingsbridge Crescent, Southall. *Nil. 21 October, 1950.

DOMESTIC CHEMICAL CO. LTD., Exeter. 31 May, mortgage, to Midland Bank Ltd. securing all moneys due or to become due to the Bank; charged on property known as Collards Yard, Monks Road, Exeter, with machinery, fixtures, etc., also a general charge. *Nil. 14 May, 1953.

Company News

Ault & Wiborg Ltd.

The issued share capital of General and Industrial Paints Ltd.—formerly Glasso Paint Products Ltd.—has been acquired by Ault and Wiborg Ltd., manufacturers of printing inks and paints. No issue of capital is contemplated by Ault and Wiborg, the purchase price being met out of current resources.

Blundell, Spence & Co. Ltd.

Blundell, Spence and Co. Ltd., paint manufacturers, have acquired a controlling interest in Vulcan Products Ltd., of London and Slough, manufacturers of specialised paints and finishes. Mr. E. B. Calvert, chairman and managing director of the Blundell, Spence Company, has been appointed chairman of Vulcan Products, and its subsidiary, Paint Removers Ltd., in succession to Mr. Leonard Wilmin, retired.

British Celanese Ltd.

The accounts of British Celanese Ltd., for the year to 3 April, 1954, show that the balance of the consolidated trading account was £4,701,411, compared with £2,236,274 for the previous nine months. In a statement accompanying the accounts, the chairman, Mr. G. H. Whigham, says that in view of the company's diverse interests, they had thought it right to expand their research activities. For many years, their research and development as well as their production had been centred at their Spondon factory. More recently, they had adopted a policy of a measure of decentralisation with regard to production, and this had entailed the movement of certain development sections to some of the new production sites. They now thought it important to decentralise research as well, and to this end they had purchased a suitable building and site for new laboratories and for pilot plant work at Putteridge Bury, Herts, where they would be able to extend their research and undertake more work of a fundamental character and where the research workers themselves would be freed from the day-to-day problems inevitably associated with production.

Thomas De La Rue & Co. Ltd.

Thomas De La Rue and Co. Ltd. announce a group profit of £525,658 for the year to 27 March, 1954, against a loss, before tax, of £78,844 for the previous year. The directors propose to pay a dividend of 20 per cent, which compares with the equivalent of 25 per cent paid in 1951-52.

Fisons Ltd.

The directors of Fisons Ltd. announce that they are to make an offer to acquire the £1,000,000 of 4 per cent cumulative redeemable preference stock of Fisons Chemicals Ltd. and the £350,000 of 6 per cent cumulative redeemable preference shares of Pest Control Ltd. For every £1 stock of Fisons Chemicals they are offering one new 4½ per cent cumulative preference share of £1 in Fisons to be issued credited as fully paid, plus a cash payment of 2s. per share. The Pest Control offer will be 22s. 6d. cash per share. The offer to Fisons Chemicals is subject to Treasury consent and stockholders' approval of the necessary increase in Fisons preference capital. Fisons acquired the ordinary capital of Pest Control in April last.

Griffin & George Ltd.

The directors of Griffin and Tatlock Ltd. and of W. and J. George and Becker Ltd., in a joint statement issued last week, announce the merging of their two organisations. Under the name of Griffin and George Ltd., they are now one of the leading laboratory furnishers in the world. Their statement says: 'The mutual decision to unite our companies will combine the

strength and experience of two organisations, both long established and, we believe, well known and well respected in scientific circles. Pending the administrative and physical integration of our organisations, which will be a gradual process, we shall continue to trade, until further notice, under our existing names and at our present addresses. Our plans for the future should achieve a progressive improvement in methods of manufacture and distribution. They will thus benefit the laboratory workers in industry, education and research, whom we serve in this country and throughout the world.'

Griffin and Tatlock Ltd., with their associated company, Standley Belcher and Mason Ltd., manufacture scientific apparatus and laboratory furniture in London and Birmingham, and have branch houses in Manchester, Sheffield, Glasgow and Edinburgh. Griffin and Tatlock (India) Ltd. operates from Calcutta and Bombay.

W. and J. George and Becker Ltd. of London and Birmingham are known throughout the world, and have manufactured laboratory equipment since 1897.

Their new offices and warehouse at Alperton, Middlesex, were completed in 1951. The original firm of F. E. Becker and Co. was founded in 1872, and was purchased by W. and J. George Ltd. in 1897.

The chairman of the new company is R. McKinnon Wood, O.B.E., and the vice-chairman is H. R. Bettinson, M.C.

Johnson, Matthey & Co. Ltd.

A final dividend recommendation of 18 per cent, making a total of 21 per cent for the year ended March 31, 1954, is announced by Johnson, Matthey and Co. Ltd. This compares with 15 per cent for 1952-53. The consent of the Capital Issues Committee has been obtained to a proposed 200 per cent scrip issue.

Lansil Ltd.

A profit of £189,849 for the year to 3 April, 1954, compared with a loss the previous year of £80,205, is shown by Lansil Ltd., cellulose acetate and artificial silk manufacturers, in a preliminary statement. The directors have decided to clear the arrears on the £750,000 5½ per cent cumulative preference shares with 18 months' payment to 30 June, 1954, but they consider it inadvisable to recommend payment of any dividend on the £1,150,000 ordinary or £100,000 deferred capitals.

H. K. Ferguson Company

Formation of H. K. Ferguson Company of Great Britain Ltd., with headquarters at 19 Berkeley Street, London, has been announced. The new company is a wholly-owned subsidiary of H. K. Ferguson Company of Cleveland, Ohio, US, and will specialise in the design and construction of chemical facilities, manufacturing plants, laboratories, power plants and other industrial facilities. Directors of the new company are Mr. J. B. Bonny, Mr. O. F. Seider, Mr. F. H. Maag, Mr. R. L. Cashen, Mr. A. J. F. Andrews, Mr. F. T. Jennings and Mr. Charles P. Stolberg. Mr. Stolberg, assistant chief of operations, will direct engineering and construction, and Mr. Raymond B. Aufmuth is chief engineer.

Market Reports

LONDON. — The chemical markets report steady conditions with the volume of new inquiry fairly good for the period. Deliveries to the plastics and textile industries have been taken up in good quantities, and the demand for raw materials for the paint industry has remained steady. Prices generally are well held and the undertone is firm.

An active home demand continues in the coal tar products market, particularly for crude carbolic acid, phenol and the light products. The pitch market is quiet due to seasonal influences.

MANCHESTER.—Most sections of the textile trade in the Lancashire area are calling for steady deliveries of heavy chemical products on the Manchester market and traders have little cause for complaint regarding the quantities of most lines being taken up by other leading industrial outlets. Fresh inquiry and actual additions to order-books during the past week have been on a fair scale. The undertone of the market is steady to firm generally. Quiet seasonal conditions rule in the fertiliser section and these are likely to continue for some time yet, but in the tar products market there is a good home-trade demand for most of the light and heavy materials.

GLASGOW.—The annual summer vacations are generally slowing up sales and the half-yearly stock takings are also taking effect. In general Scottish business is steady. The export trade has improved over the last week.

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CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

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

A. BOAKE, ROBERTS & CO., LTD., STRATFORD, E.15, require **SENIOR CHEMISTS** for their Process Development Department. These appointments would appeal to qualified men with some years of experience of Organic Chemistry, seeking the opportunity to lead a team in developing new projects from laboratory to plant scale, so as to provide new or improved products. The minimum salary envisaged is £800 per annum.

The Company also requires **ASSISTANT CHEMISTS** to participate in these projects. Industrial chemical experience is desirable in these appointments. Minimum salary is £550 per annum. Applications in detail to **PERSONNEL MANAGER.**

A. BOAKE ROBERTS & CO., LTD., LONDON, E 15, require the services of **CHEMISTS** for plant control on a shift basis. The essentials are professional qualification of graduate standard and some industrial experience. Salary initially will be in the range of £600 to £750. Applications should be addressed to the **PERSONNEL MANAGER.**

APPLICATIONS are invited from young (22 to 26 years) mechanically minded **GRADUATE CHEMISTS** for a post with a northern manufacturer of wrappin materials. The selected applicant will work under a Departmental Manager on plant and process development. Salary according to experience and qualifications. Pensionable. **BOX No. C.A. 3336, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

CHEMICAL ENGINEER required by prominent chemical plant manufacturers in Westminster. The appointment is a senior one and requires sound basis in Chemical Engineering fundamentals to B.Sc. or A.M.I.Chem.E. standard along with practical experience of plant design/operation. Excellent opportunities for man with keen business outlook and sound technical ability. Write, giving full particulars, including age, qualifications and salary required, to **BOX No. C.A. 3334, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

PROGRESSIVE Company with factories in London and Sussex has vacancies in its Research Laboratories for **GRADUATE CHEMISTS** (male or female—age 23-45) for chemical work arising from the Company's many interests. The posts demand the ability to apply chemical principles to the solution of varied problems from several industrial fields and calls for imagination and considerable adaptability and, preferably, for some years' previous experience of chemical research in industry. A salary commensurate with age, experience and qualifications will be paid, and there are also considerable benefits from superannuation, life insurance and profit-sharing schemes. Apply in own handwriting to **BOX No. C.A. 3338, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

SITUATIONS VACANT

UNITED COKE AND CHEMICALS COMPANY LTD., producers of organic chemicals from coal, require two experienced **CHEMICAL SALESMEN,** aged 28-35. Honours degree essential, preferably in chemistry. Special knowledge of coal tar chemicals or plastics, paint or synthetic resin industries an advantage. Salary £800-£1,100 depending on qualifications and experience. Pension scheme. Reply, giving details of education, qualifications and experience, to the **COMMERCIAL MANAGER, 34, COLLEGIATE CRESCENT, SHEFFIELD, 10.**

CHEMIST/ANALYST, with knowledge of modern methods of Inorganic and Organic Analysis, required by N.W. London Fine Chemical Manufacturers. Permanent pensionable position for right applicant, who should hold degree or equivalent. Particulars age, education, experience and salary to **BOX No. C.A. 3339, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

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QUALIFIED ORGANIC CHEMISTS required, preferably with experience in petroleum technology and/or technology of fats. Salary according to age and experience. This appointment offers excellent opportunity for men to specialize in both academic and applied petroleum chemistry. Details to **DR. A. C. PEPPER, ALEXANDER DUCKHAM & CO., HAMMERSMITH, LONDON, W.6.**

UNITED COKE AND CHEMICALS COMPANY LTD., producers of organic chemicals from coal, require a **TECHNICAL ASSISTANT TO THE COMMERCIAL MANAGER.** His duties will include market research and technical liaison with research and works departments and he should have practical experience of sales or development or market survey work involving visits to outside firms on his own. Age preferred 28-35. Honours degree in chemistry essential. Salary £800-£1,100 depending on qualifications and experience. Pension scheme. Reply, giving details of education, qualifications and experience, to the **COMMERCIAL MANAGER, 34, COLLEGIATE CRESCENT, SHEFFIELD, 10.**

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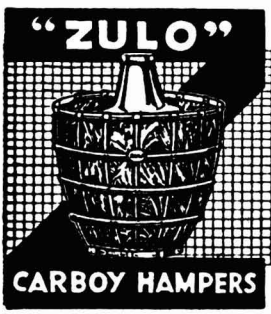
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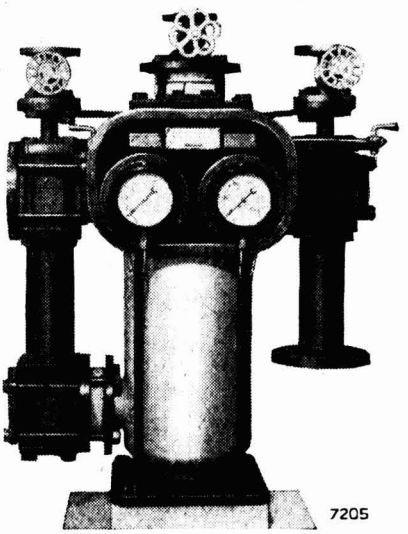

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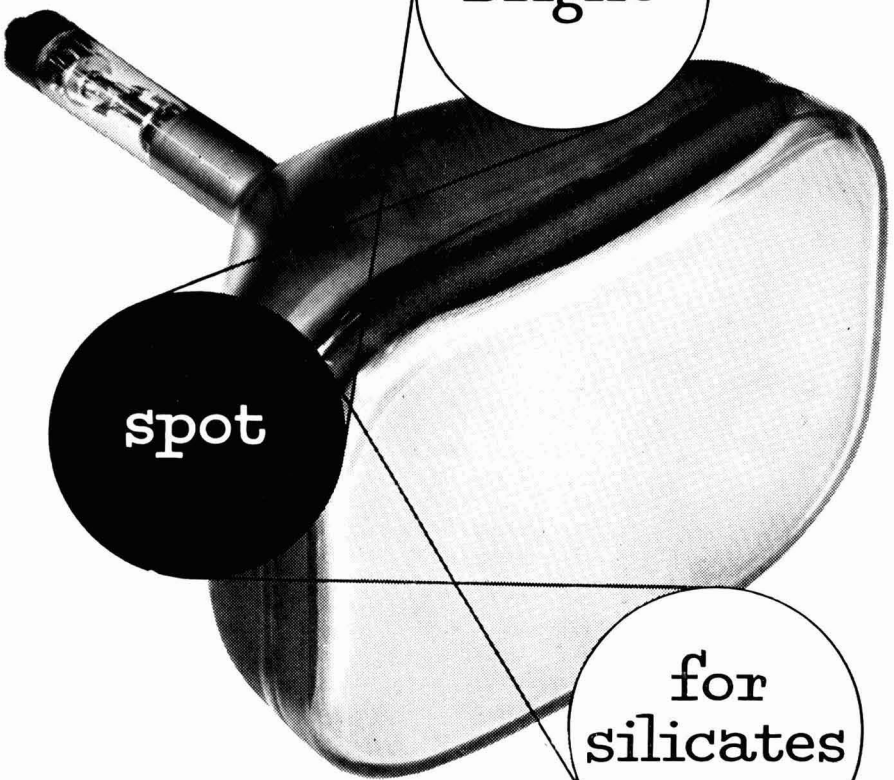

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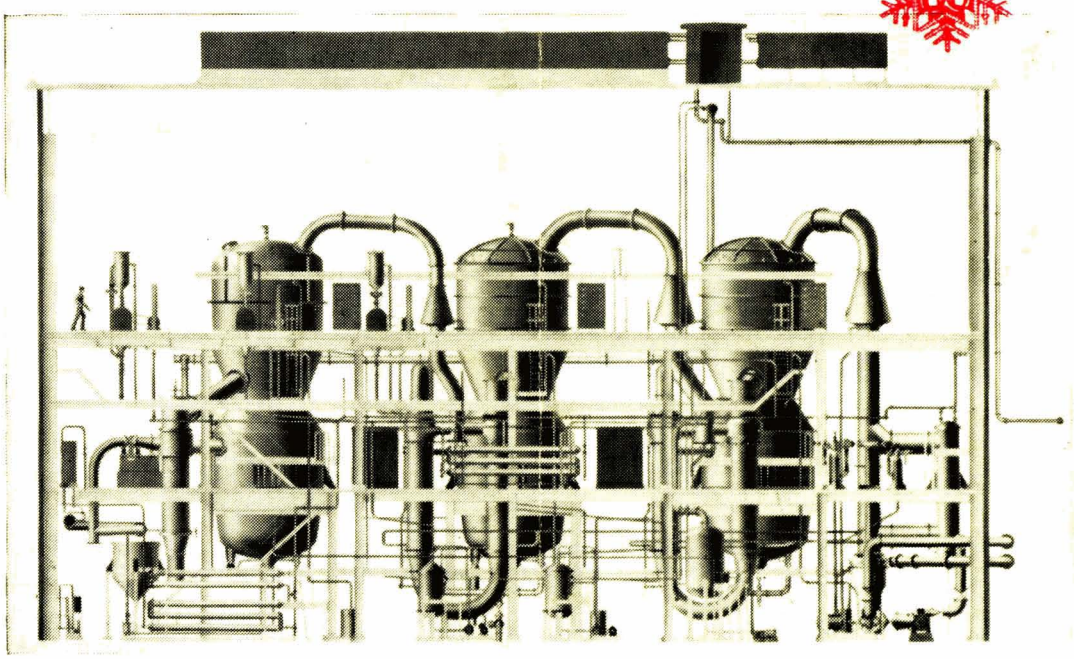
CSP 7-19-100

INDUSTRIAL CRYSTALLIZATION BY THE KRYSTAL PROCESS



TRIPLE EFFECT KRYSTAL EVAPORATOR INSTALLATION

This plant built mainly in solid nickel for the production of 300 tons/day of pure Sodium Chloride crystals, from well brine is typical of many multiple effect KRYSTAL installations, in operation throughout the world producing Sodium Chloride, Ammonium Sulphate, Ammonium Nitrate and other salts.

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