The Chemical Age

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A National Problem

THIS month the National Advisory Council on the Training and Supply of Teachers issued a special report on 'Graduate Teachers of Mathematics and Science' (Ministry of Education, HMSO, pp. 12, 6d.). It is by no means the first effort to focus public attention upon a critical shortage. No one would seem to dispute the fact that there are not nearly enough qualified teachers of science in our schools, that the deficiency is serious in its immediate effects and likely to be quite disastrous in its longer-term effects. The situation, openly visible for at least five years, has continued to drift and worsen. It is gratifying to find that this new report, limited though its terms of reference are, is evasive neither in presenting the stark facts nor in suggesting causes.

In 1952 and 1953 the increase in teaching man-power maintained a rate of 5,000 per annum, roughly 20 per cent above 1951 estimates. But across this encouraging background a deep distinction must be drawn between the teachers of science and mathematics and teachers of other subjects. There could not be greater contrast. The teaching of science is wilting from scarcity of graduates; there is already some difficulty in absorbing all the arts-graduates seeking to teach.

The shortage of women teachers of science and mathematics is even more acute than that of men teachers, although the competitive demand of industry for women graduates in these subjects is a much smaller factor. This is due to the inadequate number of women who read science and mathematics at the universities. Indeed, 45 per cent of the women honours graduates in these subjects for 1952 took up teaching, whereas only 15 per cent of the men did so.

The Report expresses concern about quality as well as quantity. In 1938 14.7 per cent of the science and mathematics graduates trained for teaching held first class honours degrees; in 1953, the percentage had fallen to 4. This was hardly unexpected. If the vocation of teaching has become less attractive to graduates in these subjects, or at any rate if other careers have become more attractive, the strongest expression of this tendency will logically be made by those who gain the most distinguishable degrees. It is to be doubted whether this is an important facet of the general crisis. Does teaching in schools require first class honours degrees? Do holders of these degrees make the best teachers? There is an old and crude adage, 'Those who can, do; those who can't, teach.' We suggest there is a grain of indirect truth in this libel of the teaching profession—those who themselves did not find the task of learning a wholly smooth and easy affair are likely to make the most thorough and understanding teachers. The subsidiary matter of quality is best ignored.

If the present situation is without features of redemption, the future outlook is one of catastrophe. Wastage of teaching man-power is not being compensated now. The inadequate number of science and mathematics teachers in our schools immediately after the war has not been enlarged; but, with the raising of the school-leaving age and as a consequence of the marked rise in birth-rate in the early post-war period, the demand per year for 1955-60 is almost twice that of 1950-55. We have not started to pay the full bill for neglect; so far we have only scowled at a few of the preliminary invoices. For the impending crisis the temperate language of an official report is hardly adequate. What is going to happen? Are numbers

of children, among whom are certain to be potential technicians and scientists, not going to be taught more than a trivial modicum of mathematics and science? Or will the efforts of an ever less adequate number of teachers be spread so widely that most children get some teaching and none receive enough? What can be the consequences a few years later for an industrial nation in a world of ever-intensifying technical complexity and competition? We may already be reaching the point when steady decline abruptly enters a vicious spiral of descent, for where can future teachers be recruited if the output from the schools of likely graduates dwindles even more miserably? Industry with her immediate needs is already taking the major share of science graduates; as quality and quantity decline, industry's requirements will leave even less for other vocations. This contracting situation has been left to drift for several years longer than it should have been. Efforts that are only now in the process of gestation are disgracefully belated. Perhaps some of our political leaders have too hastily felt that there has been too much science in the past? But there is no future at all for a nation with too little.

The new Report, as a prescription for improvement or cure, is virtually impotent. That is not the fault of the Advisory Council but of their terms of reference. They have devoted only nine lines of print to the crucial question of pay and prospects, and these merely to explain that this would take them 'into a field which a statutory body exists to cover.' However, the Council's opinion is valuably indicated in one sentence: 'We wish to say that we are satisfied that financial prospects are a main factor in the situation.' The modification or relaxation of liability for National Service of graduate teachers in science and mathematics is mentioned but only as a complex problem 'not so far considered,' for which reason no recommendation is made. With the first of these remedies outside the agenda and with the second unconsidered, it is understandable that the remaining suggestions offered are minor or trivial.

The extension of the age of retirement to 70 is recommended; this exists as a possibility now—at the wish of the teacher and the discretion of the local education authority—but it is handicapped in practice by a rule that pensionable service must end at 65. In view of the recent report on age and retirement, the position of the Ministry of Education in regard to this rule would seem untenable. A shortage of laboratory assistants reduces the scope and teaching time of existent science teachers, and the introduction of a national scale of pay for school laboratory assistants is recommended. If, however, the scale of pay eventually decided has no greater relative attraction than the Burnham scale for graduate teachers, the results may be even worse, for the recruitment of teachers is still influenced by a sense of vocation, whereas a potential school laboratory steward is more likely to compare the rewards of education with the offerings of industry. Moreover, a scale of pay likely to attract efficient laboratory stewards in good number will throw the science teachers' scale into the fullest light of injustice. The idea that university research workers or industrial scientists might undertake part-time teaching is only mildly recommended, and probably with a fair appreciation of its organisational difficulties and likely proportion of failure. A Ministry of Education pamphlet stressing the interest and satisfaction to be found in school science teaching is recommended—but presumably the writers of the pamphlet will also be unauthorised to discuss pay.

Nevertheless the Council is utterly and commendably right in the final paragraph. 'We consider that the shortage . . . constitutes a national problem . . . The situation in the schools should, therefore, be of direct interest to the universities and industry and all those concerned with the supply and use of scientific man-power. In our opinion, any action which could effect a radical improvement would require decisions in important questions of national policy . . . the appropriate level of recruitment of scientists to industry, the volume of post-graduate work at the universities . . . the size of the undergraduate population.' When will these higher-level, national considerations be made?

Notes & Comments

The Old Firm Tie

AT a time when the social and lighter sides of life are so much in evidence we feel innocently able to indulge in sartorial-cum-technical comment and with the curiosity about other people's private affairs more usually found in gossip columns. For this aberration the stimulus has been the December issue of *The I.C.I. Magazine*, which colourfully foreshadows the I.C.I. tie. Proposed first in a letter to the same publication back in 1952, the idea of such a tie was adopted by I.C.I. during the summer. Now the company's staff and pensioners have eight designs to choose from, with prizes for the poll. Most of them seem very attractive, three reds, one green, and four blues; four with the stripe *motif* expressed in the I.C.I. double wavy line, three with I.C.I. lions (carefully to be distinguished from a Scottish lion so no concessions to nationalist resurgence above the Tweed are intended !), and one with the I.C.I. initials set in their usual roundel. The top-of-the-poll design will be put into production and, needless to say, will be woven in 'Terylene.' We cannot resist the thought that most of the charming young ladies on I.C.I.'s staff will think it 'just like men' to get a tie organised as soon as 'Terylene' is available, but when nylon began did anybody organise ?—but we had better leave it there !

Possible Complications

FOR an organisation as huge and complex as I.C.I., with its various sections and numerous works both here and abroad, there is much to be said for a generic tie. Despite all the jokes, men cling to old school ties though they in truth represent an association that lasted for perhaps only four years; association with a company may last for 40 years, and bring with it no lesser sense of tradition and loyalty. However, we doubt whether I.C.I. will be the first company to have a tie. We believe that at least one of the Big Five banks developed a tie some years before the war. However, it may bring a few complications. There is a wartime story certainly grained with truth that anybody with a bold manner and a sufficiently big wad of papers under his arm could walk anywhere in one of our largest aircraft factories. Will an unlawful display of the future I.C.I. tie facilitate unauthorised tours of inspection where processes to come are brewing ? Perhaps 'Terylene' will not wear out at a sufficiently rapid rate to widen the I.C.I. circle by the process of discard. Still, wives never have appreciated the code of ties, and we can foresee agonised *cries-de-coeur* from executives returning home from their travels: 'Good Heavens, you didn't give *that* to *him* !'

Vanadium and Plants

FROM the University of California, already the world's most energetic centre of trace element research in plant nutrition, comes a claim that yet another element must take its place among the micro-essentials. In *Nature* (1953, **172,** 1039-40), Professor D. I. Arnon and G. Wessel present the case for vanadium. The evidence now presented will not surprise shrewd students of this subject; 10 years ago Bertrand of the French school, also long diligent in this fascinating branch of science, showed that vanadium is widely distributed in plants, for he was able to detect its occurrence in every one of 62 different plant species analysed. Bertrand found the element to be an essential micro-nutrient for *Aspergillus niger*, but this mould is not, of course, classifiable as a green plant. The new work at Berkeley has used one of the green algae species, *Scenedesmus obliquus*, as the test 'plant,' and the experiments appear to have originally been designed to study the iron requirements of the algae. Growth on a nutrient solution containing all the known micro-nutrients (B, Mn, Cu, Zn, and Mo) was markedly increased when additions of iron salts were made. As the iron salts used were not highly pure, it was thought that an unknown micro-

nutrient effect may be being exercised by an impurity. The trio of cobalt, nickel, and vanadium was suspected. Experiments using pure ferric chloride as the source of iron, with and without micro-additions of these three other elements, were carried out. It was soon evident that the Co-Ni-V supply was more influential than increases in the supply of iron. Next, the separate effects of the elements in this trio were tested, and it was emphatically proved that the growth-effect was exercised by vanadium. Proof that vanadium is essential for a single algal species is not, of course, proof that it is needed for all green plants. Nevertheless, this is likely, especially when Bertrand's earlier work on vanadium in plants is also considered. The positions of the accepted micro-nutrients have become established from similar beginnings. Fuller details of this work are to be published later and elsewhere; this first short account in *Nature* is clearly enough a priority-staking announcement.

Industry and Post-Graduates

THE private conference recently held in London (see THE CHEMICAL AGE, 1953, **69**, 1233) and dealing with the educational work of the research associations seems to have pinpointed one of the professional dilemmas of our times, the universities' dominant hold on the Ph.D. degree. It is learnt from the statement issued after the conference that several speakers expressed the view that the graduate scientist, whose post-graduate training brought an understanding of industry's technological requirements and the use of research in meeting them, would often be better fitted for a career in industry than the graduate who had spent two or three years on specialised research for the requirements of a Ph.D. degree. In short, why not have post-graduate work carried out in a training spell at a research association? And should this count less in status at the end than the normal Ph.D.-obtaining effort at a university? It is also learnt from the statement that some members of the conference felt that overdue importance was attached to this degree. However, it is still much sought; perhaps the attraction is naturally more glamorous to students who have seen only the academic world than to mature scientists who have spent years in industrial quarters as well.

Could Help Fill the Gap

THE use of well-established research association centres for post-graduate education seems an extraordinarily good idea, and one that could most aptly fill part of the gap in our present technological education facilities. Nothing that is as easily adjustable as human opinion should be allowed to impede the conversion of idea into practice. The DSIR is a partner in all the research association ventures; and the DSIR grants probably finance, or considerably help to finance, a very large proportion of British post-graduate research. So far as the DSIR is concerned, there should be no reluctance to provide grants for research association studies as readily as for university research. But will the universities look upon the development so kindly and broadly? Will the graduate have to lose that gain in status he would otherwise have secured by sticking to the more conventional course? Unless the general attitude of universities to the Ph.D. qualification changes considerably, it seems certain that the universities, whatever they may say, will not encourage this valuable development. The Ph.D. award at the end of a university initiation into research will continue to attract graduates unless a similar award is possible after attachment to one or more of the research associations. The problem goes deeper. Years of technological research in industry, applied research of the highest personal quality, still count for little in the scales of academic honour. Few scientists who have made notable marks in industry originally acquired; not because they are lazy or uninterested but because they know well enough that the reaction of the university will be one of 'ifs' and 'buts.' The circles of pure and applied science overlap more comfortably and understandingly in America and Germany. The plain truth is that an award of proper status is needed for technological research, and it should be the same established award as that for pure research.

A New Deal for Research

Increased Grants to DSIR

THE Department of Scientific and Industrial Research was set up in the first world war because, in the words of the White Paper, 'it appears incontrovertible that if we are to advance or even maintain our industrial position we must as a nation aim at such a development of scientific and industrial research as will place us in a position to expand and strengthen our industries and to compete successfully with the most highly organised of our rivals.'

The wisdom of this measure becomes increasingly evident as time goes on. The pace of scientific and technological advance grows faster and faster and competition in the world's markets becomes increasingly acute, and whereas the world trade in manufactured goods has increased 2.5 times in the last 50 years, Britain's share has only increased 1.6 times. With formidable competitors reappearing in our principal markets, it is evident that we need all the help which science can afford.

The DSIR might be described as the cornerstone of Britain's research, so far as the manufacturing industry is concerned. Yet this key organisation has been chronically starved of funds. Its gross annual expenditure is in the region of £5,000,000, which is equivalent to roughly 2s. per head of the total population of the United Kingdom. Out of this meagre income the Department spends more than £1,500,000 on grants to industry through the research associations and other channels. It is left with £3,500,000 with which to run some 20 research stations, besides maintaining a liaison service with overseas countries, and administering an information service.

Substantial Building Plan

DSIR's post-war plans included a substantial building programme, the cost of which would be of the order of £10,000,000. The objects of this expenditure were to house DSIR scientists in more suitable buildings, give them the equipment they required, and provide the Department with certain research facilities which were sadly overdue. Although this programme represented Britain's minimum requirements for national research, progress has been extremely disappointing. Year by year expenditure lagged behind schedule, and when at last it seemed possible that the rate of expenditure on new buildings could be raised to the agreed level of £1,000,000 per annum, the Department was suddenly subjected to ill-conceived cuts, which had the effect of postponing urgently needed projects for a further indefinite period.

Expenditure Slashed

The new Mechanical Engineering Research Laboratory at East Kilbride is to be the chief national centre for basic research in all branches of mechanical engineering. The industries which it will serve are responsible for exports aggregating in value more than £744,000,000 a year. Yet expenditure on the laboratories at East Kilbride was cut by two-thirds in the Government's economy drive. The Water Pollution Research Laboratory at present occupies a small and not very convenient house at Watford, and a hut at the Building Research Station. A site for a new station was secured at Stevenage, and tenders were called for at the end of 1950, but the letting of the contract was deferred on Government direction.

These are by no means the only major projects which have been held up, nor has the economy axe been confined to building construction. Expansion of staff has been subjected to the same cheese-paring policy. The Advisory Council's post-war plans called for an increase of scientific and administrative staff from 2,160 (the 1946 figure) to about 4,000. The staff now numbers about 3,000, and during the past three years net recruitment has averaged only 110, which is far too low. On the score of economy, recruitment was suspended by the Government when the financial crisis arose, and the staff of the Building Research Laboratory was actually reduced.

At last there are signs of a more realistic attitude on the part of the Government towards research. The principal effects of the recent announcement about the future development of the DSIR will be an increase in the funds available to the Department, the lifting of the former ban on staff increases, and an increase in the expenditure

on buildings. Does this mean that at long last DSIR will cease to be the Cinderella of Government departments, or, to put it more aptly, that Cinderella has found her fairy prince?

The income of the Department is expected to increase by £400,000 during 1954 and subsequent increases will bring it to more than £6,000,000 by 1959—an increase of 20 per cent over the five-year period. These additions to the annual vote can scarcely be regarded as munificent, bearing in mind the magnitude of the field covered by the DSIR organisation. They will nonetheless bring welcome assistance to the Department in its efforts to maintain a satisfactory balance between fundamental research, applied research, and *ad hoc* investigations.

Grants to Research Associations

In accordance with its policy of encouraging research in industry, the Department will no doubt earmark a reasonable proportion of this modest 'windfall' for the research associations, few of which have incomes large enough for all that should be done. Higher annual grants might stimulate the expansion of operational research, which is of particular value in showing where laboratory research can most profitably be directed. Operational research gives the scientist an opportunity of meeting and working with all kinds of people in an industry. Moreover, many of its results can be applied without substantial capital outlay, and have the great advantage of enabling better use to be made of existing machinery and labour. This type of research thus merits all possible encouragement at the present time.

Recruitment of staff will be started again at the rate of 150 non-industrial staff and 50 industrial staff each year. The former category includes scientists, technicians, and administrative staff.

Apart from the increases in the annual vote, £6,000,000 has been granted to the Department for use during the period 1954-1959 in the erection of new buildings. This will enable the original building plan for the Mechanical Engineering Research Organisation to be completed, the estimated cost of the total scheme being in the region of £2,000,000. The Hydraulics Research Station at Wallingford and the new buildings for the Water Pollution Research Association will also be finished. The Radio Research Station will be housed in more adequate premises than the present collection of huts; the Fire Research Station will have the new buildings which it urgently requires; another new laboratory building will be erected at the Chemical Research Laboratory; there will be a new Road Research Laboratory on a site which still remains unknown. It is also proposed to transfer the Building Operational Research Unit from its existing site near Barnet to new premises adjoining the Building Research Station at Garston, Watford.

International congresses are frequently held at the National Physical Laboratory; yet this world-famous research centre has never had a lecture hall and in organising important conferences it is chronically hampered by lack of space. This need will be met by the conversion of a wind tunnel into a suitable lecture hall.

One of the most satisfactory aspects of this 'new deal for research' is the substitution of a five-year programme for the former system of year-to-year budgeting. As Sir Ben Lockspeiser has pointed out, a research organisation should not be treated like a Government Department, which has to budget again from scratch if it fails to spend the whole of its allocation within the appropriate financial year. Expenditure on research must fluctuate, and in order that its work may be effectively planned, DSIR should be assured of a minimum income for several years ahead.

Reasonable Assurance

The Department's estimates must of necessity continue to be approved by Parliament year by year, and there can be no certainty that the programme envisaged may not be amended or halted during the five-year period by a change in Government policy or in the position of the national economy. Nevertheless, the new system does provide a reasonable assurance of continuity and should make for greater flexibility in research.

The only valid criticism of this new deal is that even at the level of £6,000,000 a year, which it is proposed to reach by 1959, expenditure on research will still be wholly inadequate for the nation's needs, bearing in mind that our industrial future is being fashioned in the laboratories of the DSIR, the research associations, and individual firms.

Catalytic Vapour-Phase Oxidation

Gaps Filled in Existing Knowledge

ALTHOUGH the vapour-phase oxidation of hydrocarbons using air as the oxidising agent is quite attractive commercially, relatively few hydrocarbons have been oxidised successfully in this manner on a commercial scale. The oxidation of naphthalene to phthalic anhydride, benzene to maleic acid or anhydride and ethylene to ethylene oxide are examples of successful industrial applications. Associated with these processes are such problems as heat removal at relatively high temperature levels, temperature control, and recovery of the product from a gas stream diluted by the large excess of air usually required. These problems must be solved if the process is to be successful.

No less important, in determining whether or not a hydrocarbon may be processed successfully by vapour-phase oxidation, are such chemical factors as the thermal stability of the hydrocarbon and product, and the stability of the product towards further oxidation. All these factors are influenced by the specific or non-specific nature of the catalyst employed.

Investigations at Yale

In order to extend the range of applications of the process, it is desirable to know more about the effect of hydrocarbon structure, catalyst type and structure, and of operating conditions, on the types and relative amounts of products formed. Many gaps in existing knowledge have been filled by an investigation carried out by the Chemical Engineering Department of Yale University. The work was started under a contract between the US Office of Naval Research and Yale University and was continued under the sponsorship of E.I. Du Pont de Nemours & Co.

It is the subject of a report by R. H. Bretton, which has been made available to the Technical Information and Documents Unit of the Department of Scientific and Industrial Research.

The hydrocarbons selected for study were *n*-butane, 1-butene, 2-butene, *iso*butylene, and 1,3-butadiene. They were chosen in the first place because they were available in large quantities industrially; hence the experimental data would have practical as well as theoretical interest. Moreover, very little work has been done on these hydrocarbons and the little that had was to be found mainly in the patent literature. Another factor taken into consideration was that they lent themselves to a study of the effect of chemical structure; it seemed possible, therefore, that from the results of the proposed investigation, a mechanism of oxidation for a given catalyst might become evident.

Butane Quite Resistant

The greater part of the investigation represented a study of the vapour-phase oxidation of *iso*butylene, 1-butene, 2-butene and butadiene over silver, silver oxide and vanadium pentoxide catalysts. Butane proved quite resistant to oxidation, and for this reason only a few runs were made with this hydrocarbon.

Mainly for the purpose of checking equipment performance and catalyst activity, the oxidation of ethylene over a silver-oxide catalyst was also investigated. In these runs with ethylene an attempt was made to duplicate results reported by other investigators. In addition, a few qualitative runs using vanadium pentoxide as a catalyst were made with acetaldehyde, formaldehyde, carbon monoxide and hydrogen.

In view of the very small amounts of intermediate oxidation products found in the oxidation of four-carbon hydrocarbons over silver-type catalysts, only qualitative results were reported for these runs. On the other hand, for the runs with a vanadium pentoxide catalyst, an attempt was made to determine quantitatively as many of the products of oxidation as possible.

The variables studied were contact time, air-hydrocarbon ratio, and temperature. All runs were made at substantially atmospheric pressure. The contact time was varied by changing either the total flow rate or the amount of catalyst. For the silver-type catalysts the contact time was varied from 0.1 to 1.8 seconds (based on inlet reactor conditions), the air-hydrocarbon ratio from 0.5 to 84, and the bath temperature from 150° to 260°. The corresponding values for

the vanadium pentoxide catalysts were 0.25 to 2.1 sec., 25 to 125 air/hydrocarbon, and 260-370°.

Preliminary experimental runs were made with *iso*butylene, using silver and silver-oxide catalysts similar to those used for the oxidation of ethylene to ethylene oxide. These early runs, characterised for the most part by burning at the top of the catalyst bed, resulted only in traces of acetone, formic acid and aldehydes. It became apparent, therefore, that some method of controlling the catalyst bed temperature would have to be found before the investigation could be carried further.

Satisfactory Results Achieved

A few runs were made with ethylene to check the performance of the equipment and the activity of the catalyst for this particular hydrocarbon and, further, to gain experience in experimental work of this kind. Satisfactory results were obtained for ethylene. Yields of ethylene oxide up to 69 per cent and conversions of hydrocarbon to ethylene oxide up to 49 per cent were obtained. The approximate conditions for the best results were: Contact time one second, bath temperature 288°, and ratio of air to hydrocarbon 20: 1. These findings are in substantial agreement with results appearing in the literature.

As a result of experience gained from these runs, plus a better knowledge of heat release, heat transfer and temperature gradients in the catalyst bed, it was possible to select operating conditions for the four-carbon hydrocarbons which gave good control of the catalyst bed temperature. Even with good control, however, only traces of intermediate products were found when a silver-oxide type catalyst was used. Other catalysts of the silver or silver oxide type were tried with no success. It was then decided that this type of catalyst, although satisfactory for the oxidation of ethylene, was unsuitable for the oxidation of the four-carbon hydrocarbons.

A vanadium pentoxide catalyst was next selected for study. The following compounds were identified in the oxidation of the various hydrocarbons over this catalyst:

*iso*Butylene: acetic acid, α-methyl acrolein, and formaldehyde. 1- and 2-Butene: acetic acid, maleic acid, acetaldehyde, formaldehyde and glyoxal. There was also strong evidence for methyl vinyl ketone. *n*-Butane: maleic acid, formaldehyde, acetaldehyde, and glyoxal. There was strong evidence for acetic acid.

In general, with increasing contact time the conversion of the hydrocarbons to various products increased at the outset, passed through maximum value, and then decreased. The maximum conversions did not occur at the same contact time for all products, the maximum values for aldehydes and ketones being observed at shorter contact times than those for acids. The effect on yields cannot be generalised. Usually the yields of intermediate aldehydes and ketones such as α-methyl acrolein, acetaldehyde and methyl vinyl ketone increased with a decrease in contact time.

The effect of increasing the temperature was to increase the over-all conversion of the hydrocarbon and usually to decrease the yield of any one compound, the latter effect being greater for aldehydes and ketones than for acids. This would indicate an optimum temperature for the conversion of hydrocarbon to any one product. This was frequently observed.

The effect of increasing the air-hydrocarbon ratio at constant contact and bed temperature was to increase the conversion of the hydrocarbon to any one compound. This was due to an increase in the overall conversion of the hydrocarbon. The effect of increasing the air-hydrocarbon ratio on yields was negligible, provided the bed temperature remained constant. If the bath temperatures were kept constant, the effect of increasing the air-hydrocarbon ratio was to decrease the bed temperature and consequently effect an increase in yield of any one compound.

Formaldehyde Conversion 5.5 Per Cent

The quantities of formaldehyde and glyoxal present were usually small and did not vary appreciably with changes in operating conditions. The highest conversion to formaldehyde was 5.5 per cent and this was obtained from *iso*butylene. Approximately one-half of this amount was found with the other hydrocarbons. The highest conversion to glyoxal occurred with 1-butene and was in the neighbourhood of 2 per cent. The maximum conversion of *iso*butylene to α-methyl acrolein was 12 per cent (yield 26 per cent) and to acetic acid 24 per cent. The corresponding values for acetic acid from 1- and 2-butene were 12 and 13 per cent. The

highest yield and conversion for maleic acid were obtained from butadiene and were 58 and 54 per cent respectively.

Acetaldehyde and methyl vinyl ketone were determined independently only in the runs with 1-butene. The highest conversions and yields found for these two compounds were 2 and 6 per cent and 4 and 9 per cent respectively. *n*-Butane proved to be quite resistant to oxidation. At a contact time of about one second, bed temperature 437° and air-hydrocarbon ratio 36, only about 7 per cent of the hydrocarbon reacted, of which much less than 1 per cent went to the products mentioned above.

A check run for butadiene made after eight months of operation indicated that the catalyst activity, as regards maleic acid production, had increased.

Arising from this work, a mechanism for the oxidation of hydrocarbons over a vanadium pentoxide catalyst has been prepared. It involves a series of atomic dehydrogenations with simultaneous formation and resultant decomposition of peroxides.

The results of the investigation suggested that certain other problems might be worthy of additional research. In the experiments described, the investigators were concerned with the vapour-phase oxidation of four-carbon hydrocarbons with air over several silver-type and one vanadium-type catalyst at atmospheric pressure and at relatively high air-hydrocarbon ratios. This immediately suggests: (1) additional work with catalysts, (2) the use of hydrocarbons other than the four-carbon ones, (3) the use of oxygen or 'enriched' air, (4) the use of high pressures, and (5) the use of low air-hydrocarbon ratios.

An Effective Catalyst

Since vanadium pentoxide was found to be an effective catalyst for hydrocarbon oxidations, the initial phase of an extensive catalyst study should include work on 'promoted' vanadium-pentoxide catalysts. It might be possible to obtain in this manner a catalyst which would become active at temperatures lower than those used in the present investigation.

Silver-type catalysts were active at temperatures considerably below those used for vanadium pentoxide, but led only to complete combustion products. However, a combination of these two types might prove effective.

A catalyst study should include other vanadium-type catalysts such as tin, bismuth or other metal vanadates. Molybdenum-type catalysts alone or admixed with the vanadium type should also be effective for hydrogen oxidations. In view of the mechanism proposed for the oxidation of hydrocarbons over a vanadium pentoxide catalyst, it might be worth while to investigate catalysts which are known to be effective for dehydrogenations; e.g., chromium oxide.

Pressure should be an important variable in catalytic vapour-phase oxidations. It is a well-known fact that for non-catalytic hydrocarbon oxidations the reaction temperature is lowered by an increase in pressure.

Only High Range Studied

In the early part of the investigation, it was shown that catalytic oxidations could be carried out effectively, as regards bed temperature control, at either high or low ratios of air to hydrocarbon. Only the high range was investigated. The lower range should also be worthy of study.

The use of oxygen or 'enriched' air should also effect a lowering of the initial reaction temperature. Such reactions might be more difficult to control and it might be necessary to use a large excess of hydrocarbon and to recycle the unreacted hydrocarbon.

The investigation of other hydrocarbons over a vanadium pentoxide catalyst would result in valuable information as regards mechanism. Obviously such an investigation might also lead to results of commercial interest. Thus the oxidation of propylene, according to the proposed mechanism, should lead to acetic acid, acrolein, and formaldehyde, with the acid predominating at moderate contact times.

Since the adsorption of gases on the catalyst surface in all probability plays an important rôle in the vapour-phase oxidation of hydrocarbons, the effect of introducing such gases as H_2O, CO, CO_2 or H_2 into the reactant mixture should be investigated. The implications are that it might be more than a simple dilution effect.

In regard to the establishment of a mechanism for vapour-phase oxidations, an investigation of oxidations at very short contact times should be made. The design of the experimental equipment and the analytical methods used in the investigation des-

cribed did not permit accurate research below a contact time of about 0.25 sec. The results indicated, however, that the first oxidation products were formed at much shorter contact times. It is also desirable that a thorough investigation of a single hydrocarbon and all its intermediate products should be made. For example, the oxidation of *iso*butylene, α-methylacrolein, formaldehyde and CO over a vanadium pentoxide catalyst could be investigated.

The nature of the catalytic effect might be another subject for research. Such an investigation should include a preliminary study of the adsorption of the reagents to be used and the products expected. This could be followed by studying several types of reactions over the same catalyst. Thus, the thermal decomposition, isomerisation, dehydrogenation and oxidation of a single hydrocarbon over a given catalyst could be examined. The investigation described was carried out using a fixed-bed catalyst. The use of fluidised beds might be advantageous in view of the exothermic nature of the reaction.

The work has revealed the necessity of removing or dissipating the heat of reaction efficiently. Practically no information of an experimental nature is to be found in the literature on the subject of heat release and temperature gradients in catalyst beds. The results of such an investigation should therefore be of considerable value for design purposes.

Antibiotics from Jerusalem

Rafa Laboratories Increasing Exports

MORE than $400,000 worth of antibiotics were exported this year by the Rafa Laboratories, Jerusalem. Dr. B. S. Levin, director, gave this information during a Press tour of the company's new premises in the industrial centre recently.

Despite the continuous decline in world prices, said Dr. Levin, penicillin and a smaller output of streptomycin had brought in more hard currency each month, reaching $70,000 in November. Finland and South Africa had lately joined Greece and Turkey as customers, and the USA had ordered tyrothrycin.

The company imports raw materials for the main antibiotic preparations from the US, and processing at Rafa saves between 40 and 50 per cent in foreign currency for Israel. The import of antibiotics has been cut considerably by the Rafa Laboratories, which this year supplied 190,000,000,000 units of penicillin, and 76 kilos of streptomycin to the Israeli home market. The laboratories can easily satisfy all local needs: at present, 80 per cent of the output is exported.

The Rafa research team has synthesised tyrothrycin and nitrofurzone for the first time in Israel, and is investigating synthetic chemicals.

Rafa concentrates on producing those antibiotics which demand much laboratory work and are not worth while manufacturing on a large scale. In this field, it can compete with world prices.

New Coking Processes

MR. D. T. Barritt and Mr. T. Kennaway, of Simon-Carves, Ltd., are the authors of a paper to be presented at a forthcoming joint meeting of the Institute of Fuel and the Coke Oven Managers' Association (Southern Section) describing new processes for producing coke from a wider range of coals than can be carbonised by normal coke-oven practice.

After reviewing the development of the coke oven up to the present day, the authors define the inherent limitations of coke ovens with regard to their operational characteristics and to the narrow range of coals which can be carbonised in them. The importance of developing alternative processes, capable of producing satisfactory coke from non-coking or weakly coking coals, has been recognised by the Organisation for European Economic Co-operation. Their Working Party's report, published earlier this year, classified and gave technical details of all known processes.

Mr. Barritt and Mr. Kennaway examine in their paper three new processes selected from that report, namely: (1) National Fuels process; (2) Brennstoff-Technik process; (3) Baumco process. In each case the basic theory of the process is outlined and a general appraisal is made of its scope and possibilities in relation to existing practice.

The meeting for presentation and discussion of the paper will be held on Tuesday, 12 January, 1954, at 5.30 p.m., at the Waldorf Hotel, Aldwych, London, W.C.2.

The Protective Action of Paints

Effects of Water on Painted Metal Discussed

AT a joint meeting of the London Section of The Oil & Colour Chemists' Association and the Corrosion Group of the Society of Chemical Industry, held at Burlington House, London, on 9 December, two papers, dealing respectively with electrical measurements in the study of paint coatings on metal, and the mechanism of protection by paints, were presented. Dr. J. C. Hudson, chairman of the Corrosion Group of the SCI, presided.

The first paper, 'Capacitance Measurements in the Study of Immersed Paint Coatings on Metals,' was by D. M. Brasher, A. H. Kingsbury and F. Wormwell; it was introduced by Dr. Wormwell and presented by Miss Brasher. It outlined the ways in which capacitance measurements on immersed paint coatings on metals might yield information concerning both the amount and manner of water uptake from the surrounding solution, and also the processes leading to subsequent breakdown of the paint.

In the first part of it the authors dealt with the information obtainable from a comparison of water uptake estimations carried out by capacitance and gravimetric methods respectively. It was pointed out that the calculation of water uptake from capacitance measurements was based on several assumptions, of which the most important concerned the mode of distribution of water within the paint film. Capacitance curves were illustrated.

Painted Nickel Foil

Reference was made also to some experimental work, carried out by Mr. Kingsbury, which had involved the estimation of water uptake, by capacitance and gravimetric methods, on 12 paint systems on nickel foil, immersed in artificial seawater. Some comparisons of water uptake/time curves obtained by the two methods were shown.

The second part of the paper was a study of the effect on water uptake and paint breakdown of variations in the osmotic pressure and ionic concentration in the surrounding solution.

Discussing the reason why the concept of osmotic pressure was used, rather than that of vapour pressure, the authors said it was not the intention to regard the paint film as a whole as a semi-permeable membrane; the system had been considered as a balance between the osmotic attraction exerted by the external solution, and that exerted by the paint film itself, as a result of the hydrophilic molecules within the film. That attractive force within the film was evidently very considerable, since water could be drawn into the paint even from 20 per cent NaCl solution, of osmotic pressure nearly 200 atmospheres.

Indication of Breakdown

Experiments were illustrated in which capacitance/time curves were used to estimate water uptake and to indicate the onset of paint breakdown. The solutions employed were sucrose, NaCl, or mixtures of the two. A paint which gave good agreement was used throughout, and it was applied to steel panels.

The authors' general conclusions were summarised as follows:—

(1) Capacitance measurements show incidence of breakdown.

(2) Capacitance measurements can be used, in certain circumstances, to estimate water uptake.

(3) In conjunction with the gravimetric method they can give information on the mode of water uptake.

(4) Water uptake is related to osmotic pressure of the solution, as would be expected.

(5) The changes in the paint film on immersion are governed not only by osmotic pressure, but also by ionic concentration of the solution. The study of both these factors should lead to a better understanding of the protective action of paints.

The second paper, 'The Mechanism of the Inhibition, by Paints, of Corrosion, with Special Reference to Basic Pigments,' was by J. E. O. Mayne and D. van Rooyen. They pointed out that previously it had been shown that water became non-corrosive after contact with certain metallic soaps (Pb, Zn, Ba, Sr, Ca) of the linseed oil fatty acids. Aqueous extracts of the lead and calcium soaps had now been analysed, mainly by

chromatography. The extracts contained the salts of formic acid, azelaic acid and an unsaturated hydroxy-acid derived from pelargonic acid; small quantities of the salts of acetic, propionic, butyric and suberic acids were also detected.

Immersion tests showed that lead and calcium formate were corrosive, while the lead and calcium salts of azelaic acid, suberic acid and pelargonic acid were inhibitive at *p*H 4.6. A synthetic mixture was made, which had similar inhibitive properties to a natural extract.

After outlining the problem and giving details of their study of it and of the experiments made, the authors summarised the results. They said that the products identified in the aqueous extracts of the lead and calcium soaps of the linseed oil fatty acids showed that the major acids isolated were formic acid, azelaic acid and an unsaturated hydroxy-acid derived from pelargonic acid; small quantities of acetic, propionic, butyric and suberic acid were also detected.

Immersion tests had shown that formic acid and its salts were corrosive. Lead acetate was corrosive at *p*H 4.6, but inhibitive above *p*H 6; the acetates, therefore, could have no inhibitive value in the extracts of lead soaps which inhibited down to *p*H 4.6; but they might function as inhibitors in the extracts of zinc and calcium soaps. It appeared probable that in a paint film the concentration of the derivatives of the steam-volatile acids would always be lower than had been observed in the experiments, owing to their volatility.

The Inhibitive Fraction

The inhibitive fraction consisted of the salts of several dibasic acids and of a series of unsaturated hydroxy acids derived from pelargonic and higher acids. The lead and calcium salts of azelaic, suberic and pelargonic acid were all inhibitive at *p*H 4.6, and a synthetic mixture had been prepared which had similar inhibitive properties to those of the natural extract.

Two general conclusions could be drawn from the investigation. The first was the establishment of a class of inhibitors which were effective at *p*H 4.6-5.0. No examination had been made of the behaviour of those inhibitors in more acid solutions, because the investigation had been concerned only with the aqueous extracts of metallic soaps, which did not yield extracts of lower *p*H than 4.6.

The second conclusion was that with this class of inhibitors the lead salts were more inhibitive than the calcium salts, which in turn were more efficient than the sodium salts. Dr. Mayne had previously shown that litharge, and products containing litharge, were capable of rendering water non-corrosive, and that observation had been confirmed recently by Pryor. It could be concluded from those observations that lead oxide, in solution, was a more efficient inhibitor than sodium hydroxide. Recently, Sanyal and Preston had shown that in certain circumstances lead and zinc benzoates were more efficient than sodium benzoate.

The authors advanced two hypotheses concerning the effect of the anion and the cation; they hoped that further work would render either or both of those hypotheses 'respectable'—to use the words of Appleton—and that that work might form the basis of another paper.

Attwood Staff Conference

HOW management consultancy was being used by some of the more important firms in the chemical industry was described by Mr. J. A. Aplin at the staff conference of The Wallace Attwood Company (Management Consultants) held at the Institut Belge, 6 Belgrave Square, S.W.1, on Friday, 4 December. The chairman was Mr. Wallace Attwood, and some 40 senior members of the staff, many of whom had come from assignments all over the country, were present.

Mr. Bedford Attwood, senior partner of the Wallace Attwood Company and chairman and managing director of Attwood Statistics Ltd., delivered the first paper, dealing with 'The New Consultancy.' He was followed by Mr. M. O. Hughes speaking on 'Organising for the Future.'

Papers dealing with management consultancy from the view-point of many different industries were given. Developments in office mechanisation were also covered by Mr. C. G. S. Jennings.

After the conference, a dinner and dance was held by The Wallace Attwood Company and Attwood Statistics Ltd., at the Park Lane Hotel, and was attended by over 200 members of the staff and friends.

Resourcefulness in Chemical Industry

USA Manufacturers' President Fears Shortage

THE view that a shortage of resourcefulness was more to be feared by the American chemical industry than a shortage of resources was expressed by Mr. William C. Foster, president of the Manufacturing Chemists' Association, when speaking in Washington recently.

For many years, he said, petroleum by-products now used in gasoline were thrown out because there was too little appreciation of the energy in them. They were only beginning to appreciate the abundance available in the silica comprising so large a part of the earth's crust. As one example, automobile bodies made of silica processed into fibreglass hinted how they might shift dependence from materials that were in short supply to those that were plentiful.

Mr. Foster continued: 'There is nitrogen in the air; magnesium in the sea and in brine wells under the land; more aluminium than iron in the soil. The great arts of synthesis are scarcely tapped. What shortages are we afraid of?'

Speaking of the 'amazing things' produced by scientists, Mr. Foster recalled that a few years ago one of the great laboratories along the Charles River in Boston defied tradition by making a silk purse out of a sow's ear. They merely boiled some pigs' ears into glue, spun the glue into filaments and wove them into a purse. He added: 'And just the other day I was told that one of the members of our Manufacturing Chemists' Association had actually synthesised a ham steak, complete with tender fibres and full protein value and not subject to deterioration.

Filled with Foreboding

'Such evidences of resourcefulness amuse and even excite us because they are at least comprehensible in the affairs of our workaday world. But when we get into the mysteries of atomic chemistry, we tend to become filled with not a little foreboding. Yet the sun is still the central source of all energy. Through the ages solar power has been stored in uranium, as it has been in petroleum and coal.

'Our minds have been so focused on the destructive uses of atomic power that we are only now beginning to see what may possibly lie ahead. However, if our vision is not yet too sharp, we may take some comfort from the fact that only 27 years ago we did not know much about what we could do with oil, and we may be on the threshold of a new experience with coal.

Chemicals from Oil

'From an experimental 75 tons of chemicals from oil produced by one company in 1925, we today find yearly production of chemicals from petroleum and natural gas running 8,500,000 tons, ever on the rise and ever giving us a new abundance of materials.

'Until a few months ago many supposed that the future of chemicals would be most largely realised in the field of petro-chemicals. This was so despite the fact that coal was the original base on which our industry was built. But the coal tar we used was really a by-product of the steel industry and such has been our expansion that we were running out of those materials. Oil promised to supply additional resources.

'Then suddenly last spring we heard that down in West Virginia a modern industrial marvel had been brought about. By a whole series of inventions and new techniques the process of hydrogenation of coal had been cut from the 45 minutes previously required, even in the best German plants, to about 4½ minutes. We wondered whether it would be necessary any longer to spend ten cents on 40 cents' worth of coal-derived aromatic chemicals in order to turn them into 15 cents' worth of gasoline.

'At first that aspect seemed dominant because ever since the discovery was made, back in 1913, that coal could be liquefied by hydrogen under heat and pressure to make oil products, our thoughts had been focused in that direction. Germany produced about 85 per cent of their aviation gasoline through coal hydrogenation during the last war; and our US concern with hydrogenation had been largely based on a desire to have a fuel substitute available. However, it quickly developed that the new process in West Virginia was not concerned with fuel production at all.

'Unnoticed by many not intimately con-

cerned with the industry, the demand for aromatics—which is to say the basic items processed from coal tar—had greatly increased. These aromatics are absolutely essential to dyestuffs and to many plastics and medicines. In addition, the prospects for new uses will be found, and through this demonstration of resourcefulness a whole new way of adding to our resources has been uncovered. Certainly, an immense potentiality has been opened to us by the scientific men who developed the process. They deserve our highest praise.

'Our resourcefulness will be remembered long after our resources are forgotten. Granted peace abroad, and granted freedom from undue restrictions at home, our industries—with chemicals in the lead—will come up with countless examples of beneficient resourcefulness. There will be inspiring examples of technical skill, and management vision, and each in its way will be a paving stone in the single road to security and abundance.'

Changes Recommended

MCA Seeks Income Tax Relief

A TEN-MONTH study of the United States income tax structure by the Tax Policy Committee of the Manufacturing Chemists' Association has resulted in 14 recommendations for changes which have been submitted to the Joint Committee on Internal Revenue Taxation.

In a letter transmitting the recommendations to the Committee, William C. Foster, president of the MCA, pointed out that his association represents a major portion of the chemical industry which is one of America's largest. He observed that the membership includes some 130 companies ranging from the largest to the smallest.

He went on to say that the rapid growth of the industry must be maintained if it is to supply the nation with the volume and variety of chemical products that will be needed in the future. 'To make this growth possible, nothing is more essential than the achievement of a sound tax structure which will provide necessary incentives to ability and effort and will not handicap companies in carrying out sound, constructive financial policies,' Mr. Foster said.

'One of the principal complaints of taxpayers generally has been concerned with the treatment of depreciation for tax purposes,' the report said, and it went on to observe that since the chemical industry is relatively new and rapidly growing, depreciation presents a peculiar problem.

This occurs, it was pointed out, because most of the capital expenditure of the chemical industry has been made in years when cost has been unusually high for facilities which, in many cases, may become outdated and of little value in a comparatively short period of time. Therefore, to compute deductible depreciation rates based on the assumption of long periods of useful life would seriously distort the actual income of these particular taxpayers and result in an inequitable payment of taxes.

Turning to research and development expenditures, the report said that national security, coupled with maintenance of the competitive position, made necessary substantial and continuing expenditures for this item. It recommended that taxpayers be permitted at their election to deduct or to capitalise research and development expenditures.

'Industry, therefore, should be encouraged, rather than impeded, in expanding its research and development activities, as it is only through such progress that the nation can keep its lead in defence production, and enjoy an expanding and prosperous economy,' the report stated.

Preservation of Timber

BECAUSE local Australian timbers for use as railway sleepers are not so readily available as hitherto, Australian research workers are concentrating upon preservative treatments for timbers of lower natural durability. At least 3,500,000 sleepers are used annually in the various Australian railway systems.

Tests by the Forest Products Division of the Commonwealth Scientific and Industrial Research Organisation, in Melbourne, reveal that Pinus radiata sleepers, pressure-treated with preservative oil, may possibly outlast Jarrah sleepers installed at the same time. The heartwood of eucalypt timbers is very difficult to penetrate with preservatives, and low pressure methods of preservation, which are used for soft woods, are not successful.

The Melbourne researchers have developed an experimental plant in which timber can be impregnated with preservative oils at pressures of 1,000 lb./sq. in. This is an innovation in wood preservative technique.

Society of Cosmetic Chemists

Lecture by Dr. J. H. Schulman

'MOLECULAR Interactions at the Solid-liquid Interface, with Special Reference to Emulsions Stabilised with Solid Particles' was the title of a lecture given recently by Dr. J. H. Schulman at an open meeting of the Society of Cosmetic Chemists of Great Britain at St. Ermin's Hotel, Caxton Street, London, S.W.1. It was illustrated with lantern slides and by practical demonstrations.

Dr. Schulman described the mechanism by which detergents in aqueous solutions could be adsorbed on to solid surfaces to form a mono-molecular covering film which converted the particle originally hydrophilic in character to lipophilic and *vice versa*. An excess of detergent served to build up a double layer and restore the hydrophilic-lipophilic balance. Such a double layer had a structure somewhat resembling that of a micelle. He indicated the conditions which permitted mixtures of metal ores to be floated and so separated from each other.

Much of the fundamental work dealing with this investigation had been carried out by means of a modified form of the Langmuir trough. In this, the disturbing film pressure acting backwards upon the boom, and originating from a film of surface active agent escaping across the boom by migration through the water, was counterbalanced by the drop in surface tension, with which it was identical, acting upon a vertical sheet of mica held by a lever attached to the beam of the film balance. Thus, the adventitious forces acting horizontally and vertically were opposed to each other and neutralised.

Oil in Water Emulsion

Transposing the sorption on the surface of insoluble particles into terms of emulsion chemistry, he showed, for example, that an emulsion of oil in a solution of sodium alkyl sulphate which would normally be oil-in-water could be inverted by the addition of barium sulphate powder, and that the subsequent addition of caustic soda made no difference to the type of emulsion, i.e. water-in-oil. In the case where the emulsion was produced with sodium oleate and the *p*H value was adjusted to 7.6 (where the oleic acid is 50 per cent dissociated) the water was a continuous phase. When, however, caustic soda was then added, the emulsion inverted and at relatively high *p*H values the emulsion became oil continuous, i.e. water-in-oil.

Effect of Varying Contact Angles

When the contact angle of the powder measured across the water was less than 90° the emulsion was water continuous and when it was over 90° it became oil continuous. If, however, the surface was covered with very long hydrocarbon chains, the contact angle could increase to nearly 180, giving nearly complete wettability of the surface by oil. Such coated powders were not held in the interface, but were dispersed in the oil phase itself, giving an unstable emulsion. Similarly, if the contact angle was nearly zero, then the particles were dispersed in the water phase and again did not contribute towards emulsification. Where dicarboxylic acids were employed they could be chemi-sorbed on the solid surface horizontally to give a spacing effect which would enable other molecules to be sorbed in the mosaic pattern.

The extent to which the particles were oil or water wettable as a result of the sorbed surface governed the type of emulsion which would be produced. When the particles were preferentially wetted with oil, this caused them to spread out at the oil surface and close in on the water surface, so that a water-in-oil emulsion was produced. Conversely, if the particles were preferentially wetted with water, then the particles at the water interface were spread out and packed together at the oil interface so that drops of oil were stabilised in a water continuum. This effect clearly followed from the statement that contact angles to the water of less than 90° give oil-in-water and greater than 90° a water-in-oil emulsion.

The lecture was very well attended and considerable discussion ensued, with Dr. Schulman giving the answers to a wide variety of questions which were put to him. Dr. Marriott proposed a vote of thanks to Dr. Schulman and this was approved in the usual way.

Tall Oil Industry Grows

Bright Future Predicted

PRODUCTION of crude tall oil approaching 1,000 tons a day within the next few years was predicted by Mr. A. Scharwachter, president of the Tall Oil Association and vice-president of Arizona Chemical Co., at the recent semi-annual meeting of the Tall Oil Association, at Sea Island, Georgia, USA.

Present production of tall oil—an oil obtained from the pine wood used in making Kraft paper—is approximately 200,000 tons yearly, said Mr. Scharwachter. Although tall oil is relatively new among industrial oils, its domestic production and uses have increased steadily since its introduction in 1930. Commercial acceptance and use of tall oil, like that of so many industrial oils, has been achieved gradually.

Mr. Scharwachter pointed out to the association members (who represent the manufacturers and sellers of tall oil) that demands for tall oil rosin exceed the supply. In addition, he said, this increasingly available industrial oil has considerable further potentialities in the manufacture of such products as linoleum, paints, soaps, cleansers, adhesives, asphalt emulsions, core oils, fungicides, varnishes, textile oils and many others. He also predicted that tall oil—which is a natural mixture of rosin acids related to abietic acid and of fatty acids related to linoleic and oleic acids—would prompt many new chemical uses within five years.

More Research Called For

Mr. L. J. Doyle, vice-president of Union Bag & Paper Corporation, and a former president of the association, called upon the tall oil industry to devote more research to the development of end uses. He emphasised the fact that the Kraft paper industry, the 'father' of the tall oil industry, is healthy because of the time, money and effort it has put into such research work. Tall oil is such a low-cost, readily-available raw material, said Mr. Doyle, that it is attractive to potential users It should be the tall oil industry's purpose to teach all industry how to use this versatile source of organic acids.

The Tall Oil Association, which was formed in 1947, has frequently brought together many of the industry's research chemists in round-table discussions or for plant visits, besides distributing reprints of technical articles regarded as being of interest to members. Publicity to promote the uses for tall oil has developed into a most important project of the association. In this connection, the association developed a series of free technical bulletins, the first eleven of which have been consolidated and are now available in bound form.

The association has taken part in assigning speakers to chemical, paint and soap conventions and has stimulated the publication of articles in trade journals to disseminate knowledge of the product.

Technological Education

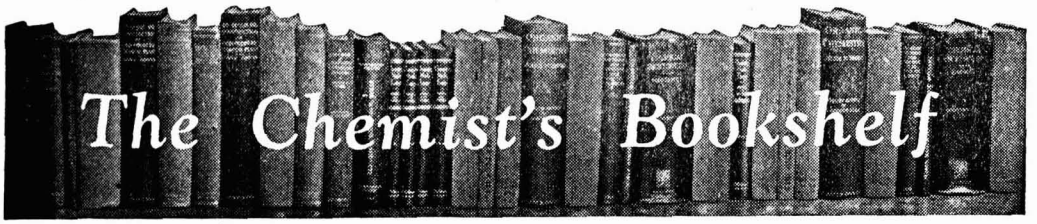
Questions in the House of Commons

IN the House of Commons last week, Mr. Malcolm MacPherson asked the Chancellor of the Exchequer to what extent the plans of the Government for the development of higher technological education depended upon an increased flow of adequately qualified students into the universities and other institutions concerned; and what steps he proposed to take in order to obtain such a flow.

Mr. R. A. Butler: 'The Government's plans for the development of higher technological education will afford improved facilities for both postgraduate and undergraduate students. I have no reason to doubt that the universities and colleges concerned, the schools and industry will all play their part in the measures needed to encourage an increased flow of students.' Mr. Butler added that the Minister of Education had also very much in mind the contribution which her department and the local education authorities could make to securing the desired result.

Mr. MacPherson asked whether Mr. Butler was aware that the stream of students coming from the schools to the universities and similar institutions was showing signs of decreasing, both in quantity and in quality. If the programme for higher technological education was to succeed, was it not necessary for greater emphasis to be put on the earlier stages of technical education?

Mr. Butler: 'That particular responsibility lies with the Ministry of Education, but as I am somewhat aware of these circumstances I can say that the more we can develop technical education prior to the higher technological education the happier I shall be.'



ATOMIC TRANSMUTATION: THE GREATEST DISCOVERY EVER MADE. By Muriel Howorth. New World Publications, London. 1953. Pp. 136, Plates 4. Paper bound, 12s. 6d.; Library edition, white/blue 15s.; white/gold linen 20s.

The reviewer's copy of this work is paper bound, and on page 115 we find the statement 'End of Vol. I,' the remainder of the book being occupied by an address to the Institute of Atomic Information for the Layman and a name index. Since the book only brings the reader up to the year 1904 presumably yet more is to come. The title page, somewhat ambiguously, carries the legends Atomic Transmutation/The Greatest Discovery Ever Made from Memoirs of Professor Frederick Soddy. Facing the title page one observes that all rights, including film rights, are reserved.

Readers of the *New Yorker* will be familiar with a feature which appears from time to time under the heading 'Exclamations We Doubt Ever Got Exclaimed.' The fourth paragraph of the introduction (entitled 'About Myself') would appear to qualify for inclusion, running as follows: 'When, in 1945, a young scientist rushed excitedly into my home exclaiming: "They've done it! Exploited the enormous energy inside the atom by means of a chain reaction. See how simple it all seems now . . . . the neutron . . . ." to (*sic*) the days in 1948 when I found volume after volume on the subject of atomic energy, from the famous Smyth Report to the—well, shall we say—pursuits of "Mr. Tomkins in Wonderland," I knew that the world had entered a new phase of cosmic understanding. Atomic scientists were unfolding the hitherto mysteries of the make-up of the Universe and were revealing to us lay people the nature of our world of which we were so profoundly ignorant.'

This is a pretty fair sample of the type of writing in the book, and it is to be feared that throughout the author has had too much of an eye to the possible film rights and too little to presenting a reasonably dispassionate account of either the history of atomic transmutation or the life of Professor Soddy. Some American writers have tackled the business of converting scientific adventure into prospective film material infinitely more ably.

At one shilling—or perhaps even two shillings—the book might be worth using to while away a long train journey—if the reader had little regard for style and were placid enough to refrain from flinging it out of the window through sheer intermittent irritation. At the prices quoted it is doubtful if it will have a ready sale.—CECIL L. WILSON.

CATHODIC PROTECTION OF PIPELINES AND STORAGE TANKS. By V. A. Pritula. Department of Scientific & Industrial Research, London. Distributed through HMSO. 1953. Pp. vi + 160. 10s.

This book is a translation of a collection of articles published by the Chief Petroleum Marketing Organisation of the Russian Ministry of the Petroleum Industry in 1950.

In the first place the translation has been very ably carried out, and in the main stiffness of style has been avoided. There are occasions when rather careful reading of the text is necessary in order to be clear as to the meaning of unfamiliar definitions (e.g. is a 'regular' resistance constant or variable?). Also, some of the figures have lost their clarity in the reproductive process.

However, these minor points are unimportant when compared with features which will recommend this book to anyone interested in the subject. The text is concise and factual; detailed composition of all the materials used is given. Further, the theoretical treatment is quantitative and—welcome change—the interested reader may find out how many anodes are needed, where they should be placed, or how much current is

needed, in order to protect a given system. In addition, a good deal of detailed operating experience is tabulated, although some is of unfamiliar application.

The book has twelve chapters, but no index, and a small (and entirely Russian) bibliography. In brief, there is much invaluable information in this book, even if one has to work a little to extract it.—T.K.R.

CORROSION TESTING PROCEDURES. By E. A. Champion. Chapman & Hall, London. 1952. Pp. 355 + 12. 36s.

The Dechema 'Tables of Engineering Materials,' with its thousands of figures concerning resistance to corrosion and chemical attack, and this book, 'Corrosion Testing Procedures,' are complementary. Whereas the former gives many details for the theoretical worker, Champion's book will be of great value to the practical investigator whose problems are the corrosion of metals in service, and the selection and production of metals of adequate resistance to corrosion. Naturally, each investigation of corrosion attack, and the means of obviating or decreasing this attack, will be made almost solely with regard to the specific circumstances involved; however, many of the procedures described here in the book will serve as useful 'jumping off' points, or may suggest alternative methods of approach.

Because of the very wide range covered by the corrosion tests, the author has divided his book into the following sub-sections:—(1) The choice and preparation of metal and corrosive. (2) Exposure of the metal to the environment in laboratory, field or service tests. (3) Cleaning of the specimens preparatory to examination. (4) Examination of the specimens or the corrosive for the effects of corrosion; other measurements which indicate the tendency to corrode rather than the effects of corrosion, and special tests, are considered separately. (5) The expression and interpretation of results, with particular reference to the form of the corrosion/time curve. There is a general introduction to each sub-section, and then more detailed information and advice are given.

It is significant that this book, which takes in so much territory, does not mention ceramics at all. This omission serves to emphasise strongly the great advantage of ceramics for many purposes—that they are not corrosively attacked by an acid, with the one exception of hydrofluoric acid.

This book should be of great help to those working practically on corrosion problems, and its value will be enhanced if the Dechema tables are also available for reference.—FELIX SINGER.

WILHELM OSTWALD (Julius Robert Mayer über Auslösung). Edited by Alwin Mittasch. Verlag Chemie, Weinheim/Bergstrasse. 1953. Pp. 56. DM. 2.50.

In 1842, Robert Mayer, one of the originators of the mechanical theory of heat, coined the dictum 'causa aequat effectum' to describe processes involving energy and heat. However, Mayer realised that there are many processes in which the 'effect' seems to bear no quantitative relation to the 'cause.' For example, a small spark passed through an explosive mixture of gases may produce a tiny pop or a powerful explosion—the result does not depend on the size of the spark. Similarly the ultimate size of a fire does not depend on the size of the flame which lit it. Mayer discussed processes of this sort in an article published in 1876, and proposed the term 'Auslösung' (initiation) to describe the relation between cause and effect in these cases. In a critical essay written in 1914, Ostwald analysed Mayer's concept in detail and discussed the mechanisms by which 'Auslösung' takes place. This little book contains Ostwald's essay (published for the first time) together with Mayer's original article. It should give much pleasure to those who are fascinated by elegant ideas and theories.—J.C.P.S.

Determination of Alcohol

A REPORT on the determination of alcohol in blood and urine has been prepared by a panel of analysts appointed by the Royal Institute of Chemistry to assist the Alcohol and Road Accidents committee of the British Medical Association in the preparation of their report on 'Recognition of Intoxication' (about to be published).

The report of the panel will be surveyed in a paper by Dr. D. W. Kent-Jones and Mr. G. Taylor at a joint meeting of the Society of Public Analysts and Other Analytical Chemists and the Royal Institute of Chemistry at the Institution of Electrical Engineers, Savoy Place, London, on 20 January next at 6 p.m.

HOME

Chemical Industry in Scotland

The importance of developing in Scotland such industries as the chemical and electronic industries was emphasised by Mr. W. S. Robertson, technical and deputy secretary of the Scottish Council (Development & Industry) when addressing a recent meeting of the Edinburgh Fabian Society on 'The Future of Scotland in a Changing World.'

The George E. Davis Memorial Lecture

Mr. Norman Swindin will deliver the George E. Davis Memorial Lecture at a meeting of the Institution of Chemical Engineers in the apartments of the Geological Society, Burlington House, Piccadilly, on 5 January at 5.30 p.m. Members' guests will be welcome. The paper on mechanical handling that was arranged to be presented on this date has been withdrawn.

Directorate Closing

The Ministry of Materials announces that, in view of the revocation at the end of this year of the statutory controls on sulphuric acid and on sulphur used in its manufacture, the Directorate of Sulphuric Acid and Sulphur Supplies at Lacon House, Theobalds Road, London, W.C.1, will be closed on 31 December, 1953. From 1 January, 1954, any inquiries on matters previously dealt with by the Directorate should be addressed to the Ministry of Materials, Branch 2A, Horse Guards Avenue, Whitehall, S.W.1.

Corrosion of Iron & Steel

Methods of protecting iron and steel against corrosion will be demonstrated to the public in the Great Hall, Battersea Polytechnic, from 10 a.m. to 4.30 p.m. on Friday, 22 January. The exhibition will be on view during the previous day to members of the Corrosion Group of the Society of Chemical Industry, by whom it is being organised. Some 30 exhibits will demonstrate the most important methods and processes for the prevention of corrosion of iron and steel in five main sections. Although many individual firms are participating, this is not a trade exhibition, but a demonstration of protective processes. Admission is free, and no tickets will be necessary.

Technical College Extension

Building of the £900,000 extension of Salford Technical College will begin next April. The first stage of the five storey wing includes a basement and part of the back of the main building. This will cost £280,000. The site adjoins Peel Park.

Suppliers' New Branch

J. W. Towers & Co Ltd., the laboratory suppliers, of Widnes, announce that they will be opening a new area branch on 1 January at Wallingford Road, Industrial Estate, Uxbridge (Tel.: Uxbridge 8461). Comprehensive stocks have been made available at this branch, which will serve London and all the home counties.

Magnesium Control Ending

The Magnesium Distribution (Revocation) Order, 1953 (S.I. 1953/1850), which has been made by the Minister of Supply, Mr. Duncan Sandys, revokes the Magnesium Distribution Order, 1951 (S.I. 1951/891) and with effect from 1 January next removes all control on the acquisition, disposal, treatment, use and consumption of virgin magnesium and virgin magnesium alloys.

Cosmetic Chemists' Lectures

Further lectures to be given this session to the Society of Cosmetic Chemists of Great Britain are: 'Colour & Colour Vision,' by Professor W. D. Wright on 5 February, and 'Talking of Perfumes,' by Mr. J. Pickthall on 5 March, 1954. Both are being held at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1, at 7 p.m.

Particle Size Analysis

As already announced, the Institute of Physics will hold a conference on 'The Physics of Particle Size Analysis' at Nottingham from 6-9 April next. Sessions have now been arranged to deal with the following subjects:—'The Motion of Particles in Fluids'; 'The Scattering of Light by Particles'; 'The General Phenomena Encountered in Particles Size Analysis'; and 'The Comparison of Methods and the Automatised Methods of Particle Counting and Sizing.'

OVERSEAS

Science Conference

Eminent scientists from all over the world are expected to attend the Sixth Annual Session of the Pakistan Science Conference which is opening in Karachi on 18 January.

New Uranium Find

What is described as 'an important new source' of uranium has been reported from the Norseman area of Western Australia, about 350 miles from Perth. The discovery was made by a geologist, Mr. L. de la Hunty.

Wolfram Deposits in Turkey

Studies by the Turkish Mineral Research and Exploration Institute have established that a new wolfram mine discovered in the mountains near Edremit, in the Marmara region, contains the richest deposits found in the world so far. The wolfram content is 7.51 per cent. Another wolfram mine at Uludag, also in the Marmara region, is being exploited by the State.

Oil in the Argentine

In a radio speech on the Argentine National Oil Day, President Peron announced that the total production of oil will have increased by 15 per cent during the current year, in comparison with last year's figures, it being possible that in view of the recent discoveries in Mendoza and Plaza Huincul, the fiscal production will exceed 4,000,000 cu. metres during 1954. He then mentioned six newly-discovered oil deposits: three in Neuquen, one in Salta, one in Mendoza, and one in Caletta Olivia.

Carob Bean Study

Experts are now studying ways and means of developing a carob or locust bean (*Ceratonia siliqua*) industry in Sicily. The modernising of existing plants for processing the bean is being considered and the need for new plants is being contemplated. In addition to the many known uses a number of other possibilities are being investigated. In addition to the gum and oil which is prepared from the endosperm of the bean, it is possible that alcohol, colouring matters and coffee substitutes may be produced from the plant.

New Copper Mill

A Quebec Copper Corporation 700-ton copper mill near Sherbrooke, Quebec, is to begin operations in January.

Antimony Ore Dearer

A slight increase in the price of antimony ore is reported from New York. The latest quotation is $2.25-2.65 per unit of 20 lb. of antimony contained, 50-55 per cent, against the previous price of $2.55-2.60.

Australian Oil Strike

Drilling is reported to have been resumed at the site near Exmouth Gulf, about 700 miles north of Perth, where oil was struck recently (see THE CHEMICAL AGE, 12 December, p. 1238). The hole has now reached 4,254 ft. The sands which produced the oil were between 3,605 and 3,620 ft.

Bone Meal in India

As part of their grow-more-food campaign, the Government of India have been trying to develop the use of bone meal by farmers and other growers. A new type of bone-digester has been evolved and steps are being taken to popularise it, particularly in Indian Community Project areas.

Copper in Manitoba

Drilling in Manitoba has developed a new mineral area near Flin Flon, according to an announcement by the Hudson Bay Mining & Smelting Co. The mine consists of two parallel ore-bodies, one of which is estimated to contain 70,000 tons of 10 per cent copper ore and the other 180,000 tons of 4 per cent copper ore.

British Guiana Bauxite Exports

Exports of bauxite from British Guiana during 1952 totalled 2,285,966 tons, an increase of 717,778 tons on the previous year's figures and valued at £4,600,000. All bauxite exported from British Guiana—where it has been produced since 1917—is subject to an export duty at the rate of 4s. 2d. a ton of calcinated ore and of 1s. 10½d. a ton on other bauxite. Royalty ranging from 5d. to 1s. 0½d. a ton is also payable on bauxite gained from certain land where mineral rights are vested in the Crown.

PERSONAL

The Dunlop Rubber Co., Ltd., have announced these appointments in their general rubber goods division as from 1 January: MR. S. A. MOUSLEY, sales manager, to be general sales manager; MR. P. A. BRIDGE to be sales manager of the mechanical group; and MR. A. B. RANKINE to be sales manager of the domestic group.

MR. DENNIS SUTTON, of Four Throws, Kings Newton, Melbourne, Derbyshire, has been appointed to the board of Loughborough Glass Co. Ltd. This firm is a subsidiary of Genatosan Ltd., of Loughborough, and manufactures laboratory and industrial glassware and also supplies a complete range of general laboratory apparatus. Mr. Sutton joined the company as general manager on 1 December, 1952, and was elected a director at a board meeting on 7 December, 1953.

MR. GEORGE WOOD, chairman of Thos. Ward Ltd., since 1950, is retiring from that position on 1 January next. Joining the staff in 1897, Mr. Wood was appointed a local director in 1919, a full director in 1923 and managing director in 1941. In recognition of his long service he has been appointed vice-president of the company. He is a director of a number of subsidiary and associated companies.

Mr. Wood will be succeeded as chairman of the parent concern by MR. HAROLD SECKER, now joint managing director, who is also a director of Parkgate Iron & Steel Co., Ltd., and of a number of companies in the Thos. W. Ward group. He was appointed a local director of Thos. W. Ward Ltd., in 1936, a full director in 1938, assistant managing director in 1944 and joint managing director in 1950.

MR. ARNOLD CARR, who, like Mr. Secker, has been with the company since boyhood, has been appointed assistant managing director. He became a local director in 1936 and a full director in 1941; he is also director of several subsidiary and associated companies in the group. MR. RAWSON F. STAGG, a local director since 1947, now becomes a full director. He, too, is also director of certain subsidiary companies.

DR. W. MASKILL, B.Sc., A.R.C.S., F.S.G.T., has been elected chairman of the executive committee of the Glass Manufacturers' Federation. Dr. Maskill is joint managing director of Messrs. Webb Corbett, of Stourbridge, manufacturers of lead crystal domestic glass. He is a graduate of Sheffield University and has been connected with the glass industry for many years.

MR. L. E. NORTON has been elected vice-chairman for the ensuing year. He is managing director of The City Glass Bottle Company Limited and a director of Key Glassworks Limited.

Obituary

MR. JOHN WATSON NAPIER, formerly a prominent figure in the Scottish gas industry, whose death occurred recently, was a fellow of the Chemical Society and of the Royal Scottish Society of Arts, and a member of the Society of Chemical Industry and of the Institution of Chemical Engineers. After studying chemistry and engineering at the Heriot-Watt College, Edinburgh, he received his early training at Crieff Gas Works. He then entered the shale oil industry, holding posts with oil firms in Loanhead and Addiewell. In 1896 he was appointed gas manager in Auchterarder and held a similar post in Carnoustie from 1899 to 1902. His next appointment was as engineer and manager of Alloa Gas Department, from which he retired in 1942.

The death has occurred of MR. JOSEPH M. MALBEN, of Lesson Park, Dublin. At one time he carried on business as a chemical importer and laboratory supplier, and was later associated with Lennox Chemicals Ltd. He retired some years ago because of failing health.

MR. JAMES H. MUIRHEAD, who for 45 years was associated with the selling side of the chemical industry, has died at Newport. He was with Arthur and Hinshaw Ltd. for many years and continued with I.C.I. Ltd., as Dundee area representative. Later he became dyestuffs area sales manager based on Edinburgh. He retired a year ago.

Publications & Announcements

THE increasing demand by the coal, gas, engineering, and other industries for conveyor and power transmission belting, including vee belts, has led the Dunlop Rubber Co. Ltd. to form a new belting division at their Speke factory which, as from 1 January, will take over technical development, manufacture and sales from the general rubber goods division. Mr. H. S. Gifford, manager of the industrial rubber products department of the general rubber goods division, has been appointed sales manager of the new division, and Mr. N. F. Twigg, assistant in the general rubber goods technical service department, its technical service manager. 'The step has been taken,' says Mr. Gifford, 'because of the growing importance of conveyor belting in industry generally, and because it was felt that by specialisation speedier and more efficient technical advisory and supply service could be given by concentrating all the company's belting activities in one self-contained division.'

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THE 131st issue of 'Aero Research Technical Notes' issued by the technical service department of Aero Research, Ltd., Duxford, Cambridge, is devoted to an article entitled 'Recent Developments in Ethoxyline Resins,' by Dr. J. B. D. MacKenzie, who is chief chemist to the company. The article originally appeared in *Adhesives & Resins* and is reproduced by permission. After explaining the chemical structure of ethoxyline resins, the author describes new forms of 'Araldite' (a registered trade name), which are now available for evaluation. Forms of the resin have been described in Technical Notes Nos. 66, 85, 107, 117, 123 and 129, copies of which are available on request to the company.

* * *

UNTIL about the beginning of the first World War, the word 'detergent' was almost exclusively confined to the vocabulary of the pedant as a synonym for 'soap.' Now it is included in common speech and moreover is used colloquially to describe those substances other than soap that have become available during the past 25 years as substitutes for soap. Much of the impetus for the new detergent industry arose in Germany during the 1914-18 war, when the shortage of natural fats—the raw materials from which soap is made—led to the search for *ersatz* materials. This shortage provided at the same time an opportunity for overcoming some of the serious disadvantages in the use of ordinary soap, resulting from its instability to hard water and to acid. The fundamental principles which have guided this work are reviewed in 'Detergent Solutions,' a monograph just published by the Royal Institute of Chemistry. The author, Dr. Kenneth G. A. Pankhurst, also examines the physico-chemical properties of detergent solutions, thus making possible an explanation of their characteristic behaviour.

* * *

MOST of the material for the latest issue of 'Road Tar,' the quarterly publication of the British Road Tar Association, 9 Harley Street, London, W.1, was provided by the International Road Tar Conference held earlier this year. There is also a brief summary of the main activities of the association for the year ended 30 June. The current programme of research which is being undertaken by the Road Research Laboratory of the DSIR under its arrangement with the BRTA is stated to be directed to improving the quality of road tar for use in open-textured carpets and dense tar surfacings, and to improving methods of using road tar in various types of surfacing materials.

* * *

BELIEVED to be the first of its kind to be published, a booklet just issued by the Anglo-Iranian Oil Co., Ltd., Britannic House, Finsbury Circus, London, E.C.2, takes the form of a pictorial review of some of the world-wide operations of the Anglo-Iranian group during 1953. Entitled 'News in Pictures,' it is extremely well produced and will do much to enlighten stockholders, employees and others as to the group's activities. A foreword points out that as every aspect of the international petroleum industry is included in the operations of the group, many pictures of interest had to be omitted. The company intends issuing a similar booklet every year in future.

British Chemical Prices

LONDON.—Conditions on the industrial chemicals market have been quiet under the influence of the Christmas holiday, but a fair inquiry for contract replacement business has been reported. Prices generally remain steady and at the time of going to press there is no information of any change in contract rates for 1954. The supply position is fairly easy but one or two commodities are scarce in relation to the immediate demand. Most of the coal tar products are moving steadily with the undertone remaining firm.

MANCHESTER.—The Manchester chemical market during the past week has been unmistakably under seasonal influences. Only a limited amount of new business has been placed in the bread-and-butter lines and it is expected it will be about a fortnight before the market gets into its stride again. On the other hand, contract deliveries up to the time of writing have kept up reasonably well, though the influence of coming stocktaking operations is making itself felt in some directions. In fertilisers the demand at the moment is on the quiet side, while in the tar products fair deliveries in most sections have again been reported.

GLASGOW.—A slightly quieter tone has been evident in the market during the past week but generally speaking trading has been better than one would normally expect at this time of the year, and the position remains very satisfactory.

General Chemicals

Acetic Acid.—Per ton : 80% technical, 1 ton, £86. 80% pure, 10 tons, £92 ; commercial glacial 10 tons, £94 ; delivered buyers' premises in returnable barrels ; in glass carboys, £7 ; demijohns, £11 extra.

Acetic Anhydride.—Ton lots d/d, £138 per ton.

Acetone.—Small lots : 5 gal. drums, £143 per ton ; 10 gal. drums, £125 per ton. In 40/50 gal. drums less than 1 ton, £105 per ton ; 1 to 9 tons, £105 per ton ; 10 to 49 tons, to £103 per ton ; 50 tons and over, £102 per ton.

Alcohol BSS, Butyl.—£161 per ton in 10-ton lots.

Alcohol, Ethyl.—300,000 gal. lots, d/d., 2s. 11d. per proof gallon ; 100,000 and less than 200,000 gal. lots, d/d, 3s. per proof gallon.

Alum.—Ground, about £23 per ton, f.o.r. MANCHESTER : Ground, £25.

Aluminium Sulphate.—Ex works, £14 15s. per ton d/d. MANCHESTER : £14 10s. to £17 15s.

Ammonia. Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate.—2 cwt. non-returnable drums ; 1 ton lots £58 per ton.

Ammonium Chloride. — Grey galvanising, £31 5s. per ton, in casks, ex wharf. Fine white 98%, £25 to £27 per ton. See also Salammoniac.

Ammonium Nitrate.—D/d, £18 to £20 per ton.

Ammonium Persulphate. — MANCHESTER : £6 5s. per cwt. d/d.

Ammonium Phosphate.—Mono- and di-, ton lots, d/d, £93 and £91 10s. per ton.

Antimony Sulphide.—Golden, d/d in 5-cwt. lots as to grade, etc., 2s. 2d. to 2s. 8d. per lb. Crimson, 3s. 4½d. to 4s. 5¼d. per lb.

Arsenic.—Per ton, £59 5s. nominal, ex store.

Barium Carbonate.—Precip., d/d ; 2-ton lots, £35 5s. per ton, bag packing.

Barium Chloride.—£42 5s. per ton in 2-ton lots.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £38 per ton d/d ; 2-ton lots, £38 5s. per ton d/d.

Bleaching Powder.—£21 per ton in casks (1 ton lots).

Borax.—Per ton for ton lots, in free 140-lb. bags, carriage paid : Anhydrous, £58 10s.; in 1-cwt. bags ; commercial, granular, £38 10s. ; crystal, £41 ; powder, £42 ; extra fine powder, £43 ; B.P., granular, £47 10s. ; crystal, £50 ; powder, £51 ; extra fine powder, £52.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid : Commercial, granular, £67 ; crystal, £75 ; powder, £72 10s. ; extra fine powder, £74 10s. ; B.P., granular, £80 ; crystal, £84 10s. ; powder, £87 ; extra fine powder, £86 10s.

Butyl Acetate BSS.—£173 per ton, in 20-ton lots.

***sec.* - Butyl Alcohol.**—5 gal. drums £159 ; 40 gal. drums : less than 1 ton £124 per ton ; 1 to 10 tons £123 per ton ; 10 tons and over £122 per ton ; 100 tons and over £120 per ton.

***tert.* - Butyl Alcohol.**—5 gal. drums £195 10s. per ton ; 40/45 gal. drums : less than 1 ton £175 10s. per ton ; 1 to 5 tons £174 10s. per ton ; 5 to 10 tons, £173 10s. ; 10 tons and over £172 10s.

Calcium Chloride.—70/72% solid £12 10s. per ton.

Chlorine, Liquid.—£32 per ton d/d in 16/17-cwt. drums (3-drum lots).

Chromic Acid.—2s. 0½d. to 2s. 0¾d. per lb., less 2½%, d/d U.K.

Citric Acid.—1-cwt. lots, 205s. cwt. ; 5-cwt. lots, 200s. cwt.

Cobalt Oxide.—Black, delivered, 13s. per lb.

Copper Carbonate.—MANCHESTER : 2s. 3d. per lb.

Copper Sulphate.—£74 per ton f.o.b., less 2% in 2-cwt. bags.

Cream of Tartar.—100%, per cwt., about £9 12s.

Diacetone Alcohol.—Small lots : 5 gal. drums, £162 per ton ; 10 gal. drums, £172 per ton. In 40/45 gal. drums ; less than 1 ton, £142 per ton ; 1 to 9 tons, £141 per ton ; 10 to 50 tons, £140 per ton ; 50 to 100 tons, £139 per ton ; 100 tons and over, £138 per ton.

Ethyl Acetate.—10 tons lots, d/d, £135 per ton.

Formaldehyde.—£37 5s. per ton in casks, d/d.

Formic Acid.—85%, £82 10s. in 4-ton lots, carriage paid.

Glycerine.—Chemically pure, double distilled 1.260 S.G., £14 7s. 6d. per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hydrochloric Acid.—Spot, about 12s. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—27.5% wt. £124 10s. per ton. 35% wt. £153 per ton d/d. Carboys extra and returnable.

Iodine.—Resublimed B.P., 16s. 4d. per lb. in 28 lb. lots.

Iodoform.—25s. 10d. per lb. in 28 lb. lots.

Lactic Acid.—Pale tech., 44 per cent by weight £122 per ton ; dark tech., 44 per cent by weight £67 per ton ex works 1-ton lots ; dark chemical quality 44 per cent by weight £109 per ton, ex works ; usual container terms.

Lead Acetate.—White : About £136 per ton.

Lead Nitrate.—About £116 per ton.

Lead, Red.—Basis prices per ton. Genuine dry red lead, £122 ; orange lead, £134. Ground in oil : red, £143 15s. ; orange, £155 15s.

Lead, White.—Basis prices : Dry English, in 5-cwt. casks £140 per ton. Ground in oil : English, under 2 tons, £155.

Lime Acetate.—Brown, ton lots, d/d, £40 per ton ; grey, 80-82%, ton lots, d/d, £45 per ton.

Litharge.—£122 per ton, in 5-ton lots.

Magnesite.—Calcined, in bags, ex works, £22 to £24.

Magnesium Carbonate.—Light, commercial, d/d, 2-ton lots, £84 10s. per ton, under 2 tons, £92 per ton.

Magnesium Chloride.—Solid (ex wharf), £14 10s. per ton.

Magnesium Oxide.—Light, commercial, d/d, under 1-ton lots, £245 per ton.

Magnesium Sulphate.—£15 to £16 per ton.

Mercuric Chloride.—18s. 3d. per lb. in 5 cwt. lots ; smaller quantities dearer.

Mercury Sulphide, Red.—22s. 3d. per lb., for 5-cwt. lots.

Methanol.—Pure synthetic, d/d, £28 to £38 per ton.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 5s. 4½d. per gal. ; pyridinised 64° O.P. 100 gal., 5s. 6½d. per gal.

Methyl Ethyl Ketone.—10-ton lots, £141 per ton del.

Methy *iso*Butyl Ketone.—10 tons and over £162 per ton.

Nickel Sulphate.—D/d, buyers U.K. £154 per ton. Nominal.

Nitric Acid.—£35 to £40 per ton, ex-works.

Oxalic Acid.—Home manufacture, in 5-cwt. casks, £139 per ton, carriage paid.

Phosphoric Acid.—Technical (S.G. 1.700) ton lots, carriage paid, £87 per ton ; B.P. (S.G. 1.750), ton lots, carriage paid, 1s. 3½d. per lb.

Potash, Caustic.—Solid, £94 10s. per ton for 1-ton lots ; Liquid, £37 15s.

Potassium Bichromate.—Crystals and granular, 11§d. per lb. ; ground, 1s. §d. per lb., standard quantities.

Potassium Carbonate. — Calcined, 96/98%, £59 10s. per ton for 1-ton lots, ex-store.

Potassium Chloride.—Industrial, 96%, t-ton lots, £23 to £25 per ton.

Potassium Iodide.—B.P., 14s. 10d. per lb. in 28-lb. lots ; 14s. 4d. in cwt. lots.

Potassium Nitrate.—Small granular crystals, 81s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 9½d. per lb. for 1-cwt. lots ; for 3 cwt. and upwards, 1s. 8½d. per lb. ; technical, £8 11s. 6d. per cwt. ; for 5 cwt. lots.

***iso*Propyl Alcohol.**—Small lots : 5 gal. drums, £118 per ton ; 10-gal. drums, £108 per ton ; in 40-45 gal. drums ; less than 1 ton, £83 per ton ; 1 to 9 tons £81 per ton ; 10 to 50 tons, £80 10s. per ton ; 50 tons and over, £80 per ton.

Salammoniac.—Dog-tooth crystals, £70 per ton ; medium, £67 10s. per ton ; fine white crystals, £21 10s. to £22 10s. per ton, in casks.

Salicylic Acid. — MANCHESTER : Technical 2s. 7d. per lb. d/d.

Soda Ash.—58% ex-depot or d/d, London station, about £14 3s. per ton.

Soda, Caustic.—Solid 76/77% ; spot, £25 to £27 per ton d/d. (4 ton lots).

Sodium Acetate.—£70 to £75 per ton d/d.

Sodium Bicarbonate.—Refined, spot, £13 10s. to £15 10s. per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 9¾d. per lb. ; anhydrous, 11¼d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite.—Powder, 60/62%, £40 per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£25 per ton d/d in minimum ton lots in 2-cwt. free bags.

Sodium Chlorate.—£75 15s. to £82 per ton.

Sodium Cyanide.—100% basis, 9¾d. to 10¾d. per lb.

Sodium Fluoride.—D/d, £4 10s. per cwt.

Sodium Hyposulphite.—Pea crystals £28 a ton ; commercial, 1-ton lots, £26 per ton carriage paid.

Sodium Iodide.—B.P., 16s. 4d. per lb. in 28-lb. lots.

Sodium Metaphosphate (Calgon).—Flaked, loose in metal drums, £123 ton.

Sodium Metasilicate.—£22 15s. per ton, d/d U.K. in ton lots.

Sodium Nitrate.—Chilean Industrial, over 98% 6-ton lots, d/d station, £27 10s.

Sodium Nitrite.—£31 per ton (4-ton lots).

Sodium Percarbonate.—12½% available oxygen, £8 2s. 10½d. per cwt. in 1-cwt. drums.

Sodium Phosphate.—Per ton d/d for ton lots : Di-sodium, crystalline, £37 10s., anhydrous, £78 10s. ; tri-sodium, crystalline, £39 10s., anhydrous, £75 10s.

Sodium Prussiate.—1s. to 1s. 1d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Sulphate (Glauber's Salt).—£10 per ton d/d.

Sodium Sulphate (Salt Cake).—Unground. £6 per ton d/d station in bulk. MANCHESTER : £6 10s. per ton d/d station.

Sodium Sulphide.—Solid, 60/62%, spot, £31 per ton, d/d, in drums ; broken, £32 per ton, d/d, in drums.

Sodium Sulphite.—Anhydrous, £59 per ton ; pea crystals, £37 12s. 6d. per ton d/d station in kegs ; commercial, £23 7s. 6d. per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £22 16s. 6d. to £25 6s. according to fineness.

Tartaric Acid.—Per cwt. : 10 cwt. or more, £10 10s.

Titanium Oxide.—Standard grade comm., with rutile structure £143 per ton ; standard grade comm., £130 per ton.

Zinc Oxide.—Maximum price per ton for 2-ton lots, d/d : white seal, £92 10s. ; green seal, £91 10s. ; red seal, £90.

Rubber Chemicals

Antimony Sulphide.—Golden, 2s. 3¼d. to 3s. 1½d. per lb. Crimson, 3s. 4¼d. to 4s. 5¼d. per lb.

Carbon Bisulphide.—£60 to £65 per ton, according to quality.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Tetrachloride.—Ton lots, £74 10s. per ton.

India-rubber Substitutes.—White, 1s. 6¾d. to 1s. 10¼d. per lb. ; dark, 1s. 4½d. to 1s. 8d. per lb.

Lithopone.—30%, £50 per ton.

Mineral Black.—£7 10s. to £10 per ton.

Sulphur Chloride.—British, £55 per ton.

Vegetable Lamp Black.—£64 8s. per ton in 2-ton lots.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, £16 2s. 6d.

Compound Fertilisers.—Per ton in 6 ton lots, d/d farmer's nearest station, I.C.I. Special No. 1 £27 9s.

'Nitro-Chalk.'—£12 9s. 6d. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean agricultural for 6-ton lots, d/d nearest station, July to September, £26 5s. per ton ; October to November, £26 7s. 6d. per ton.

Coal-Tar Products

Benzole.—Per gal., minimum of 200 gals., ex-works, 90's, 3s. 0¾d. ; pure, 3s. 4d. ; nitration grade, 3s. 7d.

Carbolic Acid.—Crystals, 1s. 4d. to 1s. 6¼d. per lb. Crude, 60's, 8s. MANCHESTER : Crystals, 1s. 4½d. to 1s. 6¼d. per lb., d/d crude, 8s. naked, at works.

Creosote.—Home trade, 1s. to 1s. 4d. per gal., according to quality, f.o.r. maker's works. MANCHESTER : 1s. to 1s. 8d. per gal.

Cresylic Acid.—Pale 99/99½%, 5s. 8d. per gal. ; 99.5/100%, 5s. 10d. American, duty free, for export, 5s. to 5s. 8d. naked at works.

Naphtha.—Solvent, 90/160°, 4s. 10d. per gal. for 1000-gal. lots ; heavy, 90/190°, 3s. 9½d. per gal. for 1000-gal. lots, d/d. Drums extra : higher prices for smaller lots.

Naphthalene.—Crude, 4-ton lots, in sellers' bags, £14 12s. to £22 per ton, according to m.p. ; hot pressed, £28 per ton in bulk ex-works ; purified crystals, £53 per ton d/d.

Pitch.—Medium, soft, home trade, 160s. per ton f.o.r. suppliers' works ; export trade, 230s. per ton f.o.b. suppliers port.

Pyridine.—90/160°, 32s. 6d. to 35s. per gal. MANCHESTER : 42s. 6d. to 45s. per gal.

Toluol.—Pure, 5s. 7d. ; 90's, 4s. 10d. per gal., d/d. MANCHESTER : Pure, 5s. 8d. per gal. naked.

Xylol.—For 1000-gal. lots, 5s. 8d. to 5s. 10d. per gal., according to grade, d/d.

Intermediates and Dyes (Prices Nominal)

***m*-Cresol** 98/100%.—3s. 9d. per lb. d/d.

***o*-Cresol** 30/31° C.—1s. 4d. per lb. d/d.

***p*-Cresol** 34/35° C.—3s. 9d. per lb. d/d.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—88/89°C., 1s. 11d. per lb.

Dinitrotoluene.—S.P. 15° C., 1s. 11½d. per lb. ; S.P. 26° C., 1s. 3d. per lb. S.P. 33°C., 1s. 1½d. per lb. ; S.P. 66/68°C., 1s. 9d. per lb.

***p*-Nitraniline.**—4s. 5½d. per lb.

Nitrobenzene.—Spot, 9¼d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyers' works.

Nitronaphthalene.—2s. per lb.

***o*-Toluidine.**—1s. 7d. per lb., in 8/10-cwt. drums, drums extra.

***p*-Toluidine.**—5s. 6d. per lb., in casks.

Dimethylaniline.—3s. 1d. per lb., packed in drums, carriage paid.

Law & Company News

Commercial Intelligence

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

Increases of Capital

The following increases of capital have been announced:—REID, ROWLETT & CO., LTD., from £100 to £1,000; STEAD PRODUCTS LTD., from £1,000 to £5,000.

New Registrations

David Davies & Son (Chemical Supplies) Ltd.

Private company. (526,132.) Capital £3,000. Manufacturers' agents, manufacturers of and dealers in proprietary medicines, emulsions, drugs, chemicals, etc. Directors: David Davies and Mrs. Dina Davies, 3 Whitehall Place, Rumney, Cardiff.

Maurice Cagen Ltd.

Private company. (526,301.) Capital £3,000. Manufacturing, pharmaceutical, photographic and general chemists, druggists, etc. First directors to be appointed by the subscribers. Reg. office: 306 Kirkstall Road, Leeds 4.

Eyerene Ltd.

Private company. (526,457.) Capital £100. Manufacturers of and dealers in fine chemicals and chemical products, etc. Directors: Frank A. Fox and Herbert Perkin. Reg. office: 9 Richmond Chambers, Bournemouth.

Amadine Manufacturing Co. Ltd.

Private company. (526,707.) Capital £100. Manufacturers, processers and dealers in animal and vegetable adhesives and adhesive substances of all kinds; manufacturers of and dealers in oils, paints, pigments and varnishes, etc. Directors: Albert C. H. Robinson and Laude H. L. Saunders, directors of Gloy & Empire Adhesives Ltd. Secretary: W. A. Morley. Reg. office: Acme Works, Landfield Street, Clapton, E.5.

Bostwick Laboratories Ltd.

Private company. (526,505.) Capital £100. Objects: To engage in research, development, manufacture and distribution of chemical composites, medicinal and other products and their application in aerated, air-dispersed, aerosol or other forms for use in industrial, agricultural, medical, domestic or other purposes, etc. First directors to be appointed by the subscribers. Solicitors: Stephenson Harwood & Tatham, 16 Old Broad Street, London, E.C.2.

Company News

Associated British Engineering Ltd.

The directors of Associated British Engineering Limited announce the declaration of a 3 per cent interim dividend on the ordinary stock for the year ending 31 March, 1954, payable 19 January, 1954.

Distillers Company Ltd.

The directors of the Distillers Company Ltd. have declared an interim dividend on the Ordinary capital for the year ending 31 March, 1954, at three and three-fifths pence per 4s. share, less income tax at the rate of 9s. per £, payable 27 February, 1954, to shareholders on the register at 18 December, 1953.

Midland Tar Distillers Ltd.

Group net profit of £126,821 for the year ended 30 June last is reported by Midland Tar Distillers Ltd. This compares with £130,967 for the previous twelve months and is after tax of £166,987 (£174,895) and £125,927 (£119,289) for depreciation; provision for contingent liability was nil, as against £5,000 for the previous year. A dividend of 8 per cent is proposed, which is the same as for the previous year, but is on an ordinary capital increased from £675,000 to £1,250,000 by issue last January.

Murex Ltd.

In respect of the year ending 30 April next, Murex Ltd. are maintaining the interim dividend of 6 per cent on an increased ordinary capital of £2,200,000; the interim dividend of the same amount for 1952-53 was paid on £2,000,000. The directors have informed stockholders that, as foreshadowed at the meeting in September last, the level of activities during the first six months of the current financial year was below that of recent years, when demand for the company's products was exceptionally heavy. There are indications, however, of a modest improvement during the past two months.

Chemical & Allied Stocks & Shares

THIS year has been an active one for stock markets. Values both in the gilt-edged and industrial sections have moved higher and there has been a widespread relaxation of the conservative dividend policy which had ruled since the end of the war.

The decision of many leading companies to pay out a little more in dividends to shareholders has arisen from a general recognition that it is unfair to continue to limit dividends, and that if industry is to be able to call on investors to put up new capital in the future companies must show a willingness to pay reasonable dividends in a year of favourable financial results. In fact, allowing for the increase in the cost of living many shareholders are in fact getting a smaller net return than before the war on their investments in well-known companies, even allowing for the higher dividends recently announced.

Increased Competition

Financial results of chemical and kindred companies issued this year have made a mixed showing, largely owing to increased competition both in home and export markets. In general, however, most sections of the industry have been able to report some improvement in trading conditions. Progress reports issued by a number of companies, including Monsanto, Laporte and Reichhold Chemical, and also the raising of the Imperial Chemical interim dividend from 5 per cent to 6 per cent, have been pointers to the trend in earnings.

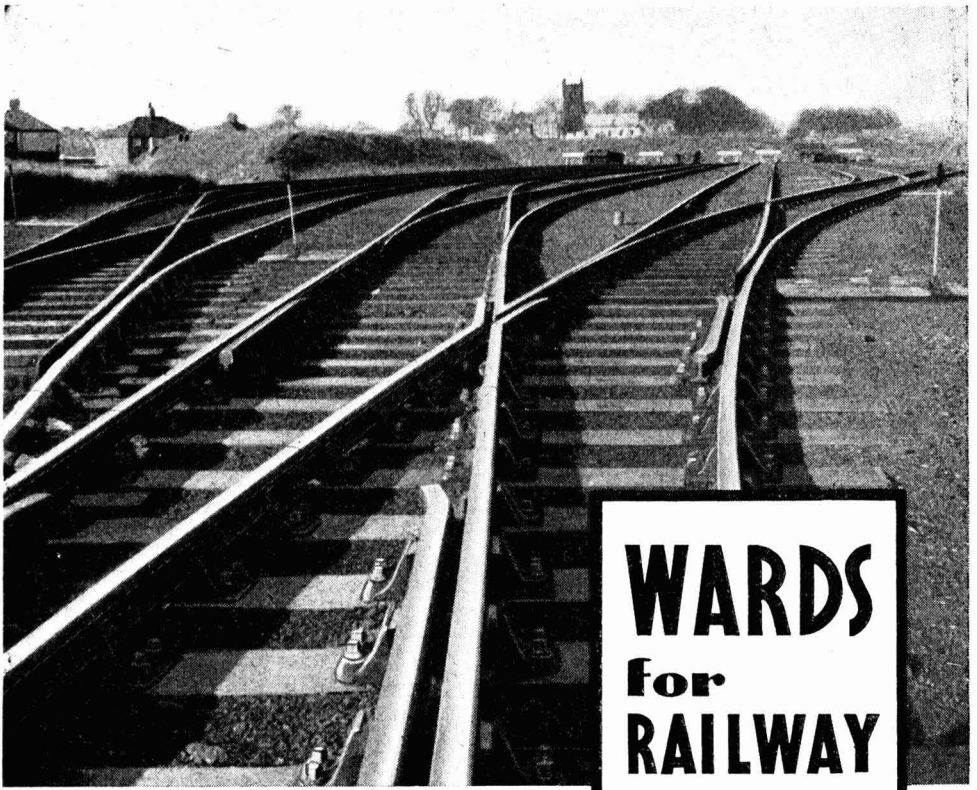
An outstanding feature was the raising of Fison's dividend from 10 per cent to 12½ per cent. At the time of writing Fisons £1 shares are quoted at 39s. 9d. They have had extreme levels of 30s. 6d. and 42s. 7½d. this year. Extremes for Imperial Chemical have been 42s. 3d. and 53s. 1½. and the current price is 52s. 9d. virtually at the year's highest. In view of the larger interim dividend, the market is assuming the total dividend may be raised from 13 per cent to 15 per cent and is also hoping that a share bonus is in prospect. Among other chemical shares, Laporte 5s. units are 12s. 3d. at the time of writing; they have been down to 9s. 9d. and up to 13s. in the past 12 months.

The following give current prices and the year's highest and lowest levels for a number of other well-known chemical shares: Monsanto 5s. units 21s. 7½d. (24s. 3d. and 20s. 4½d.). British Chrome Chemicals 5s. shares 16s. 6d. (16s. 10½d. and 15s. 3d.). Reichhold 5s. shares 7s. 4½d. (8s. 6d. and 5s. 3d.). Albright & Wilson 5s. shares 18s. 4½d. (18s. 4½d. and 15s.). Hickson & Welch shares 9s. (9s. 9d. and 9s. 4½d.). William Blythe 3s. shares 6s. (6s. 3d. and 4s. 6d.). Brotherton 10s. shares 24s. 6d. (24s. 7½d. and 21s. 9d.). Boake Roberts 5s. shares 10s. (11s. 6d. and 7s. 6d.).

Elsewhere Boots Drug 5s. units are now 22s. 4½d. compared with extreme levels this years of 23s. and 19s. Courtaulds, which have responded to the 100 per cent share bonus news and higher dividend foreshadowed by the directors, are closing the year at almost their highest level this year. They are 50s. 6d. at the time of writing. Their lowest this year has been 37s. 6d. British Celanese are now 24s. 10½d. compared with 1953 extremes of 28s. 3d. and 21s. 6d. Turner & Newall are 69s. compared with the year's extremes of 69s. 3d. and 48s. Triplex Glass 10s. shares are 21s. 9d. at the time of writing; highest and lowest this year have been 24s. 6d. and 20s. 3d. Unilever's extremes have been 58s. and 41s. compared with the current price of 55s. 9d. United Molasses, now 31s. 6d., have been up to 34s. and down to 26s. 9d. this year. The year's extremes for the 4s. units of the Distillers Co. have been 18s. 3d. and 15s. 10½d.; the current price is 17s. 6d. Oils have been prominent. Anglo-Iranian are 170s. at the time of writing, the year's highest. Shell at 97s. 6d. are almost at their peak level on market expectations of a higher interim dividend in January. Earlier this year they were 76s. 3d.

Fire at Oil Refinery

A small fire occurred early in the morning of Tuesday, 22 December, in the percolation department at the Vacuum Oil Company's refinery at Coryton, Essex. No one was injured and the fire was extinguished in 15 minutes. Some damage was caused to the continous percolation unit, which was due to come into production shortly. Repairs to the damaged unit were started immediately.



WARDS For RAILWAY SIDINGS

IN the planning and construction of railway sidings, Wards offer a high degree of technical skill and experience. Wards have been building sidings for nearly half a century and thus bring to the subject an extensive knowledge of a variety of operating conditions. Similarly, in the supply of railway equipment generally, Wards Rail Department service covers new and re-usable rails of all normal sections, as well as switches, crossings, turnouts, buffer stops, etc. Associated supplies include colliery arches, pit props, roofing bars, floor plates, and, of course, all manner of track accessories and tools.

In short, Wards have a comprehensive service on every aspect of railway siding planning, construction and maintenance for industrial operation.

The layout illustrated above shows a ladder of sidings at the Primrose Hill Unit of the National Coal Board, by whose courtesy the photograph is reproduced.

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SC/23

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.

JOHNSON MATTHEY & CO., LIMITED, Refiners of Precious and Rare Metals, have vacancies for **PRODUCTION CHEMISTS** in their works in the North London area. Candidates should be between the ages o 25 and 35, have an Honours Degree in Chemistry, Chemical Engineering or Metallurgy, or equivalent qualification, and preferably five years' works experience. Write, giving full particulars of age, qualifications and experience and salary required, to the **SECRETARY** at **78, HATTON GARDEN, LONDON, E.C.1.**

METALLURGICAL ASSISTANT required for the investigation of material problems associated with highly stressed structures. Higher National Standard in Metallurgy or Engineering. Apply in writing ,stating age, experience, and present salary, to **ELECTRO-HYDRAULICS, LIMITED, WARRINGTON.**

FOR SALE

CHARCOAL, ANIMAL AND VEGETABLE horticultural, burning, filtering, disinfecting, medicinal, insulating ; also lumps ground and granulated; established 1830 ; contractors to H.M. Government.— **THOS. HILL-JONES, LTD., "INVICTA" WORKS, BOW COMMON LANE, LONDON, E. TELEGRAMS : "HILL-JONES, BOCHURCH LONDON." TELEPHONE 3285 EAST.**

ECONOMIC BOILERS, 10 ft. Danks. 12,000 lb. evap, 250 lb. pressure ; 8 ft. diam. by 14 ft. Paxman. 180 lb. w.p. Twenty others, all sizes.
Whessoe Open Top Riveted Steel **MIXING TANK** 13 ft. diam., by 15 ft. deep, 9/16 in. plate.
NEW GALVANISED PIPING. Immediate delivery.
Johnson Filter **PRESSES,** 25 in., 18 Frame, practically new.
TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS.**
ONE Stainless **CONICAL HOPPER,** 7 ft. 3 in. diam., overall depth, 7 ft. 6 in.
TWO Broadbent **WATER-DRIVEN CENTRIFUGES,** 30 in. diam., 12 in. deep, 1,150 r.p.m., 150 lb. pressure.
SIX O.T. TANKS, 7 ft. diam., 14 ft. deep, rubber and brick lined.
Six Aluminium CONDENSERS, 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ¾ in. o.d.
FORTY Riveted **RECEIVERS,** 8 ft. 6 in. long, 5 ft. 6 in. diam., 75 lb. w.p.
CAST-IRON PIPES. 800 yds. 6 in. ; 400 yds. 8 in. **NEW.**
VALVES in Stainless, Gunmetal, Enamel Lined.
Free Catalogue. "Watkins Machinery Record," available

FRED WATKINS, (BOILERS) LTD.,
COLEFORD, GLOS.

FROM STOCK—300 lb. beta-Chloropropionyl Chloride, 1 ton Calcium Hydride, 1 ton 2-Nitro Propane. Send offers to **BOX NO. C.A. 3283, THE CHEMICAL AGE, '54, FLEET STREET, LONDON, E.C.4.**

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C.I. FILTER PRESS, 25½ in. square, by **MANLOVE ALLIOTT,** plate and frame type, 13 chambers, arranged for washing. Excellent condition.
TWO HYDRO EXTRACTORS, 72 in., by **BROADBENT.** (One new and unused.)
TWO "HORMANN" 30 cm. Stainless Steel **FILTER PRESSES.**
STORAGE BINS in stainless steel, cylindrical, with covers. 40/12/14/10 gallons capacity.
CANNON STEAM-JACKETED ENAMEL-LINED PANS, 10 and 25 gallons. All new and unused.
DOULTON 25-gallon **COPPERS** with lids. **NEW** and unused.
WELDED VESSELS of all types, in mild steel or stainless. Fabricated to customer's specifications.
HYDRO-EXTRACTOR, 26 in., by **CHERRYTREE.**

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PAIR "WATSON LAIDLAW" ELEC. HYDROS, 30 in. monel baskets 400/3/50.
"KUSTNER" JAC. VAC. TWIN 'Z' BLADE MIXERS, 20 in. by 19 in. by 16 in. deep.
Three—**STAINLESS STEEL PORTABLE TANKS,** 275 gall. each.
Two—150 gall. **WELDED STEEL JACKETED MIXING PANS,** 4 ft. 10 in. deep by 2 ft. 10 in. diam. **DITTO,** 20, 30, 100 up to 1,300 galls.
UNUSED WEIR CONDENSERS, 105 sq. ft. (brass tubes) area.
CYL .VAC. OVENS, 8 ft. by 5 ft., 7 ft. by 5 ft., 7 ft. by 4 ft. and 7 ft. by 3 ft. diam.
"GARDNER" MIXERS, 5 ft. 6 in. by 2 ft., by 2 ft. 4 in., 5 ft. by 19 in. by 20 in., also sifter/mixers.
50 gall. **S.S. GAS HEATED JAC. MIXER,** 22½ in. by 36 in. deep.
BOILERS, STILLS, PUMPS, CONVEYORS, DRYERS, AUTOCLAVES, ETC.
HARRY H. GARDAM & CO., LTD.,
STAINES.

TANKS
FOR STORAGE

12—30 ft. × 8 ft. diam.
4—14 ft. × 7 ft. **(TILE LINED).**
80—3 ft. to 5 ft. × 3 ft. to 5 ft. diam. **(CYLINDRICAL)**
40—6 ft. × 5 ft. **(CYLINDRICAL, CONED AND STONEWARE LINED).**
20—6 ft. × 5 ft. **(CYLINDRICAL, UNLINED).**
50—2 ft. 9 in. × 3 ft. 9 in. **(CYLINDRICAL, STONEWARE LINED).**

ALSO

8—**STAINLESS STEEL SEPARATORS,** 4 ft. 4 in. × 20 in. diam.
35—6 in. **STAINLESS STEEL BENDS.**

MADEN & McKEE, LTD.,
317, PRESCOT ROAD,
LIVERPOOL, 13.

FOR SALE

8 brand new jacketed **STERILIZING VESSELS,** 7 ft. long by 3 ft. diam., complete with fittings.

2—18 in. **KEK PLATE MILLS,** complete with feeders delivery bins, motors and entablature.

9 Worssam **ROTARY PRESSES.**

POWDER DRESSING or **SIFTING MACHINES,** various sizes.

1 Johnson **FILTER PRESS,** 36 in. square, plate and frame type, double inlet and enclosed delivery ports.

1 Johnson **FILTER PRESS,** 47 plates, 32 in. square, centre feed, bottom corner open delivery.

Wood **FILTER PRESS,** fitted 69 ribbed plates, 2 ft. 8 in. square, with top centre feed and bottom enclosed delivery channel.

24 in., 30 in. and 36 in. **HYDRO EXTRACTORS,** self-balancing, swan-neck type, self-emptying bottom, belt and motor driven.

Heavy cake **CRUSHING MILL,** 2-pair high, by Nicholson, for cake up to 3 in. thick, rolls 30 in. long, top with coarse teeth 9 in. diam. bottom with finer teeth 12 in. diam.

Bennett Copper-built **EVAPORATOR,** 4 ft. diam. by 4 ft. 6 in. high, steam jacketed bottom, mounted on legs, with swan-neck vapour pipe and separate vertical belt driven vacuum pump.

" U " shaped horizontal jacketed **MIXER,** 7 ft. long, 3 ft. wide, 3 ft. 3 in. deep, belt and gear driven.

3—5 roll **REFINERS,** fitted chilled iron, water-cooled rolls, 40 in. long, 16 in. diam. belt and gear driven, with clutch drive suitable for motor, by Baker Perkins, Ltd.

1 No. 1A water-cooled **CIRCULATOR MILL.**

6—Excellent Nickel-lined Jacketed **TILTING PANS,** 60 gallons capacity and for 40 lb. working pressure.

2—Brand New Enclosed Aluminium **TANKS,** approximately 11 ft. long by 4 ft. 9 in. wide by 7 ft. 3 in. deep.

5—Excellent Porcelain **DISC MILLS.**

1—Aluminium **STILL,** steam jacketed, dished top and bottom; approximately 4 ft. 8 in. diameter by 6 ft. deep.

1—Very fine **GARDNER SIFTER** and **MIXER.** Internal dimensions of trough, 5 ft. 9 in. by 24 in. by 28 in. deep, complete with wood-built hopper, elevator, A.C. motor and starter, all in first-class condition.

RICHARD SIZER, LTD.,
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HULL.
Telephone 31743.

MORTON, SON & WARD, LIMITED
offer

"MORWARD" "U"-shaped Trough POWDER MIXERS, any size up to 3 tons.

MIXERS—Horizontal or Vertical, jacketed or unjacketed. Several in stock.

JACKETED PANS in stainless steel or mild steel, with or without mixing gear.

TROUGH MIXER by **CHALMERS,** 3 cwt., stainless steel lined tilting trough.

TROUGH MIXERS by **GARDNER,** 3 cwt., stainless steel lined troughs.

ONE 500g. **JACKETED AUTOCLAVE** with detachable cover, 150 lb. in jacket.

500g., 300g. and 200g. **AUTOCLAVES** in mild steel riveted construction, with detachable covers.

HYDRO EXTRACTORS

Large selection in stock, 72 in. to 36 in., by **BROADBENT,** and 42 in. by **WATSON LAIDLAW,** all electric, underdriven, thoroughly reconditioned, complete with starters and guranteed.

PUMPS: A range of new **MONO** Pumps and several other 2 in. to 6 in. in stock. New and second-hand.

INQUIRIES INVITED.
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600

PROCESS PLANT

LABELLING MACHINE by Rawsons, for pint or 16 oz. size flat or square. Capacity, 24-30 per min. Numbering device. Motorised 400/3/50. Unit mounted on rubber-tyred wheels.

BOTTLE-RINSING MACHINE by Thomas & Hill. Chain conveyor type, 12 ft. centres, double-row bottle fixtures, 132 head. Rotary jet rinsing. Capacity, 150 doz. half or pint bottles per hour. Motorised 400/3/50.

Electric **MAGNETIC SEPARATOR** by H. G. Richardson. Reco type D.83, 180 volts, 1 amp.

GEORGE COHEN SONS & CO., LTD.,
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STAINLESS STEEL PLATE HEAT EXCHANGER by **A.P.V. CO., LTD.** Type HH. 76 plates 43 in. by 16 in., total projected area 346 sq. ft. Hydraulically operated opening and closing gear.

STAINLESS STEEL CRYSTAL DRIER by **MITCHELL,** 3 ft. 6 in. diam. by 1 ft. 6 in. deep. **STEAM JACKETED** flat bottom with two S.S. paddles underdriven through bevel gearing from direct-coupled 1 h.p. 400/3/50 geared motor. Jacket working pressure, 15 lb per square inch.

M.S. SPIRIT EXTRACTION PLANT, comprising 3 ft. diam. by 5 ft. deep extractor with dished bottom jacketed for 5 lb. per square inch working pressure, condenser, separator, storage tank.

KESTNER HORIZONTAL TUBULAR EVAPORATOR, having six turns copper tube 1¼ in. bore by 6 ft. long, complete with copper reception pot.

STEAM JACKETED COPPER STILLS, 150 gallons capacity. Fitted swan-neck, sight and light glasses, etc., and complete with copper coil condenser. Jacket working pressure 40 lb. per square inch.

STEAM JACKETED COPPER BOILING PAN, 100 gallons capacity. Bolted-on cast-iron jacket suitable for 40 lb. per square inch working pressure.

DOUGH MIXER, having " U " trough 1 ft. 5 in. by 1 ft. 7 in. wide at top by 2 ft. deep. Sheet brass trough, cast-iron ends, G.M. agitator. Belt driven and arranged for hand tilting.

M.S. HORIZONTAL " U " TROUGH MIXER, 3 ft. by 1 ft. 9 in. by 2 ft. deep. Fin-type agitating gear belt driven through helical gearing from fast and loose pulleys. Arranged for hand tilting.

Cast-iron **VACUUM DRYING OVEN** by **TAYLOR,** 4 ft. by 2 ft. 10 in. by 4 ft. 6 in. front to back, having ten steam-heated M.S. platens pitched at 3 in. Hinged door at each end. Steam working pressure, 15 lb. per square inch.

HARRISON-CARTER DISINTEGRATORS, sizes 2½ and 00. Belt driven.

PROCESS & CHEMICAL ENGINEERING CO., LTD.,
6/8, NORTHUMBERLAND PARK,
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MONEL METAL-LINED STEAM JACKETED PAN, 75 gallons capacity; also **COPPER STEAM JACKETED PAN,** 40 in. diam. by 12½ in. deep. **HAROLD POTTER & CO., LTD., CANAL STREET, NOTTINGHAM.**

ONE TORRANCE MICRO TWIN-ROLLER MILL. Cast rolls, 14 in. by 8 in. Water cooled. Fast and loose pulley-drive.

TWO DE LAVAL SEPARATORS, VEE-BELT DRIVE. Good condition.

THOMPSON & SON (MILLWALL), LIMITED,
CUBA STREET, LONDON, E.14. TEL. EAST 1844.

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SURPLUS STORES
ALL NEW

STAINLESS STEEL TUBING, ⅜ in. to 3½ in. diam.
STAINLESS STEEL SHEETS, 26 Ga. up to ¼ in. TK.
STAINLESS STEEL VALVES, ¼ in. to 6 in.
ALUMINIUM TUBING, 1⅞ in., 2 in. and 3 in. diam.
COPPER TUBING, ¼ in. to 4 in. diam.
VALVES, STEEL, CAST IRON, BRONZE, ⅜ in. to 6 in. diaphragm, globe and gate.
RELIEF VALVES for various pressures, 2½ lb. to 60 lb.
REDUCING VALVES.
CAST-IRON PIPE, 6 in., 8 in., 9 in. and 12 in. flanges and fittings.
STEEL PIPE, 1½ in. to 6 in. and fittings.
PIPE FLANGES, ⅜ in. to 6 in.
PRESSURE GAUGES, 4 in. dial 0-20 up to 100 lb.
Full particulars upon request to :
NELSONS LANCASTER ESTATE CO.,
CATON ROAD,
LANCASTER.

RED. GEAR UNITS, 12, unused. Highfield No. 15, Hor. 90°. Bev. Gear Type. 25 h.p. 1450/420 r.p.m. Details apply : **BAKELITE LIMITED, PURCHASING DEPARTMENT, REDFERN ROAD WORKS, TYSELEY. BIRMINGHAM, 11.**

SACK AND BAG MERCHANTS AND MANUFACTURERS. New and reconditioned for Home and Export. (Use **JUTEX** for sack repairing). **ALTRINCHAM JUTE LTD., WRIGHT STREET, BROADHEATH, ALTRINCHAM, CHESHIRE.**

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INDUSTRIAL BY-PRODUCTS, LTD., 16, Philpot Lane, London, E.C.3, will be pleased to receive particulars of any by-products, waste materials and residues for disposal.

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CRUSHING, GRINDING, MIXING and DRYING for the trade.
THE CRACK PULVERISING MILLS LTD.
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PULVERISING of every description of chemical and other materials for the trade with improved mills, wharfage, and storage facilities. **THOS. HILL-JONES. LTD., "INVICTA" WORKS, BOW COMMON LANE, LONDON, E. TELEGRAMS : "HILL-JONES, BOCHURCH LONDON." TELEPHONE 3285 EAST**

WET AND DRY GRINDING, Micronising, Grading and Mixing of Minerals and Chemicals for all trades. Also suppliers of ground zircon, sillimanite, fused silica, precision casting materials and a wide range of ground minerals.
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PATENTS & TRADE MARKS

KINGS PATENT AGENCY, LTD. (B. T. King, A.M.I.Mech.E., Patent Agent), 146a, Queen Victoria Street, London, E.C.4. ADVICE Handbook, and consultation free Phone: City 6161.

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