The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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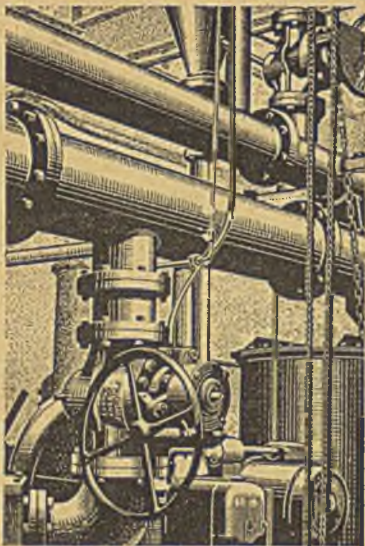

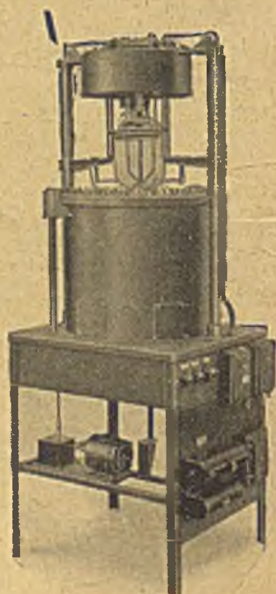

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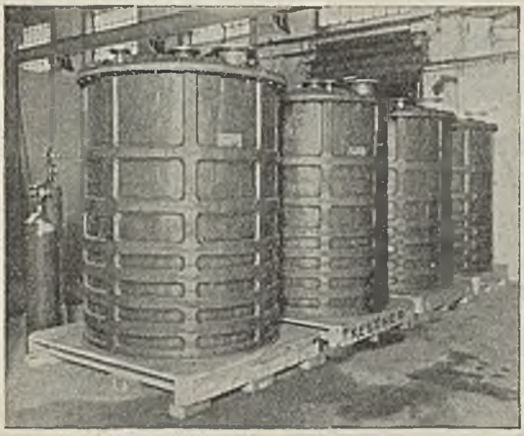

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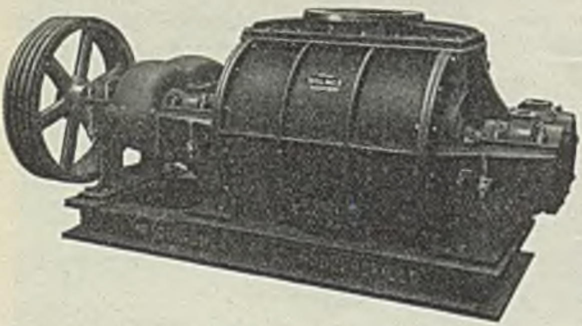


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A New Leaven

AN industry or an undertaking left to itself not infrequently becomes atrophied at least to the extent of an inability to move with the times. This is true not only of industries, it is true also of Governments and of every phase of human affairs; and indeed of almost every individual as he becomes older. The disposition to experiment, to change, to move with the times, lessens with age in almost any form of human organisation. The times in which we live do not deal kindly with this sort of thing, and there is on all sides a demand for modernisation of methods, of equipment, and of outlook. One of the main changes which have occurred in industry during the last 30 years or so is that industrial processes are no longer static and that in consequence the knowledge of one generation may be comparatively obsolete and useless to the next generation.

There can be little doubt that in a long-industrialised country such as ours, in which industrialisation started in or about the year 1750 and has been continuing ever since, the tendency to retain obsolete methods is greater than in countries such as the U.S.A. and Germany where the phenomenon is of more recent growth. After 1918 it was freely recognised that the structure of British industry was not suited to the conditions in which it had to operate, and an inquiry into industrial and commercial efficiency was set up. This inquiry yielded valuable reports, but had virtually no influence on private industry. In other words, industry, not being compelled to do something, did nothing. The responsible and constructive forces were defeated by the reactionary forces and the result was the bad conditions of the 1920's.

All over the world we see the growing demand for self-government by races which have hitherto been subjected to government by other nations. The same thing is happening in industry where those whose prototypes of 100 years ago were little better than slaves are now, as the representatives of labour, demanding a share in management. This aftermath of war is stirring in many countries, not least in America and in Great Britain. In America a ferment of strikes is sweeping the country and it may not be impossible that they are due to the absence of the conditions set out in our leading article of September 8, entitled *A Voice from*

On Other Pages

America. There has come into our hands an American pamphlet entitled *Battle Line for American Industry* which recalls speeches made just two years ago in Philadelphia. The chairman of that meeting, Mr. H. B. Taylor, himself a great industrialist, said these words: "Let us clarify the true battle line in American industry. That battle line is not between management and labour, where some would draw it. It is between the constructive forces of management and labour together on the one hand, against the forces in both that make for division and conflict."

At the same meeting Senator Truman, now President of the United States, referring to the disposition on the part of some leaders of management to believe that ultimately labour must be put into its place by force, and of some labour leaders who, paying lip-service to co-operation with managements, were privately bending every effort to increase their power for an industrial conflict after the war, said: "There is only one answer to this sort of thing. We must start now to draw the true battle line in American industry—between the responsible and constructive forces in both management and labour against the small but active minority who believe in a finish fight. If we can succeed nationally in bringing mutual understanding and team work between the right-thinking leadership of both sides of the industrial picture, then we will not only increase production, we will save American industry for America and pave the way to the greatest era of peace and plenty we have ever known."

What was said of America is true equally in this country. The facts must be faced squarely. They are that there is more inefficiency in British industry than there should be. We do not profess to say how inefficient we are because we know that there is a very great deal on the credit side also. There is, however, much that we can do and that we must do if we are to be able to meet our competitors on equal terms. Labour, no less than management and shareholders, depends for its livelihood upon industry. It is just as important to labour that industry should be efficient as it is to management.

We believe that most managements and most labour leaders see the matter from the angle of mutual co-operation for mutual good. There can be no abrogation of the duties and responsibilities of management. Members of the present Government have made it clear that in every industry, whether nationalised or not, the manager is the captain of his ship and as such must be unquestionably obeyed. If he is not a good captain he may have to be removed, but he can only be replaced by another captain. Labour, however, has much that is constructive to contribute to industry. If the constructive forces of management and labour cooperate, as we believe they will, the forces that make for division and conflict will not succeed in fermenting strikes, lock-outs, and other troubles.

We welcome, therefore, the working parties which Sir Stafford Cripps is setting up in various industries. To quote his own words: "The Government must in one way or another get the best advice on the steps that should be taken to make each one of Britain's industries more competitive in the markets of the world and to supply the domestic consumer with the best goods at the cheapest price consistent with good conditions for those in industry." The working parties will, of course, be judged by their results, but it is interesting to notice that they are to make recommendations of any kind apart from nationalisation which they believe will increase efficiency and will enable industry to meet the very hard competition which is bound to come as soon as the immediate shortages all over the world are made up. It is intended that all the major industries of the country shall be dealt with in a similar way. It is hoped that either the Government or the employer will act on the reports and recommendations of these working parties, but if not the Board of Trade will have to consider what is to be done. The parties are made up of independent chairmen, of four employers, of four Trade Union representatives, and of four independent members whose specialised knowledge should be of value. Here, at least, is a useful stage in co-operation between all men of good will: management, labour, and experts. We shall watch their deliberations with the keenest interest.

NOTES AND COMMENTS

A Hopeful Budget

WHILE it would not be altogether unfair to stigmatise Mr. Dalton's first Budget as a milk-and-water affair, in justice to the Chancellor it must be remembered that this is only an interim Budget, not the full-dress business which we look forward to with mixed feelings every April. Considering the economic difficulties in which this country finds itself at the moment, the Chancellor has been distinctly clever in contriving so mild a series of budgetary changes. By Income Tax reliefs for the lower income groups and by a slight increase in the surtax he has pleased his political supporters without too great an effect on the revenue; and by an appreciable lowering of E.P.T he has revived to a certain extent the flagging spirits of the manufacturers. Even though the reduction of E.P.T. to 60 per cent. cannot be described as a heroic step towards the essential trade revival, yet it is a step, and to receive a 20 per cent. reward for the creation of new business (when all taxes have been paid) is distinctly better than nothing. The removal of purchase tax from certain grades of all-important domestic appliances is the most encouraging step of all. Though it is not in itself fundamental, we may surely regard ourselves as at liberty to hope that this is the first move in a general lightening of the burden on "consumer" goods.

Imperial College Centenary

THIS week marks the culmination of the centenary celebrations of the Imperial College of Science and Technology, the principal ceremony being a meeting at the Albert Hall, at which the King, in his capacity as Visitor of the College, will broadcast. Chemists have a particular interest in this centenary, as it is reckoned from the date of foundation of the Royal College of Chemistry, the oldest of the various constituent bodies now unified in the Imperial College. Incidentally, it is peculiarly appropriate that the Albert Hall should be the scene of the crowning ceremony, as it was largely owing to the support of Albert, Prince Consort, that the founders of the original College of Chemistry were able to make so auspicious a start, and it was no doubt through his influence that Queen Victoria gave consent to the addition of the title "Royal" to the name of the college only two months after its inception. A historical pamphlet issued on the occasion of this hundredth anniversary tells the complicated story of how many and various foundations have come to be incorporated in the three constituent bodies—the Royal College of Science, the Royal School of Mines, and the City and Guilds College—which make up the Imperial College to-day. Visitors will have seen for themselves, on Friday and Saturday, what progress has been made since the first departments of the Royal School of Mines were transferred to South Kensington in 1872, into what is now known as the Huxley Building; and it is perhaps unfortunate that this building is not being shown, if only by way of contrast to the more modern equipment. An informative pamphlet for visitors gives a brief sketch of the work in hand at the moment, and a topographical indication of where the various buildings (most confusing to the uninitiated) lie in relation to one another.

Fuel Co-operation

COMMENT upon the kind of co-operation in industry which is referred to in our leading article this week was provided at the annual luncheon of the Institute of Fuel, held in London the other day. Mr. Arthur Horner, coal production officer of the National Union of Mineworkers, described how the men who worked in the mines were being converted to the application of science to coal production, having come to the conclusion that coal was too hardly won to be wasted. This is an encouraging indication of the attitude of a highly important section of workers to the raw material of their work, and we believe it may be taken as a sign that the publicity which has been given to science in recent years—in which we ourselves have taken what share we could—has made its impact felt in a quarter where it is of the highest value. As Dr. E. W. Smith (who presided at the luncheon) said, it does not much matter whether an industry is publicly or privately owned; what is important is who runs an industry. If there is freedom for the administrators and technicians to get on with the job, this country, he thought, would come out well. These comments arose from the leading speech of the occasion, which was delivered by the Minister of Fuel and Power, Mr. Shinwell, who assured his hearers that the Government had no intention of entrusting the administration of the mining (or any other) industry to Civil Servants. They would have, he said, to dispossess some of the owners, but he wondered whether they were not delighted that they were about to be dispossessed. If the workers really will co-operate, as Mr. Horner suggests, we believe that, from the point of view of technical efficiency, Dr. Smith has hit the nail on the head—no new experience for him.

Publicity for Science

A WELL-MEANING attempt was made last Saturday by the London Section of the Royal Institute of Chemistry to discuss the Publicity of Science with special reference to Chemistry. Experts on both scientific exhibitions and films put their case with great skill, supported by a trumpet-blowing act from a leading representative of the B.B.C. The secretary of the British Association also spoke, choosing as his subject "The Press." While Dr. Howarth has incontestably done work of great merit in his own sphere, we regret to have to register the opinion that he does not appear to appreciate the position of the Press in relation to Science, a point which he in fact admitted when stating that his generation had failed to bridge the gulf between scientists and the Press. It was disappointing that he did not think it necessary to distinguish between lay journalists and members of the scientific and technical Press, and that it did not occur to the organisers of this discussion-meeting to invite a working journalist, preferably a writer on scientific subjects, to add his views to those of the four other speakers. Similarly, the absence of a representative of the chemical industry was greatly to be regretted. We might add that it was a mistake to convene a meeting of such importance on a Saturday afternoon. The omission of the meeting from the Calendar of Events in *The Times* gives a fair indication of the publicity-mindedness of the organisers.

Efficiency of Blind Workers

MANUFACTURERS of scientific apparatus, glass bottles, and cosmetics, plastic moulders, light and heavy engineers, and tinplate workers were among the 110 firms employing blind labour, who gave evidence in a recent investigation carried out by the National Institute for the Blind and assisted by 500 of the blind employees themselves. Tests showed that a blind worker is often more efficient than one with sight. In machine operations the blind workers gave an average output of 101.8, the average of a sighted worker being put at 100. Figures for "inspection" (93) and "miscellaneous" (92.9) jobs were less impressive. Most of the workers topped the 100 mark, but in each category the average was seriously affected by a small minority who proved to be fitted only for "assisted" employment. One interesting disclosure was that totally blind workers give a greater output than partially blind. Mr. E. W. Page, head of the N.I.B. employment section, attributes this to the finer concentration allowed by total blindness.

The China Clay Trade

Improved Man-Power Position

THE china-clay industry is making a slow but sure recovery from the dislocation of war. From January next the Concentration Scheme applied during the war ceases to function, and licences will no longer be required to produce china clay. This will enable all closed pits to resume production as soon as labour becomes available.

The Ministry of Labour has promised the industry more workers as they are demobilised. The china-clay worker has always been noted for his industry, and in consequence firms employing them during the war have been reluctant to release them. Men are, however, urgently required in order that the industry may meet the demands for china clay for the home and overseas markets. It is believed that the Board of Trade and Ministry of Labour (whose officials have had a conference with the leaders of the industry), will give special attention to its requirements, in view of the importance of the export trade.

South Wales and the Future of the Chemical Industry—I

An Integrated Scheme Based on Coal-Oil-Power Supplies

by D. D. HOWAT, B.Sc., Ph.D., F.R.I.C., A.M.I.Chem.E.

THE heritage of the Industrial Revolution has exerted a profound influence on the course of industrial development in this country. Predominant among its influences has been the tendency to concentrate on the heavy industries—coal and steel. Another factor was the establishment of a large number of comparatively small firms, each of which had arisen from the drive and initiative of one man—himself often a working man. In the age in which they arose quite a good case could be made economically for those concerns which ensured goods and services at highly competitive prices. Rings and cartels were impossible in the highly competitive conditions then obtaining. The price paid for the industrial prosperity of Britain in those days was heavy—excessive hours of work, exploitation of women and children, bad housing, and the utter absence of hygienic conditions. Many of the worst effects of these evils have been removed or considerably mitigated, but up to the present day British industry suffers under disadvantages and handicaps directly derived from the Industrial Revolution.

A Baneful Heritage

A glaring example of this unfortunate heritage was to be found in the towns and industrial valleys of South Wales. Basically, the whole industrial economy of this district—with a population of over three million people—depended upon the export of coal and steel. Many pits and a large number of tin-plate mills worked to capacity for many years to supply the markets overseas. With the advent of industrial development overseas, particularly in Germany, France, the U.S.A., and Japan, the markets for the products of the heavy industries of South Wales began to contract rapidly. Signs of this trend were evident even before the war of 1914-18, but conditions became really critical during the inter-war years. Not only were former customers supplying their own needs but they were competing in those markets that were still open.

Now the heritage of the Industrial Revolution exerted its baneful influence to the full. From the small mines with inadequate shafts, poorly designed haulage-ways, and general lack of adequate mechanisation, coal could not be produced at prices competitive with that won from the highly efficient mines of Holland, Poland, and the Ruhr. In steel manufacture the same melancholy tale was repeated. Tin plate from the small, relatively old-fashioned mills of the Welsh valleys could not compete with the product of the large-scale continuous strip mills of the U.S.A. and Germany.

First among the really large-scale attempts to modernise the heavy industries of Wales was the new Richard Thomas plant at Ebbw Vale. Comprising coke-ovens, blast-furnaces, Bessemer converters, open-hearth steel furnaces, cogging mill, and continuous strip mill, the plant represents a whole-hearted attempt to instal an efficient, integrated steel production unit. Opened in 1936, the plant has done extremely useful work and rendered valuable service during this war. Many criticisms have been expressed of the Richard Thomas-Baldwins merger on the grounds that a great deal of obsolete plant is involved, although another new continuous strip mill has been projected since the merger.

Inadequate Modernisation

Apart from the development at Ebbw Vale, advances in improvements and modernisation of the coal and steel industries of South Wales have been meagre and inadequate. In consequence, in spite of its resources of coking, bituminous and anthracite coals, South Wales remained a "depressed area" right up until the outbreak of war. On the purely chemical side there was little of interest industrially beyond the coke ovens. Chamber sulphuric acid plants were in existence in places, including Newport and Swansea, while nickel refining was carried on at Clydach and zinc smelting at Swansea. While the nickel refining plant is relatively modern in design and equipment, the carbonyl process will not compare for efficiency with electrolytic refining as practised at Port Colborne, Ont., Canada. Zinc smelting is carried out in the old-type horizontal retorts, while the latest vertical-type large-capacity retorts, based on the New Jersey Zinc Co.'s patents, have been installed at Avonmouth.

Until 1939, therefore, the industrial position was highly unsatisfactory, and many competent observers were convinced that the only salvation for the industrial development of South Wales lay in the introduction of diversified new industries. While the war-clouds gathered over Europe and strategic plans were based upon the assumption that France would remain a powerful military ally, South Wales represented an attractive location for new war-time industries out of reasonable range of air attack. Even before 1939 some tentative moves were made, a Bayer bauxite purification plant being installed near Newport, while at Swansea a plant was built for the production of magnesium by the newly-developed carbo-thermic (Hansgirg) process.

Chemical Developments

With the outbreak of war the pace of development became much more rapid. In the Swansea district anthracite duff provides a relatively cheap fuel for electric power generation in steam stations. Additional generating capacity was installed and the power was used to supply the magnesium reduction plant and the electrolytic plants for aluminium production which were installed near-by. These sources of electric power led to one of the most important developments in the chemical history of Britain—the introduction of a calcium carbide manufacturing plant located on the channel coast near Swansea. Further along the coast the great Pembrey R.O.F. was built for the manufacture of explosives.

Inland, in the centre of the Merthyr coal-mining area, a large new synthetic plant was established for the production of methanol and ammonia, water-gas from coke providing the carbon monoxide and hydrogen required for the synthesis. Near Barry a suitable site was found for a plant designed to recover magnesia from sea-water, the magnesia so produced being reduced to metal in a reduction plant near Cardiff. At this same plant three large electric arc furnaces were installed for the manufacture of ferro-alloys, 70 per cent. ferro-silicon in particular. As a further item in establishing diversified industries two R.O.F's were built for the manufacture of medium-calibre anti-aircraft and tank guns, thus laying the foundation for precision light engineering. Several R.O.F's were also built as filling factories, employing at peak production 20,000 to 40,000 people.

A survey of the developments outlined serves to show that there is in existence now in South Wales the real basis for an adequate diversity of industry. On the chemical side the plant now installed, if adequately utilised, will make South Wales a powerful factor in the future of the chemical industry of Britain. Further, several of the processes installed are new to this country and their future development and expansion are essential to our industrial prosperity.

Taking first of all the production of light metals, this is a completely new industry for Wales and one of distinct promise. Bauxite ores from Ireland, India, the Gold Coast, Brasil, and British Guiana are unloaded at the Bayer purification plant near Newport on the Bristol Channel. In the critical days of our extreme need of aluminium ores a new source was developed in the Gold Coast. Although the ores contained a high percentage of moisture they formed a very welcome addition to our scanty supplies. From this purification plant at Newport 40,000 to 50,000 tons of purified alumina were produced annually, yielding on reduction about half that tonnage of aluminium metal. As 1½-2 tons of coal are consumed in the production of each ton of alumina the purification plant must obviously be located in close proximity to a coal field. The Bayer purification process, involving quite intricate chemical processes of digestion in strong caustic solutions, followed by settling, filtering, and subsequent precipitation, has long been regarded as difficult to operate successfully. The purified alumina was reduced to metal in the plants either in the Swansea district or in the North of Scotland. Although the alumina reduction plants near Swansea were equipped with the most modern plant, including the new Söderberg continuous electrode, they had to be shut down some time ago as a result of the coal shortage for electric power generation.

Magnesia Recovery

Magnesia recovery from sea water has constituted one of the remarkable new chemical developments of the past 10 years. With an average magnesium content of 0.14 per cent present as the chloride in sea-water, the metal may be precipitated as the hydroxide by interaction with calculated additions of milk of lime. When introduced first into Britain in a plant on the North-East coast, the precipitating agent employed in the process was dolomite (MgO.CaO) and not straight lime. Employment of dolomite has a number of advantages including easier sedimentation and filtration together with the recovery of the magnesia from the dolomite. When the plant was established near Barry the use of straight lime as the precipitating agent was decided upon. In view of the successful operation of a number of plants on the West Coast of the U.S.A. no serious difficulties were anticipated following the introduction of straight lime for precipitation. Practical difficulties were, however, experienced and the initial costs of the process proved to be high. Instead of an anticipated production cost of £5 10s. per ton of magnesia, the actual cost proved to be £24 12s. 5d., the plant being later shut down on the recommendation of the Select Committee on National Expenditure.

Although operation of this plant has not proved economically successful, there can be little doubt that the process has been well established on a commercial scale in the U.S.A. In view of the great importance of magnesia for pharmaceutical purposes, in the refractory industry, and as a source of magnesium metal, it is to be hoped that steps will be taken very shortly to place the process on a sound basis in this country, and preferably in the plant already equipped in South Wales. During the post-war years it will be sheer folly to purchase abroad, out of our scanty reserves of foreign currency, supplies of a raw material which can be easily produced from our cheapest source of raw materials—the sea.

From the sea-water precipitation plant the magnesia was despatched to the reduction plant near Cardiff. Here reduction of the oxide to metal was effected by aluminium powder, the reaction being carried out under vacuum at a temperature of about 1200° C. This process necessitates very carefully designed plant and equipment, as will be obvious from the operating conditions specified. An outstanding feature of the plant was the erection of a kiln furnace through which the reduction units were moved at predetermined rate, while a continuous vacuum was maintained. Special entrance and exit chambers were provided at the ends of the kiln furnace to enable reduction units to be admitted to, and withdrawn from, the furnace without impairing the vacuum.

This plant functioned reasonably well, constituting a remarkable achievement in chemical engineering but, as will be obvious from the nature of the process, production costs were high. When adequate supplies of magnesium were forthcoming from Canada and the U.S.A., plant was shut down on the recommendation of the Select Committee on National Expenditure. Nevertheless, the experience gained and the type of plant operated were of great value and may in the future constitute the basis for the development of the ferro-silicon reduction (Pidgeon) process for the production of magnesium. In actual fact 70 per cent. ferro-silicon, which is employed in the Pidgeon process, is being manufactured in an adjacent plant. This valuable ferro-alloy plant is equipped with three large electric arc furnaces, fitted with Söderberg continuous self-baking electrodes, daily production of ferro-silicon, at peak periods, being at the rate of 30 to 40 tons.

The Ferro-silicon Process

While the entire output of ferro-silicon was absorbed for other purposes during the war there does not appear to be any good reason why the plant should not be used for a thorough investigation of the normal operation and costs of the ferro-silicon process. In the U.S.A. and Canada the ferro-silicon process, although developed on an extensive scale for war purposes, has proved to be more expensive for the production of magnesium than the electrolytic plants. Full investigation should be made as to whether local conditions in this country offer any hope of making the ferro-silicon process, which does not necessarily involve the use of electric power in the actual reduction, competitive with the electrolytic process.

The other significant development in the light metal industry in South Wales occurred with the establishment of a plant at Swansea for the commercial-scale application of the carbo-thermic reduction (Hansgirg) process for magnesium production. When magnesia is mixed with carbon and fed into the chamber of an electric arc furnace the oxide is reduced to metal at the temperatures obtaining. To prevent back-reactions the gaseous mixture of metal vapour and carbon monoxide leaving the furnace must be chilled rapidly by the injection of large volumes of under-cooled hydrogen. Elaborate plant is necessary both for the preparation of the large volumes of hydrogen required and for the removal of the carbon monoxide absorbed by the hydrogen during each cycle. The water-gas catalytic conversion process is used for the production of the hydrogen while absorption of activated carbon is the method employed for the removal of the carbon monoxide. This plant, with an estimated annual output of about 1000 tons, is expected to produce magnesium at a price of 1s. 6d. per lb. when operating at full capacity. This figure compares very closely with the present production costs of electrolytic magnesium in Britain, as recorded by the Select Committee on National Expenditure.

Calcium Carbide

Outstanding in the chemical history of this country was the war-time establishment of a calcium carbide plant near Swansea. Built and equipped by the Ministry of Supply, the plant has been operated by a private firm acting as agents for the Ministry. Up till the war, no facilities for carbide manufacture existed in this country, which in this respect, was, unfortunately, unique among the great industrial powers of the world. Cartel activities were largely responsible for this very serious deficiency in our chemical industrial potential. Calcium carbide production in Europe was controlled by a single large cartel which offered large quantities of carbide to consumers in this country at cut prices. This procedure, coupled with other less desirable activities, effectively strangled the establishment of a carbide manufacturing industry in this country. With the outbreak of war, and particularly with the occupation of Norway, supplies of carbide to this country were severely cut. To counter this deficiency this large manufacturing plant was set up in South Wales. Of the latest and most modern design, the plant incorporates three large electric arc furnaces fitted with 4 ft. diam. Söderberg continuous self-baking electrodes. Consumption of electric power has been reduced to the low figure of about 3300 kWh per ton, while annual production is believed to be about 100,000-150,000 tons. Another plant is in existence in England, but is considerably smaller than the South Wales plant, which remains the first real large-scale modern carbide manufacturing plant in this island. As 0.9 tons of coke are required for each ton of carbide manufactured the plant is admirably situated in relation to the coke-ovens of South Wales. Although the production is high it is believed that the entire tonnage has been employed during the war for welding and cutting in the engineering industries. While demands on this score may ease considerably with the fall in munitions production, it is obvious that the national capacity for carbide manufacture is not nearly adequate to sustain the needs of the engineering industries and to supply acetylene for plastics production. Pre-war production of carbide in Germany was about 600,000 tons annually and it would appear, therefore, that about double the existing capacity in Britain will be required to supply the necessary quantities of acetylene from home-produced carbide.

Methanol and Ammonia

Near Merthyr a large synthesis plant has been erected for the manufacture of methanol and ammonia. This also is a Ministry of Supply factory operated by an agency firm, and is one of the two exactly similar plants erected in this country after the outbreak of war. Coke is the essential raw material, although, unlike carbide manufacture, no large consumption of electric power is involved. The coke is gasified in producers from which the water-gas passes first to oxide boxes for sulphur removal, the spent oxide so produced being employed for sulphuric acid manufacture in one of the older chamber plants in the district. The purified water-gas passes through catalytic conversion units to enable the necessary adjustments to be made in the carbon-monoxide/hydrogen ratio. After carbon monoxide conversion the gases pass through the methanol and ammonia catalytic synthesis chambers in series. By suitable control of the various stages the methanol/ammonia ratio may be adjusted within certain limits depending upon current demands. Production of each of these compounds is believed to be at the rate of 10,000 to 15,000 tons annually.

Other war-time developments of interest are the acid plants—including the modern contact sulphuric acid units—in the two Government factories: R.O.F. Pembrey and the Admiralty establishment on the borders of South Wales. According to the most recent information both these factories are to be retained for peace-time establishment, but on a considerably reduced scale. A great opportunity is presented here, particularly at R.O.F. Pembrey, to utilise some of the surplus chemical plant as an investigation and development station for local problems. Great assistance could be rendered to this area by a pilot-plant investigation of the Fischer-Tropsch synthetic process for oils and fatty acids from coal and coke; of methods of underground gasification of thin uneconomic coal seams; of the use of coke-oven gases for ammonia synthesis; and of the separation and utilisation of olefines from the coke-oven gases for chemical synthesis.

The foregoing briefly outlines the major steps taken towards the establishment of a balanced diversity of industry in this area during the war. There can be little doubt that had some measure of this diversity of industry been introduced 15 years ago some of the worst unemployment of the inter-war years might well have been obviated. In this way the welfare of the district could have been at least partially secured and a real contribution made to the economic well-being of the whole country.

(To be continued.)

WAX FROM BRITISH PEAT

An interesting account of the extraction of ester waxes from British lignite and peat, by C. M. Cawley and J. G. King, is contained in the current issue of *J.S.C.I.* (1945, 64, 237). During the war wax extracted from Devon lignite was found to be a satisfactory substitute for montan wax, hitherto imported from Germany, and the result of the work has led to some important conclusions. Although Devon lignite wax has many properties in common with good-quality montan wax, there are considerable difficulties in the way of winning a sufficient quantity to repay commercial operation, the strata being discontinuous and intermingled with clay. Peat wax, on the other hand, though softer in texture and having a lower melting point (63°-73° C., as compared with 73°-83° C.) deserves consideration from the commercial point of view, not only on account of the comparative ease of winning suitable peat, but also because of the beneficial effect on the production of peat as a fuel in districts into which it is now necessary to import coal. Twenty samples of peat were examined, nine from English mosses, and eleven from Scottish.

A study circle, which has been working in Sheffield University on the application of statistical methods to local industries, is being enlarged into an Industrial Applications Section of the Royal Statistical Society (*see* Forthcoming Events). The provisional committee of the new section includes Mr. A. H. Dodd, chief chemist, Newton Chambers & Co. The honorary secretary is Mr. F. C. Turner, c/o Department of Engineering, Sheffield University.

American Work on the Atomic Bomb

II—The Practical Work

(*Continued from* The Chemical Age, *October* 20, 1945, *p.* 359)

MEANWHILE, on the more practical side, enough experimenting and planning had been done to indicate the problems to be encountered in constructing and operating a large-scale production plant. Some progress was made in the choice of the type of plant, first choice at that time being a pile of metallic uranium and graphite, cooled either by helium or water, the latter method being eventually chosen. A specific programme was drawn up for the construction of pilot and production plants.

Production Plant Design

In January, 1943, the decision was made to build a plutonium production plant with a large capacity. This involved a pile developing thousands of kW and a chemical extraction plant to extract the product, all designed from the results of micro-experiments with a pile of only 0.2 kW and as much material as would nearly make a pinhead! The work was to be undertaken by Du Pont in collaboration with the Metallurgical Laboratory of the University of Chicago which had done the experimental work already described.

The engineering problems included some entirely new to industrial work. The nature of a pile consisting of lumps of uranium embedded in a graphite lattice precluded easy removal of the uranium and was unsuited to the concentration of the coolant at the uranium lumps. It was therefore changed in favour of a rod design, though whether that would have $k_{\infty} > 1$ was not certain. The material would be so highly radioactive that unloading of the uranium when required would have to be done by remote control from behind a shield. Pipes to carry the water had to be made of materials which would neither absorb neutrons nor disintegrate under the heavy density of neutron and gamma-radiation present in the pile. From the nuclear physics point of view only seven materials were feasible—Pb, Bi, Be, Al, Mg, Zn and Sn. Be was not available and of the others only Al was thought possible from a corrosion point of view.

The uranium had to be protected from corrosion or disintegration with the cooling water; this proved a most difficult problem. Thousands of kW of energy had to be dissipated in the cooling water; the water system had to be highly dependable, with fast-acting controls to shut down the plant if the water supply failed; moreover, the water would be highly charged with radiation and must be discharged before being turned into a river. The pile must be automatically controlled to keep it operating at a determined power level. The radiation given off from it was so strong that operating personnel could not go near the pile; therefore the whole pile had to be enclosed in very thick walls of concrete, steel or other material, but it had to be possible to load and unload the material through shields that were tight both to radiation and to air.

Waste Disposal Problems

The disposal of waste from the plant involved some special problems. Plutonium does not give off penetrating radiation, but the combination of its alpha-ray activity and chemical properties make it one of the most dangerous substances known if it once gets in the human body. The really troublesome products, however, are the fission products, *i.e.*, the major fragments into which the uranium is split by fission. The fission products are extremely active and include some 30 elements. Among them are radioactive xenon and iodine, which are released in considerable quantities when the slugs (*i.e.*, the uranium residues after the reaction) are dissolved, and must be disposed of by high chimneys which enable the gases to be so mixed with the surrounding air that the radioactive gases will not endanger the surrounding countryside. Some products can be disposed of in solution and here, again, pollution of the rivers must be considered.

The health problem demanded a special panel. Their work involved the provision of instruments and clinical tests to detect any evidence of dangerous exposure of personnel, research on the effect of radiation on persons and estimates of the shielding and safety measures to be incorporated in the plant. In addition, a far-reaching research programme was initiated to study the factors as yet unknown in connection with these and other problems. As a result of this work it was decided to undertake the large-scale manufacture of plutonium as material for the production of the atomic bomb.

Manufacture of Plutonium

The progress of further work on the production of plutonium up to the experimental explosion of the first atomic bomb is shrouded in a fog of security silence, but some general facts are disclosed. Two types of neutron absorption are essential to the operation of a plutonium plant. One is neutron absorption in U-235, resulting in fission which maintains the chain of neutrons. The other is neutron absorption in

U-238, which leads to the formation of plutonium. The operation of the pile was thus directed to this end. The original fast neutrons are slightly increased in number by fast fission, they are reduced in number by resonance absorption in U-238 (which ultimately leads to production of Pu), and they are further reduced by absorption at thermal energies in graphite and other materials and by escape from the pile. The remaining neutrons, which have been slowed in the pile to thermal speeds, cause fission in U-235, producing a new generation of fast neutrons similar to the previous generation, and these go through the processes here described. In any steadily reacting pile, the effective multiplication factor, k, must be kept at 1, whatever the power level.

The second part of the problem was the separation of the plutonium from the uranium slugs left in the pile. About 20 elements resulting from the fissions and other disintegrations are found to be present in significant amounts in the pile after the reactions, the most abundant amounting to about 10 per cent. of the aggregate. The longer the pile has run, the larger is the concentration of Pu and (unfortunately) the larger the concentration of long-lived fission products, which are radioactive. The problem was thus to make a chemical separation of several grams of Pu per day from several thousand grams of uranium contaminated with large amounts of dangerously radioactive fission products comprising 20 different elements. Four methods are possible, namely volatility, absorption, solvent extraction, and precipitation. While the other processes should not be ruled out for future use, the one chosen consisted of a series of reactions involving precipitation of Pu″″ with carriers, dissolving, oxidising to Pu″″″ and reprecipitation of the carrier while the highly oxidised Pu remains in solutiton. The Pu″″″ is then reduced to Pu ″″ when the impurities remain in solution. Successive oxidation-reduction cycles are carried out until the desired decontamination is achieved.

Chemical Engineering Problems

Details have been given of the practical problems involved in the production of plutonium. It will be of interest to deal more specifically with these problems. A pilot plant for the production of plutonium was built at Clinton in Tennessee, its object being to produce some plutonium and to serve as a pilot plant for chemical separation. The size of the Clinton pile was chosen to produce 1000 kW. It consisted of a rectangular cube of graphite containing horizontal channels filled with uranium. The uranium was in the form of metal cylinders protected by gas-tight cases of aluminium. The uranium cylinders or slugs could be slid into the channels in the graphite, space being left to permit cooling air to flow past and to permit the slugs to be pushed out at the back of the pile when they were ready for processing for the recovery of plutonium. The pile also contained control rods, instruments and so forth. An impressive array of instruments and safety devices was included, but the pile proved remarkably simple in operation, and for the most part the operators had nothing to do but to control the reading of the instruments. Plutonium processes had to be carried out by remote control and behind thick shields. Uranium slugs that had been exposed in the pile were transferred under water to a cell having heavy concrete walls, and there dissolved. Subsequent operations were performed by pumping solutions or slurries from one tank or centrifuge to another.

Within a few days of its start the Clinton pile was brought up to a power level of 500 kW at maximum slug surface temperature of 110°C. Improvements in the air circulation and elevation of the maximum uranium surface temperature to 150°C. brought the power level to 800 kW. Later a change was made in the distribution of uranium to level out the power distribution in the pile by reducing the amount of metal near the centre relative to that further out and thereby to increase the average power level without anywhere attaining too high a temperature. Improved sealing of the slug jackets made it possible to raise the temperature somewhat, as a result of which a power level of 1800 kW was attained. In May, 1944, this was further increased by installation of better fans. Performance considerably exceeded expectations.

If the pile was simple both in principle and in practice, the plutonium separation plant was not. This was not surprising since (as previously indicated) it was based on experiments using only microgram amounts of plutonium. Nevertheless it worked, and in February several grams of plutonium were delivered. Furthermore, the efficiency of recovery which at the start in January was about 50 per cent. had been raised by June to between 80 and 90 per cent. All this involved a vast amount of laboratory and pilot-plant work.

Full-Scale Plant

The next step was to construct the full-scale plant known as the Hanford Engineer Works. It is hoped that the full story of this extraordinary enterprise and its companion, the Clinton Engineer Works, will one day be published. An area of nearly 1000 sq. m. was brought under Government control. Three piles were constructed, the first being put into operation in September, 1944. The piles were spaced several miles apart for safety and the separation plants were well away from the piles and from each other. The whole works comprised piles, plutonium separation plants, pumping stations and water-treatment plants with a low power chain-reacting pile for material testing. All three piles were in operation by the summer of 1945.

Professor Smyth remarks that "no one who has lived through the period of design and construction of the Hanford plant is likely to forget the 'canning' problem, *i.e.*, the problem of sealing the uranium slugs in protective metal jackets. On periodic visits to Chicago the writer could roughly estimate the state of the canning problem by the atmosphere of gloom or joy to be found around the laboratory. It was no simple matter to find a sheath that would protect uranium from water corrosion, would keep fission products out of the water, would transmit heat from the uranium to the water, and would not absorb too many neutrons. Yet the failure of a single can might conceivably require the shut-down of an entire operating pile."

The solution of this problem is not disclosed, but it is pointed out that thin aluminium was feasible from the nuclear point of view, and was chosen early as the most likely solution of the problem. But the problem of getting a uniform heat-conducting bond between the uranium and the surrounding aluminium, and the problem of effecting a gas-tight closure for the can, both proved very troublesome. Nevertheless by the summer of 1945 no can failure had been reported.

With the production of plutonium in adequate quantities by the uranium-graphite pile this part of the problem may be said to have been completed. Nevertheless, experiments on what appears to have been pilot-plant scale showed that a chain-reacting unit with uranium and heavy water would attain a considerably higher multiplication factor, and consequently a pile of smaller size could be used than is possible with graphite because heavy water is more effective than graphite in slowing down neutrons and it has also a smaller neutron absorption. In spite of the advantages of heavy water, however, this project was given up because the heavy water was not available.

Isotope Separation

We now pass on to an altogether different problem and one that was pursued in parallel to the production of plutonium. Even before the discovery of plutonium, the possibility was recognised of producing an atomic bomb of U-235, freed or partly freed from U-238. This involved the problem of isotope separation. The methods by which this could be done were already known and the problems were fundamentally technical rather than scientific. Many of the experiments done on plutonium were of vital interest for military use either of Pu or of U-235, and for the future development of nuclear power, but a great deal of work was done on isotope separation projects—much of which cannot be disclosed—and the problem was regarded as important.

Possible Methods of Separation

Known methods were: (1) *Gaseous diffusion*, in which UF_6, which boils at 56°C., was used. (2) *Fractional distillation*, already applied to the separation of light and heavy water, which differ in b.p. by 1.4°C. (3) *Centrifuging*, which achieved success by using tall high-speed centrifuges operating on vapour. These had the advantage over diffusion that the separation factor depends on the difference between the masses of the isotopes and not on the square root of the difference. (4) *Thermal diffusion*, in which thermal convection may set up a counter-current flow; it has been used successfully to separate the light and heavy uranium hexafluorides. (5) *Chemical exchange methods*, depending on the fact that in simple exchange reactions between the compounds of two different isotopes, the "equilibrium constant" is not exactly the same for each isotope so that separation can occur. This has been used for light elements, but is not well suited to heavy elements. (6) *The electrolysis method* resulting from the discovery that water contained in electrolytic cells has an increased concentration of heavy-water particles. Before the war practically all heavy hydrogen, including that of Norway, was produced by this method. (7) *The electromagnetic method*, in which ionised gas molecules passing at high velocity through a magnetic field will move in semicircular paths or radii proportional to their momenta. The light ions will move in smaller semicircles and may be collected at the right position.

Of these methods, (2), (5), and (6) are preferred for the separation of deuterium from hydrogen, while (1), (3), (4), and (7) are suitable for uranium. It was recognised that there might be advantages in combining some of these methods because of the need for re-processing discarded material from each stage; a process that is best for the earlier stages of separation is not necessarily best for a later stage. The two main methods operated for the concentration of U-235 were gaseouss diffusion and electromagnetic separation.

Separation of U-235 by Diffusion

By the end of 1941 the possibility of separating the uranium hexafluorides had been demonstrated in principle by means of a single-stage diffusion unit employing a porous barrier (*e.g.*, a barrier made by etching a thin sheet of silver-zinc alloy with hydrochloric acid). A considerable amount of work on barriers and pumps had also been done, but no answer entirely satisfactory for large-scale operation had been found. Reports received from the British, and the visit by the British group in the winter of 1941-1942, clarified a number of points. Professor Smyth adds: "At that time the British were planning a diffusion separation plant themselves."

If a gas consisting of two isotopes starts to diffuse through a barrier into an evacuated vessel, the lighter isotope diffuses more rapidly than the heavier. The result, for a short time, at least, is that the relative concentration of the lighter isotope is greater on the far side of the barrier than on the near side. If the process is allowed to continue indefinitely, equilibrium will become established and the concentrations will become identical on both sides of the barrier. Even if the gas which has passed through the barrier is drawn away by a pump, the relative amount of the heavy isotope passing through the barrier will increase since the light isotope on the near side of the barrier will have been depleted by the earlier part of the diffusion.

To separate the uranium isotopes, many successive diffusion stages (*i.e.*, a cascade) must be used. The best flow arrangement for the successive stages is that in which half the gas pumped into each stage diffuses through the barrier, the other (impoverished) half being returned to the feed of the next lower stage. If it is desired to produce 99 per cent. pure $U^{235}F_6$, and using a cascade in which each stage has a reasonable overall enrichment factor, roughly 4000 stages are required.

Of the gas that passes through the barrier of any given stage only half passes through the barrier of the next higher stage, the other half being returned to an earlier stage. Thus most of the material that eventually emerges from the cascade has been re-cycled many times. Calculation shows that for an actual uranium-separation plant it may be necessary to force through the barriers of the first stage 100,000 times the volume of the required gas that comes out of the top of the cascade. The corresponding figures for higher stages fall rapidly because of reduction in amount of unwanted material ($U^{238}F_6$) that is carried along.

The general objective of the large-scale gaseous diffusion plant was the production each day of a specified number of grams of uranium containing some ten times as much U-235 as is present in the same quantity of natural uranium. However, it was apparent that the plant would be rather flexible in operation, and that considerable variations might be made, as desired, in, say, degree of enrichment of the final product.

The Process Gas

Uranium hexafluoride has been mentioned as a gas that might be suitable for use in the plant as "process gas," not the least of its advantages being that fluorine has only one isotope, so that the UF_6 molecules of any given uranium isotope all have the same mass. This gas is highly reactive, however, and is actually a solid at NTP. Therefore the study of other gaseous compounds of uranium was urgently undertaken. As insurance against failure in this search for alternative gases, it was necessary to continue work on uranium hexafluoride, as well as on devising methods for producing and circulating the gas.

Even assuming full atmospheric pressure on one side and using an optimistic figure for the porosity, calculations showed that many acres of barrier would be needed in the large-scale plant. At atmospheric pressure the mean free path of a molecule is of the order of 0.0001 mm. or 0.1 micron. To ensure true "diffusive" flow of the gas, the diameter of the myriad holes in the barrier must be less than one-tenth of the mean free path. Therefore, the barrier material must have almost no holes appreciably larger than 0.01 micron (4×10^{-7} in.), but must have billions of holes of this size or smaller. These holes must not enlarge or plug up as the result of direct corrosion or dust coming from corrosion elsewhere in the system. The barrier must be able to withstand a pressure "head" of one atmosphere. It must be amenable to manufacture in large quantities and with uniform quality. By January, 1942, a number of different barriers had been made on a small scale and tested for large-scale production and plant use.

The whole circulating system, comprising pumps, barriers, piping, and valves, had to be vacuum-tight. Any lubricant or sealing medium needed in the pumps should not react with the process gas: in fact, none of the materials in the system should react with the process gas, since such corrosion would lead not only to plugging of the barriers and various mechanical failures but also to absorption (*i.e.*, virtual disappearance) of uranium which had already been partially enriched.

When started, the plant must be allowed to run undisturbed for some time, until enough separation had been effected for each stage to contain gas of appropriate enrichment. Only after such stabilisation is attained is it desirable to draw off (from the top stage) any of the desired product. Both the amount of material involved (the hold-up) and the time required (the start-up time) are great enough to constitute major problems in themselves.

The Large-Scale Plant

By 1942 the theory of isotope separation by gaseous diffusion had been worked out, and it became clear that a very large plant would be required. The major equipment items in this plant were diffusion barriers and pumps. Neither the barriers nor the pumps which were then available had proved generally adequate, so that the further development of pumps and barriers was specially urgent. Other technical problems involved corrosion, vacuum seals, and instrumentation.

The large-scale diffusion plant was erected at Clinton and consists of so many more or less independent units that it was put into operation section by section, as permitted by progress in constructing and testing. Thus there was no dramatic start-up date nor any untoward incident to mark it. The plant was in successful operation before the summer of 1945. The steam power plant for this installation is one of the largest ever built.

Barriers that were thought to be satisfactory were developed, and several were actually adopted for the plant and installed in many stages. But by the summer of 1945 a barrier considerably different from that first suggested was preferred, particularly in respect to ease of manufacture. The problem was no longer one of barely meeting minimum specifications, but of making improvements resulting in greater rate of output or greater economy of operation. Professor Smyth adds: "Altogether, the history of barrier development reminds the writer of the history of the 'canning' problem of the plutonium project. In each case the methods were largely cut and try, and satisfactory or nearly satisfactory solutions were repeatedly announced; but in each case a really satisfactory solution was not found until the last minute and then proved to be far better than had been hoped."

Pumps must operate under reduced pressure, must not leak, must not corrode, and must have as small a volume as possible. Many different types of centrifugal blower pumps and reciprocating pumps were tried. In one of the pumps for the larger stages, the impeller is driven through a coupling containing a novel and ingenious seal. Another type of pump is completely enclosed, its centrifugal impeller and rotor being run from outside, by induction.

Electromagnetic Separation

Work was started simultaneously on the separation of uranium isotopes by electromagnetic methods. The main process developed was called the Calutron, because the apparatus was built up by dismantling the California University Cyclotron. This is the method previously described, in which a stream of fast-moving uranium ions is deflected through 180° by a magnetic field, the heavier U-238 particles being less deflected than the lighter U-235, each being collected at a separate position. Early experiments showed promise both in the scale of the operations and the degree of separation achieved. The three major problems were the difficulty of producing ions, the limited fraction of the ions used in the process, and space-charge effects in the neighbourhood of the positive ion beam which interfere with the separating action. These last were found capable of being neutralised by ionisation of the residual gas in the magnet chamber. Security reasons prevent a description of the highly technical methods used to overcome the difficulty of producing ions. The better recovery of the ions was achieved by better focussing of the magnetic field. The general advantages of this method were the large separation factor, small hold-up of material, short starting-up time, and flexibility of operation. By November, 1943, the first plant units were ready for trial at the Clinton Engineer Works.

The need for increased production from this plant led to work on a thermal diffusion method enriching the uranium (in respect to U-235) in the feed material. A method was worked out, but the enormous consumption of steam made it appear impracticable to use thermal diffusion for the whole job of separation. However, an enriched material was produced satisfactorily by this method. The electromagnetic separation plant was in large-scale operation during the winter of 1944-45 and produced U-235 of sufficient purity for use in atomic bombs.

Designing the Bomb

Progress up to the spring of 1943 was sufficient to justify the inception of a new laboratory, which seems to have been established in collaboration with the British, and in which British staffs worked, for the design and development of the bomb. This laboratory improved the theoretical treatment of design and performance problems, refined and extended the measurements of the nuclear constants involved, developed means of purifying the materials to be used, and finally designed and constructed operable atomic bombs. Unfortunately, no proper account can be given of what was done in any division and none of the work of the Ordnance, Explosives and Bomb Physics Divisions can be discussed at all. It would serve little purpose to give a list of those problems that can be mentioned, but without stating the solution. It is, however, interesting to consider the very difficult general problem that faced the investigators when they started to design a bomb, given a supply of U-235 and/or Pu.

Clearly, the capture of neutrons by uranium, which results in fission, must be promoted, and this reaction must produce at least as many new neutrons as are lost from the mass in the ways discussed previously. Of these, non-fission capture by uranium may be reduced by removal of U-238 or by the use of lattice and moderator; non-fission capture by impurities may be reduced by purification of the materials; and the escape of neutrons from the system can be reduced (relatively) by increasing the size of the system, and by a reflector (*e.g.*, a layer of graphite) round the active material which reflects many neutrons back into the pile. In the design of the pile for production of Pu and for laboratory investigation care had to be taken that the chain-reacting system did not blow up; now it must blow up.

An explosion is a sudden and violent release (in a small region) of a large amount of energy. To produce an efficient explosion in an atomic bomb, the parts of the bomb must not become appreciably separated before a substantial fraction of the available nuclear energy has been released, since expansion leads to escape of neutrons from the system and thus premature termination of the chain reaction. Using known principles of energy generation, temperature and pressure rise, and expansion of solids and vapours, it was possible to estimate the order of magnitude of the time interval between the beginning and end of the nuclear reaction. Almost all the technical difficulties arise from the extraordinary shortness of this interval.

The device of using a lattice and moderator, excellent as it is for the non-explosive pile, is unsatisfactory for a bomb. First, the thermal neutrons take so long (although the period is measured in micro-seconds) to act that only a feeble explosion would result. Second, a pile is ordinarily far too big to be transported. It is therefore necessary to cut down parasitic capture by removing the greater part of the U-238 or to use plutonium.

Critical Size Problems

A chain-reacting unit must be above a critical size before it will be self-sustaining; but the data on which to compute the size were too meagre, and had to be determined. The presence of a reflector delays expansion and thus increases efficiency. The process of reflection takes time, however, and on that account may not increase efficiency.

The details of detonation and assembly provided some rare problems. It is impossible to prevent a chain reaction from starting once the size exceeds the critical size because there are always enough neutrons (arising from cosmic rays, from spontoneous fission reactions, or from alpha-particle-induced reactions in impurities) to initiate the chain Thus, until the bomb is to be detonated it must consist of separate parts each one of which is below the critical size. To produce detonation these parts must be brought together rapidly. But in the course of this assembly process the chain reaction is likely to start, because of the presence of stray neutrons, before the bomb has reached its most compact form. Thus the explosion may prove relatively useless.

The problems here are (1) to reduce the time of assembly to a minimum, and (2) to reduce the number of stray (predetonation) neutrons to a minimum. It was considered (prior to April, 1943) that the obvious method of rapid assembly of the atomic bomb was to shoot one part as a projectile in a gun against a second as target. Whether this method was used in fact we do not know; published accounts give no hint. But Professor Smyth remarks that "the projectile mass, projectile speed, and gun calibre required were not far from the range of standard ordnance practice, but novel problems were introduced by the importance of achieving sudden and perfect contact between projectile and target, by the use of tampers (*i.e.*, reflectors) and by the requirement of portability." It will be agreed that "there were problems of instantaneous assembly of the bomb that were staggering in their complexity."

Ball and Pebble Mills

Interesting Paper at Bristol

AT their first meeting of the 1945/46 session, on September 28, the Bristol Section of the Oil and Colour Chemists' Association (Mr. W. G. Wade in the chair) heard an interesting paper on "Ball and Pebble Mills" given by Mr. R. G. Baines, A.M.I.Mech.E.

This type of mill, the lecturer said, was first used for dry grinding about the middle of last century and adapted for the paint and varnish industry some 25 years ago. An ingenious model was exhibited which clearly depicted the threefold action occurring during dispersion of a finely-divided powder in a liquid medium, *i.e.*: (a) cascading of outer balls; (b) rolling together of inner balls; and (c) rubbing action between surface of pot and adjacent layer of balls. The advantages claimed for simplicity in use and low power consumption with consistent results were pointed out and amplified.

The materials available for construction were discussed, including points to be considered for facilitating cleaning and quick change-over. Steel ball mills were compared with porcelain pebble mills, and the advantage to be gained by incorporating lifter bars to overcome the slip inevitable with the former type was explained. The use of compressed air and its limitations for discharging were mentioned. The difficulties to be borne in mind when transferring from laboratory to works practice were enumerated and a formula shown to determine the critical speed—the usual speed adopted being 60/70 per cent. of this critical figure. Optimum figures for charge and pebbles respectively were suggested and, as regards dry grinding, the relation existing between diameter and time and output.

Instrumentation

Sir Frank Smith on Automatic Instruments

Sir Frank Smith.

WITH the purpose of promoting the interchange of knowledge and experience between those employing automatic controllers and recorders in different fields, and of encouraging collaboration between physicists and chemical engineers, a joint conference was convened in London on October 19-20 by the Institution of Chemical Engineers, the Institute of Physics, and the Chemical Engineering Group (Society of Chemical Industry).

Sir Frank Smith, President of the Institute of Physics, in his opening address, expressed his conviction that the importance of instruments in the progress of scientific knowledge, in the quantity production of goods of many kinds, and in the maintenance of a uniform standard of quality was not sufficiently realised in this country either by industry or by the Government; nor, he might add, is it fully appreciated by many technicians and scientists.

Radar and the Atom

" In recent months," Sir Frank Smith said, " we have heard much of Radar and the atomic bomb, but little or nothing of the instruments without which neither could have been developed. The principles on which Radar is based were enumerated by Clerk Maxwell more than half a century ago, but principles are neither instruments nor machines, and no developments were possible until instruments of an entirely new kind were invented. Radar would be impossible without an instrument to measure intervals of time smaller than a millionth of a second. Many decades ago, J. J. Thomson produced the first instrument which made this possible. I refer to the cathode-ray tube. This subsequently became the cathode-ray oscillograph. By development it became the eye of the television camera and was also used as the screen for most television receivers. Of course, I do not forget the radio valve, and its part in the development of Radar. The wireless valve, as you know, was the development of an instrument, the one-way rectifier of Sir Ambrose Fleming. Without such instrumental developments as those of the cathode-ray tube and the rectifying valve there could have been no Radar.

" The atomic bomb has resulted from a study of nuclear physics, and it is certain that there could not have been much advance in our knowledge of the atom without the cloud-track apparatus invented by C. T. R. Wilson and the mass spectrograph of F. W. Aston. Rutherford did much of his research work with Wilson's cloud chamber, and always he was full of praise of the instrument which served him so well. To Aston's beautiful mass spectrograph we owe our knowledge that when transmutation of one element to another takes place there is a change in mass. The mass that disappears is converted into energy. Without instruments of this type it is extremely doubtful whether the liberation of atomic energy would ever have been achieved.

" Indeed, nearly every big advance in industry is the result of knowledge obtained in the first place by the use of a new instrument. Those who have studied the history of the steam engine know that it was the indirect result of a study of the barometer. It was through the study of the quicksilver column that men learned for the first time that the air in which we live had weight and exerted a pressure on the ground. It was this knowledge that led man to invent the first atmospheric steam engines which subsequently developed into steam expansion engines.

The Instrument Industry

" When the first world war started the British instrument industry was comparatively small. To-day, it is in a much better position, although in many respects it requires strengthening. It is essentially a key industry and I can but hope that in the near future the Government will take appropriate steps to ensure that the industry is established on a firm basis. The cessation of war contracts places the industry in a very difficult position. There is no main feature of the country's life but what is dependent in some form or other on instruments. Instruments are the eyes and ears of all progressive industries; we depend on them for the satisfactory supply of gas, electricity, water, the transportation of food and many other services. The cinema projector is an instrument which was invented by an instrument maker and contains optical and electrical instruments of great precision. The modern moving talking picture would not have been possible had it not been for an exploratory instrument, the photo-electric cell, which was produced not for industrial purposes but for the advancement of knowledge.

"Television is based on photo-electric cells, on radio valves and cathode-ray tubes. This country may well be proud of what it has done to advance television. When war broke out we were easily ahead of all other countries. The war stopped research and development in television, but I have reason to believe that in 1946 we shall not be far behind. In war instruments this country has done wonders, especially in the development of those operating on electronic principles.

"However, the main objective of this conference is not to praise ourselves for what we have done, but rather to enlarge on what should be done, and I consider the main objective is to speak to many of the big industrialists of this country and urge on them the need for increased instrumentation of their industries. Some of the big industries of this country are well instrumented; other are not.

"The Government has urged industry to be more scientifically minded and it has stated with no lack of emphasis that if we are to maintain a decent standard of living we must increase our export trade. No one who has studied the returns of the Board of Trade and examined the quality of the products made in this country and abroad can doubt that if we are to have a large and prosperous export trade we must turn out articles of exceptional quality and at competitive prices.

"The people of the United States believe that they lead in most things. They believe that their industries are more efficient than ours and that they have the highest standard of living in the world. There is, I think, little doubt that they accept changes more readily than we do. There is enthusiasm for things which are new and there is a readiness to accept standardisation for a period when mass-production of a new article commences. We can learn much from the United States in instrumentation.

"In the main, the material articles which we export may be placed in two categories. The first, those which can be manufactured by mass-production methods, and the second, special products. My remarks on instrumentation are largely confined to the first category; that is to say, products which are in demand in large quantities and which can readily be produced by mass-production methods. There are many who think that, apart from motor cars, there is not much room for mass-production in this country. This is quite wrong. There are many articles which are needed by the public in hundreds of thousands and in some cases millions. These articles can be, and should be, produced by quantity production methods. Such methods lead to greater uniformity in quality, little waste, greater use, and cheaper cost. To produce these articles cheaply and at the same time to make them attractive it is necessary to have big industrial units for their production, and there must be control of the manufacturing operations by instrumentation.

"Mass-production in its extreme form results in little or no variety of the products. You may remember the saying in the early days of the Ford car that one could buy a Ford in any colour provided it was black. It was only when Ford found means of making cars of any colour with negligible increase in cost that the proviso was removed. Variety in mass-production products can only be achieved by some increase of cost, but some small changes can often be produced without any large increase in the cost. In this country I have little doubt that a batch system coupled with quantity production would prove to be most beneficial.

"Instrumentation is, of course, labour-saving machinery, and it is highly desirable that such labour-saving devices should come up to the same standard in this country as in the United States. There is no doubt that unless the industries in this country prove themselves to be as efficient in peacetime as in wartime, we are in for trouble."

Reports on German Chemical Works

Copies for Inspection

THE first batch of reports from investigating teams on visits to German chemical works has been released by the Government. An official announcement on the general policy and procedure in the release of such information to industry will be made shortly. In the meantime, a copy of each of the reports listed below is available for examination by appointment in the office of the Association of British Chemical Manufacturers, 166 Piccadilly, London, W.1. Appointments to examine reports should be made with Mrs. Consitt; the reports desired must be specified by their reference numbers. Reports cannot be taken away or sent on loan through the post. These arrangements are necessary because only one complete set is available for perusal. It i hoped that copies will be available eventually for all inquirers who want copies for their records. The reports are available equally to members and non-members of the Association.

These reports are issued by the Government with the warning that their subject matter may be protected by British Patents or Patent Applications and that this publication cannot be held to give any protection against action for infringement.

A list of titles, with abbreviated contents, of the reports so far released follows herewith.

XXII—7. *I.G., Ludwigshafen.* Manufacture of Butadiene, Styrene, Buna Rubber, Koresin, and Igamid; and Reppe Acetylene Chemistry Processes.

XXIII—4. *I.G., Leverkusen.* Report on Crude Rubber, Reclaim, and Buna; manufacture of Perbunan, Buna-S-Type Polymers, and report on Polymerisation Research.

XXIV—22. *Electrochemical Industry, Bitterfeld Area (I.G.).* Production of Magnesium, Aluminium, Magnesium Alloys, Alkalis and Chlorine, etc.; Chlorine Plants (Kali Chemische and Deutsche Solvay); Light Metal Plants (Junkers, Leipzig-Leichmetall, Metallgus-Leipzig, Preussische-Hütten und Bergwerks A.G.).

XXIV — 21. *I.G. Mainkur Works, Fechenheim.* Production of Melamine, Maprenal MJB, Japanlac Substitute, Benzoguanamine, Maprenal BG, Kaurit MKF, Phenothiazine, Dyes, Textile Agents, etc.

XXIV—18. *I.G. Griesheim Elektron, Frankfurt.*

XXVI—11. *I.G. Höchst.* Chlorine, Sodium Sulphide, Methane Chlorination, Monochloroacetic Acid, Sulphuric Acid and Chlorosulphonic Acid, Acid-proof Cements, Synthetic Tanning Agents, Acetaldehyde, Vinyl Acetate Monomer and Polymers and their commercial applications, Polyurethane, Synthetic Carbazole, Insecticides, Pharmaceuticals and Medicinals, Substitute for Glycerine (Glycerogen).

XXVI—47. *Gebr. Giulini, Ludwigshafen.* Production of Purified Alumina and Aluminium Hydrate.

XXV—17. *Electrochemical Industry, Burghausen Area.*

(1) I.G. Gendorf. Chlorine, Hydrogen Ethylene, Acetylene.
(2) Alex. Wacker, Burghausen. Chlorine, Acetylene Chlorination, Calcium Carbide, Ferrosilicon.
(3) I.G., Gersthofen. Chlorine and Metallic Sodium.
(4) Süddeutsche-Kalkstickstoff, Trostberg. Cyanamide.
(5) *Aluminium.* (a) Vereinigte Aluminium Werke, Ranshofen, near Braunau, Austria. (b) Vereinigte Aluminium Werke, Toging. (c) Vereinigte Aluminium Werke, Pocking.

XXIV—19. *Anorgana, Gendorf.* Chemicals manufactured and projected from Acetylene; Charts: Acetylene + Formaldehyde, Butyrolactone, Acetylene + Acetaldehyde.

XXVI—62. *The German Chlorine Industry with particular emphasis on I.G. and the War Influence.* Summary of chlorine requirements for various production in long tons per day; cost in RM per 100 kg. of electrolytic product; comparison between various processes; code names of products.

XXIII—21. *I.G., Leuna Nitrogen Fixation Plant.*

XXV—19. *I.G., Wolfen Farbenfabrik, near Halle.* Inorganic and organic products; Dyes; Nitrogen products; Fertilisers; Chemical Warfare materials; Detergents; Resins and Plastics; Insecticides; Rubber Chemicals; Photographic, Perfumery, and Aromatic Chemicals.

XXV—20 *Alex. Wacker, Burghausen.* Butanol and Butyraldehyde, Chlorinated Compounds, Alcohol Solvents, Ethyl Acetate, Acetic Anhydride, Insecticides, Artificial Shellac, data on Polyvinyl Emulsions.

XXVI—33. *Werke Koholtze, Lülsdorf, near Cologne.*

XXVI—48. *Dr. F. Raschig, Chemische Fabrik, Ludwigshafen.* Manufacture of Synthetic Phenol.

XXVII—92. *Carbide, Cyanamide and Cyanide Industry.*

(1) Calcium Carbide for Acetylene—Alex. Wacker Werke, Burghausen; for Cyanamide—Süd-Deutsche Kalkstickstoff-Werke, Hart; I.G. Ludwigshafen; A.G. für Kalkstickstoffdünger, Knapsack; Société Electro-métallurgique de Montricher, France.
(2) Calcium Cyanamide—Süd-Deutsche Werke, Trostberg, Bavaria; A. G. für Sticksdünger, Knapsack.
(3) Sodium Cyanamide.—I.G., Ludwigshafen.

XXVII—82. *Fischer Tropsch and Allied Processes.* Kaiser Wilhelm Institute für Kohleforschung Mülheim/Ruhr. Ruhr Chemie A.G., Holten-Sterkrade; Chemische Fabrik Holten, Holten-Sterkrade; Oxo G.m.b.H., Holten-Sterkrade.

XXIV—16. *Pharmaceutical Targets in Southern Germany.*

XXVI—9. *C. H. Boehringer Sohn, Ingelheim am Rhein.*

XXVII—14. *I.G., Höchst.* Plans for the Wehrmacht: Replacement of Phosphorus in Grenades. Radio-Measuring Grenade ("*Funkmessgranate*"). Adhesive Mines, Laughing Gas CM 1, Fire Extinguishing Material CB, Hexogen, Tetranitromethane and Nitroform (*X-Stoff*), Panzer Glass, Fog Acid (*Nebelsäure*), Hydrazine, Special Fuels, Sea Rescue Foam Powder (*Seenot-Schaumpulver*), Plastics, Pharmaceuticals, Insecticides, Metal Working Lubricants, Patent Activities, etc.

Personal Notes

SIR JOHN BOYD ORR, M.P., has been elected Rector of Glasgow University, having defeated Lord Lovat and Sir Thomas Beecham at the polls.

MR. A. J. G. SMOUT has been released from his appointment as Director General of Ammunition Production in the Ministry of Supply.

MR. A. P. SACHS has been elected president, for the coming year, of the Association of Consulting Chemists and Chemical Engineers, Inc., New York.

MR. R. W. WILSON, assistant research metallurgist at the Kalgoorlie metallurgical laboratory, has been promoted to the position of senior research metallurgist, succeeding Mr. Alan C. MacDonald.

DR. D. P. CUTHBERTSON, Grieve Lecturer in physiological chemistry at Glasgow University, has been appointed director of the Rowett Research Institute, Aberdeen, in succession to Sir John Boyd Orr, M.P.

DR. A. M. WARD has been appointed Principal of the Sir John Cass Technical Institute as from January 1, 1946, in succession to Mr. J. Patchin, who is retiring. Dr. Ward is at present Principal of the Technical College, Guildford.

SIR JEREMIAH COLMAN has resigned his position as vice-chairman of Reckitt and Colman, Ltd., for reasons of health. He will remain a member of the board and chairman of J. and J. Colman, Ltd. SIR BASIL MAYHEW has been appointed vice-chairman of the first-named firm.

MRS. SEAN T. O'KELLY, wife of the President of Eire, who was Analyst to a number of Irish local authorities, has asked for indefinite leave to be granted to her. In the meantime MISS MARIE MACNEILL, M.Sc., who was chief assistant to Mrs. O'Kelly in her Dublin laboratories, is taking over the duties on a temporary basis.

DR. A. W. WYLIE, of the Division of Industrial Chemistry of the Australian Council for Scientific and Industrial Research, has been awarded the Grimwade Prize in Industrial Chemistry for 1944. He submitted a thesis embodying the results of the chemical study of a number of Australian raw materials with a view to their industrial application.

The Melchett Medal for 1945 was presented to PROFESSOR C. H. LANDER, of the Imperial College, at the annual luncheon of the Institute of Fuel last week. On the same occasion the 1940 Melchett Medal was handed to the French Ambassador, M. Massigli, for presentation to M. ETIENNE AUDIBERT, the leading fuel expert of France, who could not be present in person because of a motor-car accident.

MR. G. W. LACEY, B.Sc., A.R.I.C., on relinquishing his appointment as Controller of Light Metals in the M.A.P., in order to rejoin the British Aluminium Co., Ltd., has been appointed general sales manager. MR. G. A. ANDERSON, B.A., who recently relinquished his appointment as Deputy Controller of Light Metals, has rejoined the company and has been appointed deputy general sales manager. To assist these gentlemen, a fully-developed sales division of the company has been organised.

Obituary

MR. T. F. JOHNSON, Scottish manager of British Bitumen Emulsions, Ltd., and of Graphite Oils Co., Ltd., died suddenly last week.

MR. THOMAS WILLIAM JORDAN, who died at Hazel Grove, aged 77, on October 16, was managing director of the Manchester Paint and Varnish Co., Ltd.

We regret to announce the death in London, on October 18, of LADY BAIN, wife of Sir Frederick Bain, M.C., chairman of the Chemical Control Board during the war years and a director of I.C.I. Lady Bain was a daughter of the late Dr. J. G. Adami, vice-chancellor of Liverpool University.

MR. JOHN ALSTON TURNBULL, who died recently in a London hospital at the age of 65, only a week after his return from India, had been for more than 30 years a partner in the firm of J. and R. Hutchison, manufacturing chemists, Calcutta. A native of Glasgow, and son of a manufacturing chemist in that city, he served for a time with J. & P. Coats, Ltd., before going to India.

That invaluable document, the priced catalogue of B.D.H. laboratory chemicals and testing outfits, has just been re-issued by THE BRITISH DRUG HOUSES, LTD., Graham Street, London, N.1. The accustomed form is retained, but a note is included referring to the recent reduction in the price of mercury and its salts, and the increase in the price of silver and its salts. A new feature is the section covering tablets for milk testing (methylene blue, resazurin, Ringer's solution) and for the determination of vitamin C.

NU-WAY HEATING PLANTS, LTD., 54 Gillhurst Road, Birmingham, 17, manufacturers of Nu-Way Patent Water-Seal Stokers (to a specification), as well as of Rotavac Industrial Oil Burners, Oil-Fired Furnaces, Nu-Way Industrial Space Heaters, etc., have issued a catalogue giving details of the most modern method of underfeed firing. In many fields Nu-Way Automatic Stokers offer a simple means of reducing costs and increasing efficiency.

Parliamentary Topics

Awards to Inventors

IN the House of Commons last week, Major Cooper-Key asked the President of the Board of Trade whether it was his intention to appoint committees to examine the claims for awards for inventions submitted to State departments during the war; and whether he would make known the procedure whereby such claims can be made.

Mr. Glenvil Hall: It is the Government's intention to put forward at an early date proposals for a Royal Commission on Awards to Inventors.

Steel Industry

Mr. A. Edwards asked the Minister of Supply and of Aircraft Production whether any proposal had been made to the steel industry on the lines of the proposals made to the cotton industry for reorganisation.

Mr. Wilmot: No, Sir. I do not consider this particular method would be suitable for application to the industry in question.

Replying to Mr. Jennings, the Parliamentary Secretary to the Minister of Supply and of Aircraft Production said that no legislation for the nationalisation of the steel industry would be introduced this session.

Blast Furnaces

Questioned by Mr. Edwards whether he could give an assurance that the steel industry's plans to erect 18 new blast furnaces had been referred to the Blastfurnacemen's Association for their comments and co-operation in determining their location, Mr. Wilmot said that the Iron and Steel Federation's long-term plans for development had not yet been submitted to the Government, but that it was his intention that the views of organised labour in the industry should be taken into account before they were approved.

DDT and Gammexane in Agriculture

Replying to Mr. Bartlett, who asked whether the indiscriminate use of DDT and Gammexane for agricultural purposes would have no deleterious effects, the Minister of Agriculture said that there was no direct evidence that Gammexane and products containing DDT were likely to have harmful effects when used for agricultural purposes strictly in accordance with manufacturer's directions. Further research and experiment were being carried out.

X-Ray Equipment

Mr. Skeffington asked the Prime Minister which department was now responsible for the X-ray industry; and what consultations had been held with that industry as to its post-war position.

Mr. Wilmot: The Ministry of Supply is the war-time production authority for X-ray equipment and accessories. No consultations with the industry have yet taken place.

Fog Dispersal

Mr. De la Bère asked the Minister of Fuel and Power whether he would make a comprehensive statement on apparatus to counteract fog and indicate the methods by which it was proposed to utilise the knowledge gained for the benefit of the public.

Mr. Foster: Fog dispersal by heat has been effected at certain airfields during the war by the use of petrol-burning installations generally described as FIDO. A number of these airfields are still available for the diversion of aircraft in emergency, and FIDO equipment is being installed at Heath Row, the projected civil airport for London. Fog dispersal by FIDO can, however, only be undertaken for limited areas, as it involves considerable equipment and a heavy consumption of petrol

Penicillin

Mr. Awbery asked the Minister of Supply whether he was now in a position to increase the production of penicillin, with a view to its greater use among all grades of medical practitioners.

Mr. Leonard: Steps have already been taken to increase materially the production of penicillin. New factories are under construction which, together with those now working, will provide sufficient penicillin to meet all foreseeable requirements. As soon as supplies permit, it will be made more widely available.

New Control Orders

Exemption from K.I.D.

THE Board of Trade now has under consideration the question of the renewal of the exemption from Key Industry Duty of certain articles covered by the Safeguarding of Industries (Exemption) (No. 1) Order, 1945 (S. R. & O. 1945, No. 692), which exempts them from K.I.D. until December 31, 1945. The list of articles concerned was published in THE CHEMICAL AGE on July 14, 1945 (p. 32). Communications relating to them should be addressed to the Principal Assistant Secretary, Industries and Manufactures (General) Department, Board of Trade, Millbank, London, S.W.1, within one month from October 17.

Tartaric Acid and Cream of Tartar

The Minister of Food has made an Order (S. R. & O., 1945, No. 1308) dated October 18, reducing the maximum prices of tartaric acid and cream of tartar (a) on a sale by a first-hand distributor, or a distributing dealer, and (b) on a sale by wholesale. The Order will come into force on November 3.

General News—From Week to Week

The embargo on the re-export of certain grades of shellac has now been withdrawn by the M.O.S.

The third Summer School in X-ray crystallography, held in Cambridge in September, was attended by 31 scientists from universities, government departments, and industrial laboratories.

The Minister of Food announces that, as from November 11, no lard will be allocated to trade users for manufacturing purposes. Compound cooking fat will be available against traders' lard datum.

Courtaulds, Limited announce their purchase from Industrial Rayon Corporation, Cleveland, Ohio, of patents issued by Great Britain and its Dominions and countries of Continental Europe covering the Industrial Rayon Corporation's continuous process for the manufacture of viscose rayon yarn.

The 116th course of lectures at the Royal Institution "adapted to a juvenile auditory" will be delivered at Christmas this year by Sir Robert Watson-Watt, on Thursdays, Saturdays, and Tuesdays, December 27 to January 8. His subject will be "Wireless." Subscriptions: Adults, 21s.: children (10-17), 10s. 6d.

The application of stereoscopic photography in the investigation of mechanical problems was the subject of a recent lecture in London to the Association for Scientific Photography. The lecturer, Mr. R. Peel, expressed the hope that his paper would stimulate interest in the stereoscopic method of recording experimental work.

An encouraging sign of the increased resumption of international scientific relations was the delivery of the Croonian Lecture to the Royal Society on October 25. The lecturer was Professor August Krogh, of the Zoophysiological Laboratory, Copenhagen, and the lecture was postponed from 1940. The subject dealt with was: "Exchanges of Inorganic Ions through the Surfaces of Living Cells and through Living Membranes generally."

A new organisation, the Crucible and Tool Steel Association, has been formed in Sheffield to foster the commercial and technical interests of the crucible and tool steel trade. The old-established Crucible Steel Makers' Association remains in being, but its activities will be confined to labour matters. The first president of the new association is Mr. S. H. LeTall (Watson, Saville & Co.), who is also president of the old association; and Mr. L. Chapman (Wm. Jessop & Sons) and Mr. W. Brazenall (Walter Spencer & Co.) will represent the association on the council of the British Iron and Steel Federation.

Pig iron and steel ingot production for September (weekly average) totalled 139,500 tons and 240,700 tons, respectively. The weekly averages for the first half of this year are 133,900 and 231,600 tons.

Foreign News

Industrias Metalurgicas, S.A. Colombia, which formerly manufactured aluminium utensils, has begun the production of plastics.

A scheme to survey India's uranium resources and to conduct research on radioactive elements has been accepted by the governing body of the Indian Council of Scientific and Industrial Research.

The erection of a fertiliser plant has been approved by the Egyptian Government in connection with a power project at Aswan. The plant will have an annual capacity of 300,000 metric tons, or half the country's requirements.

A bill to secure State control of Swedish sources of uranium is to be introduced by the Government, says the Stockholm correspondent of *The Times*. Extraction of uranium will be permitted under licence only, and export will be forbidden.

Progress was made during the first part of 1945 in establishing new plantations of rotenone-bearing roots in the Amazon Valley of Brazil, but production of roots and powder did not increase appreciably in the first quarter above that of 1944.

An agricultural research station, with its principal objective the testing of petroleum-derived chemicals as sprays, fumigants, plant-growth agents, fertilisers, and weed-killers, has been established at Modesto, California, by the Shell Oil Company.

Sodium metal is already being produced at the converted U.S. Government magnesium (ferrosilicon) plant at Mead (Wash.), operated by the Electro Metallurgical Company. No production of calcium metal, however, has yet been reported.

The well-known Swedish concern, A/B Förenade Superfosfatsfabriker, is erecting a new plant for the production of sulphuric acid and superphosphate in the harbour quarter of Norrköping. An annual output of 100,000 tons of superphosphate is projected.

The export of Spanish iron ore to Holland was resumed last week when a British and a Norwegian ship were loaded with ore destined for Ijmuiden. By the end of the year, exports of iron ore from Spain to European countries are expected to reach normal levels, with a monthly average of 60,000 tons

A second oil refinery is being built in Malmö by the Johnson shipping group—which also owns Sweden's first oil refinery, located at Nynashamn. Construction is to be completed early next year. It is reported that the Swedish Co-operative Society also plans to erect an oil refinery.

A new process for casting magnesium, substituting stirring at a relatively low temperature for the costly superheating method, has been developed at the University of California's physical metallurgy laboratories, according to Professor R. Hultgren, quoted by *Chem. Met. Eng.* (52, 9, 174).

The fertiliser situation in the Canary Islands remains very unsatisfactory, the shortage of nitrogenous materials being particularly acute. A shipment of Chilean nitrate received during the first quarter of the year could be distributed to growers only in small quantities.

At Saint-Pierre and Miquelon, a cod-liver oil refinery, set up and operated by the administration, has recently started the manufacture of gelatine capsules of refined oil. Provided with modern equipment, the factory possesses its own power plant and has an output capacity of from six to eight million capsules a year.

Production of mica in the Labwor district of Uganda, which began in 1943, has increased since that time. A total of 2000 pounds was exported in 1943. Production at the beginning of 1944 was about 1100 pounds per month, increasing to 2000 pounds monthly by the end of the first half of that year.

United States interests concerned with oil explorations in Denmark, have set aside the sum of 15,000,000 Danish crowns for drilling work at several places near Kolding, near the German frontier, across which oil deposits were discovered a number of years ago by the Germans. In the course of these drilling operations, the presence of potash deposits has been disclosed.

A new cobalt mine and ore-treatment plant has been opened up at Kamoto, in the western mines of the Union Minière du Haut Katanga in the Belgian Congo. A cobalt recovery plant has been erected at Jadotville, and a plant for production of electrolytic cobalt has been completed. In addition, two new electric furnaces have been installed for working up cobalt concentrates of the Kabolele mine.

Bethlehem Steel Corporation has begun work on its $20,000,000 programme for the modernisation of two of its bar-producing plants. The output of high-quality carbon and alloy bars is to be increased. The programme includes construction of a 10-inch bar mill, consisting of four new buildings, and extensions to three existing buildings. Work is expected to be concluded by next autumn.

The 487-mile Rhone Valley pipe-line, laid by U.S. troops from Marseilles to the Saar basin, together with 64 pumping stations, storage facilities, etc., has been taken over by France at the end of last month. It will be used to supply motor fuel for civilian purposes. As the line has been laid at great speed to serve the needs of the American and French armies, it remains to be seen whether it will be of permanent value to France.

The American Foundrymen's Association intends to celebrate its 50th anniversary by holding an International Foundry Congress and a foundry exhibition in the Cleveland Auditorium, Cleveland, next May. Interest in attending such a congress has already been expressed by British foundry associations, as it would make available to the industry many outstanding and hitherto secret developments which may prove vital in peace-time.

According to an estimate made by Mr. H. Vagtborg, president of the Midwest Research Institute, Kansas City, the United States will have to devote a sum of $1000 million annually to scientific research, in view of the scientific and industrial commitments which the country has undertaken. It is pointed out that this sum is still only 0.75 per cent. of the national income, whereas Russia devotes 1 per cent. of its national income to research. Some anxiety is expressed in high quarters about the number of trained men available to carry on the required research.

All I.G. plants and currency holdings in Germany are to be confiscated by the Allied Control Commission for Germany, according to a statement issued on October 12 by General Clay, U.S. member of the committee. Part of the concern's 300 plants will be dismantled and distributed as reparations, the section devoted entirely to war production will be scrapped, and a proportion, mainly concerned with pharmaceutical products, will be retained for peace-time production in Germany. According to General Clay, the war has left about three-quarters of the I.G. plants intact.

In the Bordeaux region a marked increase in the manufacture of superphosphates and production of potassium nitrate has taken place. The production of liquid oxygen, dissolved acetylene and liquid carbonic acid has reached normal levels, and in some cases even exceeds the monthly average output of 1938. There is, however, a shortage of containers for transport. Production of explosives and mining accessories does not show the same improvement, output of mining explosives being at present 63 per cent. of the average monthly output in 1938, that of compressed black powder 71 per cent., that of containers for liquid oxygen only 21 per cent., and that of detonators 41 per cent.

Forthcoming Events

October 29. Oil and Colour Chemists' Association (London Section). Royal Institution, Albemarle Street, W.1, 6.30 p.m. Professor E. N. da Costa Andrade: "Viscosity and Plasticity" (third lecture).

October 29. Chemical Society (Manchester Section). **Royal Institute of Chemistry,** and **Society of Chemical Industry.** Engineers' Club, Albert Square, Manchester, 7 p.m. Mr. F. P. Dunn: "The Publications of the Three Chartered Bodies."

October 29. Chemical Society (South Wales Section) and **Swansea University College Chemical Society.** Chemistry Lecture Theatre, University College, Swansea, 6 p.m. Professor J. Kendall, F.R.S.: "The Separation of Isotopes and Thermal Diffusion."

October 30. Royal Statistical Society. (Industrial Applications Section, Sheffield Group). Royal Victoria Hotel, Sheffield, 2.30 p.m. Inaugural meeting.

October 30. Hull Chemical and Engineering Society. Regal Room, Regal Cinema, Ferensway, Hull, 7.30 p.m. Mr. D. J. T. Bagnall: "Food Frauds."

October 31. Imperial Institute, Prince Consort Road, London, S.W.7, 3 p.m. Dr. F. Dixey: "Nigeria, Its Geology and Mineral Resources."

October 31. Society of Chemical Industry (Nutrition Panel). Rooms of the Chemical Society, Burlington House, Piccadilly, London, W.1, 7 p.m. Mr. N. T. Gridgeman: "Present Knowledge of the Chemistry and Physiology of Vitamin-A."

October 31. Society of Chemical Industry (Plastics Group). Lecture Theatre, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, 6.30 p.m. Dr. S. L. Bass (Director of Research, The Dow Corning Corporation): "Silicones—New Engineering Materials."

November 1. Chemical Society. Burlington House, Piccadilly, London, W.1, 5 p.m. Mr. L. Hunter: "Mesohydric Tautomerism"; Mr. A. G. Foster: "The Sorption of Condensable Vapours by Porous Solids. Parts III and IV"; and Mr. A. Campbell and Mr. J. Kenyon: "Retention of Asymmetry During the Beckmann, Lossen and Curtius Changes."

November 1. Mineralogical Society. Rooms of the Geological Society, Burlington House, W.1, 5 p.m. Papers on simpsonite, microlite and tantalite from Southern Rhodesia; on barium felspare from Broken Hill, New South Wales and on the X-ray examination of decomposition products of chrysotile (asbestos) and serpentine.

November 2. Royal Institute of Chemistry (Glasgow and West of Scotland Section). Royal Chemical College, Glasgow, 7.15 p.m. Discussion: "The Training of a Chemist," (Led by Dr. Nisbet.)

November 2. Institute of Welding (South London Branch). Borough Polytechnic, Borough Road, S.E.1, 7.30 p.m. Mr. H. W. G. Hignett: "Some Thoughts on the Weldability of Alloy Steels."

November 3. Institution of Chemical Engineers (N.W. Branch) and **Society of Chemical Industry** (Liverpool Section). Inaugural joint meeting. Large Chemical Theatre, Liverpool University, 3 p.m. Mr. T. Wallace: "Starting up a New Chemical Factory."

Commercial Intelligence

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

Mortgages and Charges

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

BASIC MINERALS, LTD., London, E.C. (M., 27/10/45.) September 29, £5350 debenture, to R. G. Seatoun, London; general charge. *Nil. November 24, 1944.

Satisfaction

DURSTON, LANG & CO., LTD., London, W., manufacturers of fire-extinguishing machines. (M.S., 27/10/45.) Satisfaction October 1, £50, registered August 16, 1944.

Company News

Greeff-Chemicals Holdings, Ltd., has declared an interim dividend of 3 per cent. (same).

Oxley Engineering Co., Ltd., reports a net profit, for the year to June 30, of £14,669 (£13,094). The ordinary dividend is maintained at 15 per cent.

New Companies Registered

Fromberg and Charles, Ltd. (399,278).—Private company. Capital £1000 in £1 shares. Manufacturers of and dealers in articles made from plastic materials, rubber, synthetic rubber and all substitutes therefor, and in chemicals and chemical compositions, etc. Directors: M. Fromberg; William C. Watkin. Registered office: 10 Coleman Street, London, E.C.2.

French Talc, Ltd. (398,964).—Private company. Capital, £400 in £1 shares. Importers and exporters of and dealers in French talc, etc. Membership is restricted to the subscribers and such other persons as shall execute an agreement already prepared. Subscribers: H. A. Blackwell, Thermetal House, Garston, Liverpool; C. W. Brown; Samuel Cox. Solicitors: H. C. Morris & Co., Regina House, London, E.C.4.

Ropla, Ltd. (399,568).—Private company. Capital £100 in £1 shares. Dealers in and manufacturers, importers and exporters of chemicals, gases, plastic substances, glues, resins, lacquers, dyes, disinfectants, fertilisers, oils and varnishes, grinders, etc. Subscribers: Israel Woolf (first director); Kathleen Cleary. Registered office: Coventry House, 3 South Place, Moorgate, E.C.2.

Chemical Trade Inquiries

Belgium.—A firm established at Antwerp wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of chemicals (all kinds). Present inquiries cover (a) sulphate, sulphide, sulphite, hyposulphite (tech.), and bisulphite of soda; borax; ephedrine hydrochloride; phenacetin; boric acid; copper sulphate; carbonate of magnesia; vanillin; hydrofluoric acid; lactic acid; manganese dioxide; graphite; magnetic iron oxide; sodium hexametaphosphate; ethylene glycol; coumarin; dextrine; zinc chloride; basic fuchsin; potassium and sodium bichromate; acetates (butyl, isobutyl, ethyl, methyl, and lead); butyl alcohol; potassium permanganate; powdered aluminium and zinc; sodium aluminate; and mercury bichloride (Ref. LC); and (b) cresylic acid; *m*- and *p*-cresol; naphthalene (crude and refined); solvent naphtha (90/160 and 90/180); and creosote oil (Ref. BLC). Details as to deliveries, etc., on application to The Chemical Age.

Chemical and Allied Stocks and Shares

DURING the early part of the week Budget considerations were the main factor in stock markets, but generally values have moved to higher levels under the lead of British funds. The latter responded readily to the reduction in short-term money rates, and all high-class investment stocks were marked higher, including leading industrial shares. Other groups continued to respond to hopeful assumptions as to "fair compensation" in the event of nationalisation, including home rails, colliery and electricity supply shares. On the other hand, shares of the joint stock banks showed declines ranging up to 2s. on the cut by the Government in its rate for borrowing from the banks. The rise in industrial shares has naturally reduced yields, which, however, is regarded as justified, assuming that E.P.T. is eventually abolished.

Shares of chemical and kindred companies have reflected the general tendency; best levels were not fully held, but prices have moved higher on balance. Imperial Chemical further strengthened to 40s. 6d., but eased later to 40s., although the view persists that when E.P.T. is abolished there may be a prospect of dividends above the 8 per cent. of recent years. Turner & Newall rallied to 81s. 3d., United Molasses were better at 42s. 4½d., and Triplex Glass 10s. units at 38s. regained part of an earlier decline. Wall Paper Manufacturers deferred units, however, receded to 41s. 9d. on the unchanged dividend. Lever and Unilever eased to 51s. 6d. on the directors' statement on dividend policy. Dunlop Rubber moved up to 54s. on encouraging views as to the outlook, and Metal Box shares rose further to 95s. on the company's interests in home and overseas markets, while British Aluminium rallied to 39s. British Plaster Board at 36s. 3d. responded to the general tendency, and General Refractories at 18s. were better also Pinchin Johnson at 38s. 6d.

Iron and steel shares were favoured on yield considerations, Guest Keen moving up to 41s. 6d., Staveley to 50s., United Steel to 25s. 6d., Colvilles to 25s. 6d., and Dorman Long to 27s. Allied Ironfounders at 52s. 3d., South Durham Steel at 27s. 9d., Stewarts and Lloyds at 54s. 9d., and Tube Investments at £5¾ also moved higher. Elsewhere, Gas Light & Coke improved further to 22s. 9d. Textiles firmed up, but were little changed on balance, Bradford Dyers being 26s. 4½d., Calico Printers 20s. 10½d., Bleachers 14s. 3d., and Fine Spinners 25s. British Celanese have been active around 35s.; and Courtaulds at 55s. were firm on the news of acquisition of various U.S. patents.

Borax Consolidated deferred kept steady at 44s. 3d., and British Oxygen were 86s. 3d., while Nairn & Greenwich moved up to 81s. 3d., and Barry & Staines were 54s. 3d. The units of the Distillers Co. showed steadiness at 116s. B. Laporte kept firm at 87s., W. J. Bush were 77s. 6d., Cellon 5s. shares 26s., and elsewhere, Blythe Colour 4s. ordinary moved higher at 22s. 6d. and British Drug Houses advanced further to 45s. Greeff-Chemicals Holdings 5s. ordinary firmed up to 9s. 6d. xd and Burt Boulton were 26s. United Glass Bottle moved higher at 71s. 6d. Fisons were 55s., Cooper McDougall & Robertson 33s. 9d., and there was a further general rise in the electric equipment group on trade expansion prospects, General Electric moving up to 96s. 6d., Associated Electric to 59s., and English Electric to 56s.

Boots Drug were higher at 57s. 6d., Sangers 31s. 9d., and Timothy Whites 43s. Oil shares have been dull, although slightly higher prices ruled for Shell and Burmah Oil. Ultramar Oil fell sharply at one time on the news from Venezuela, but later regained some ground. V.O.C. were slightly lower on balance, while Trinidad Leaseholds improved to 92s. 6d.

British Chemical Prices

Market Reports

STEADY contract deliveries of heavy chemicals have been reported on the London general chemicals market during the past week, and although fresh inquiry has only been on a moderate scale it has resulted in further additions to order books. Values have been maintained throughout and the undertone remains firm. Among the soda compounds deliveries of both the solid and liquid grades of caustic are steady, while the demand for soda ash and bicarbonate of soda has continued on active lines. Nitrate of soda has been the subject of fresh inquiry and offers are steadily absorbed. There has been no change in the position of chlorate or yellow prussiate of soda, and a fair demand is reported for hyposulphite of soda. Among the potash chemicals there is a steady call for supplies of permanganate, while both bichromate of potash and yellow prussiate of potash are moving steadily into consumption. In other directions, crude and refined glycerine are steady, and borax is a good market, while carbide of calcium, sulphur, and white powdered arsenic are all being taken up in reasonable quantities. There is no change to report in conditions in the market for coal-tar products.

MANCHESTER.—A satisfactory feature of trading in chemical products on the Manchester market during the past week has been the steady call for contract deliveries from textile and other industrial users in the area. New business during the week has been moderate, with bookings for shipment included in the orders that have been placed. Prices generally are on a firm basis. Among the fertilisers, lime, basic slag, and sulphate of ammonia are about the busiest sections. In the tar products trade, crude tar, creosote oil, naphthalene, crude and crystallised carbolic acid, and motor benzol are meeting with a steady demand, but in most other sections new buying is reported to be on the slow side.

GLASGOW.—In the Scottish heavy chemical trade during the past week business has been rather quieter in the home market owing to labour troubles at the various docks. Prices keep firm. Export business remains unchanged.

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