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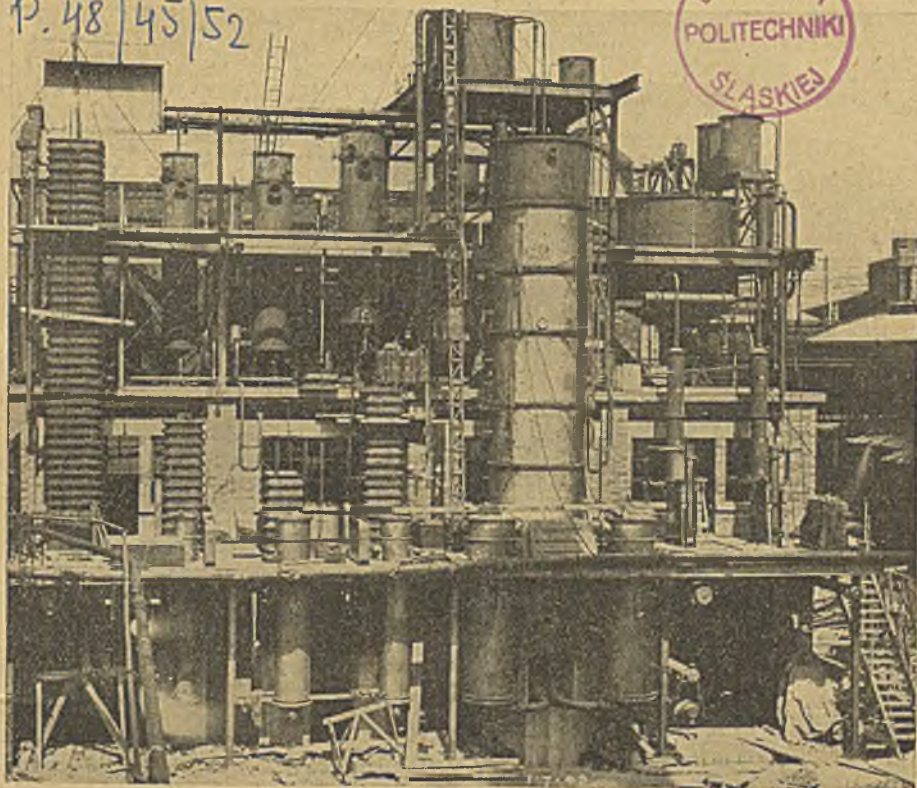
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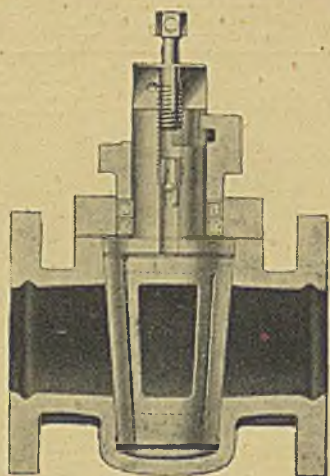
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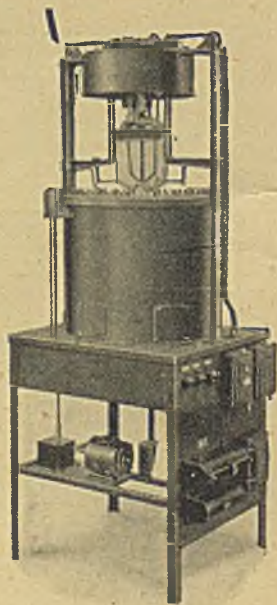
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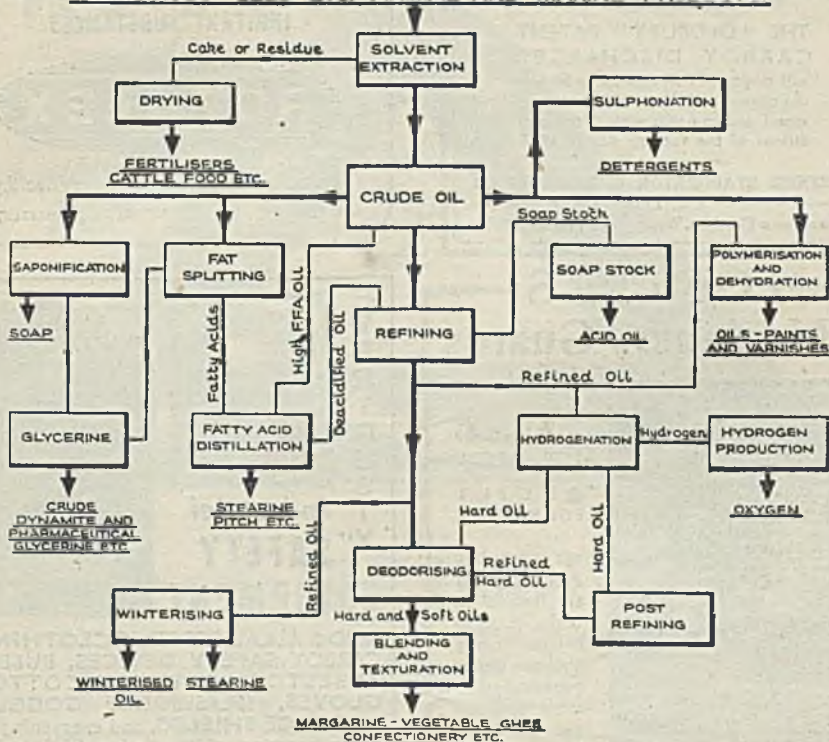
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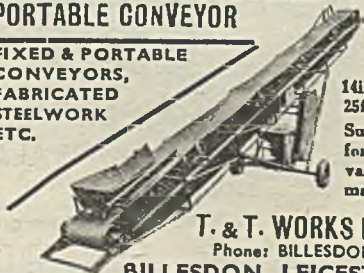
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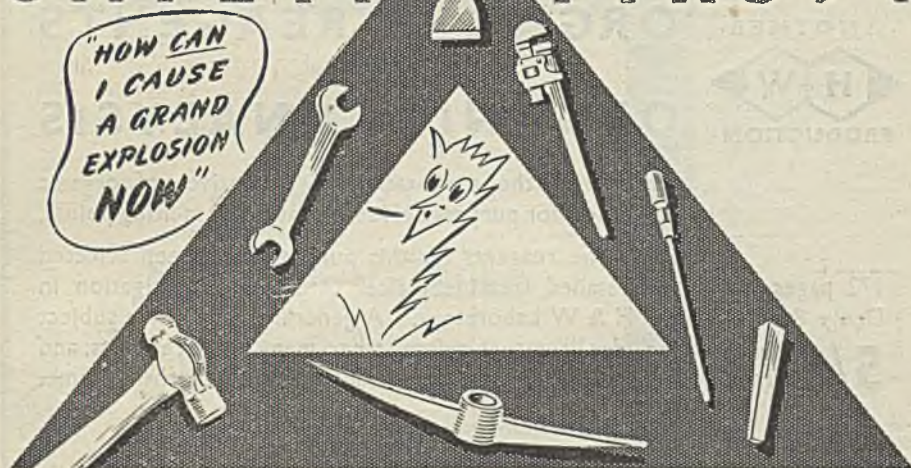
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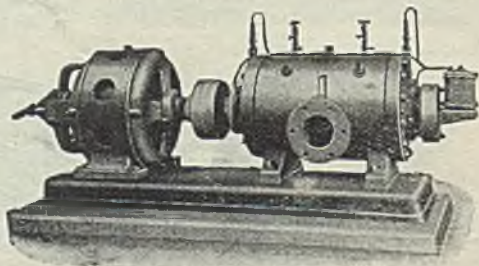
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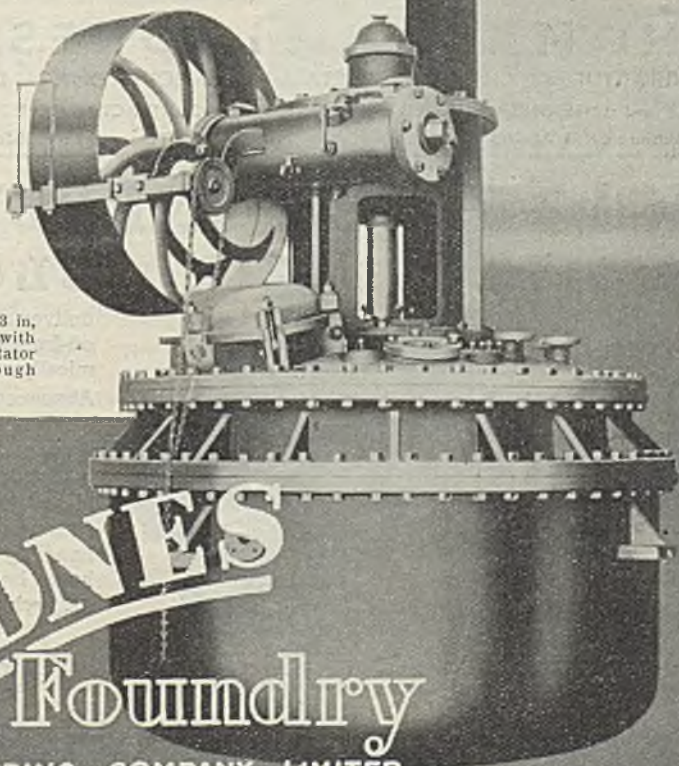
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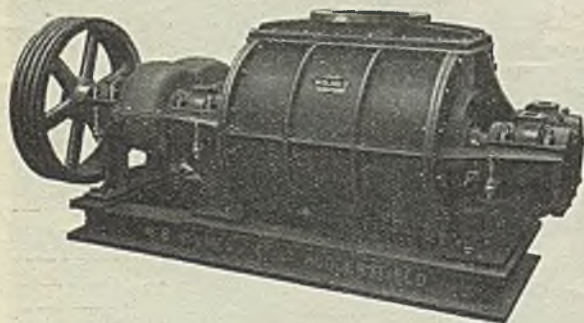
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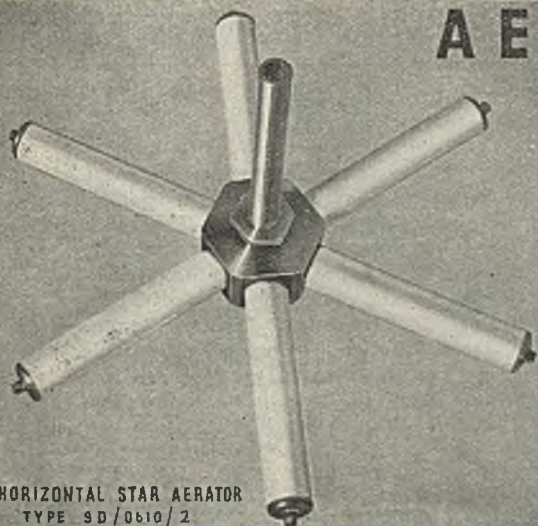
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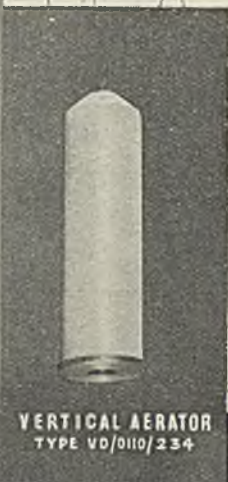
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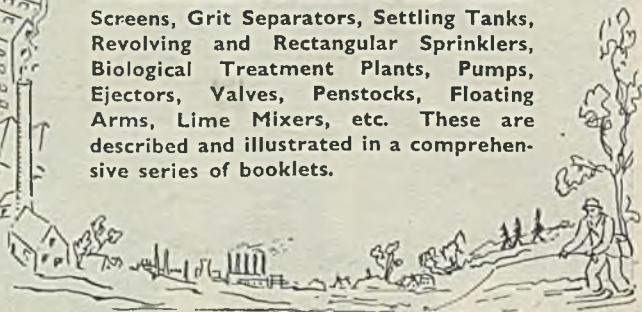
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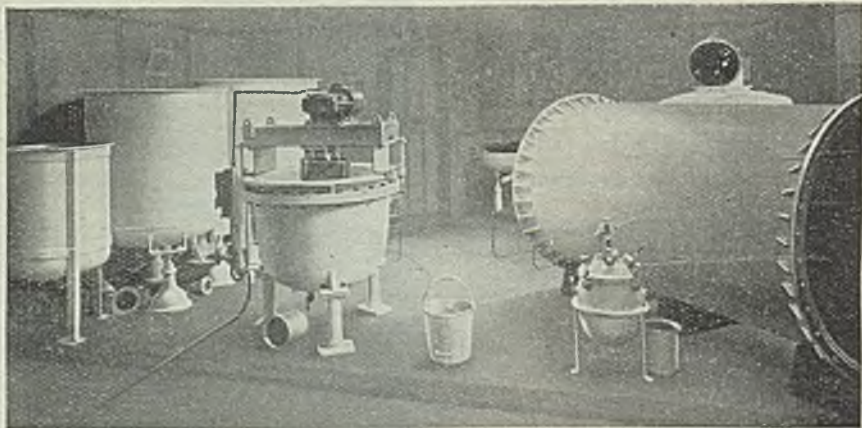


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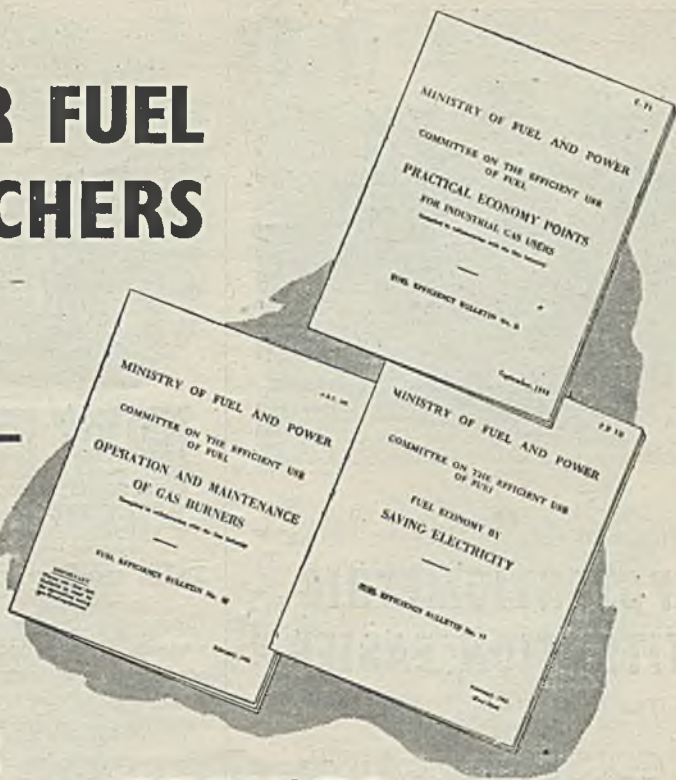
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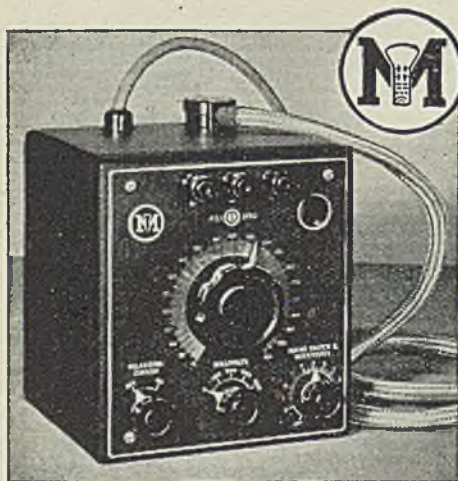
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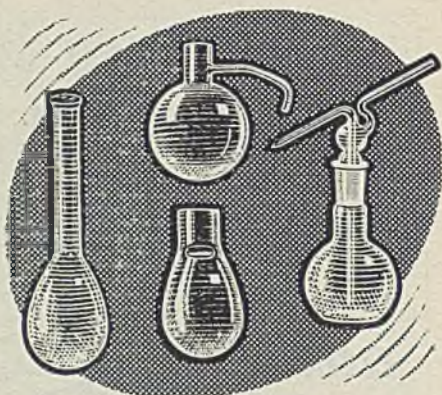




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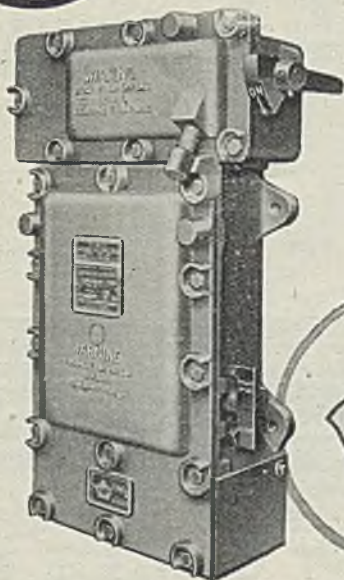
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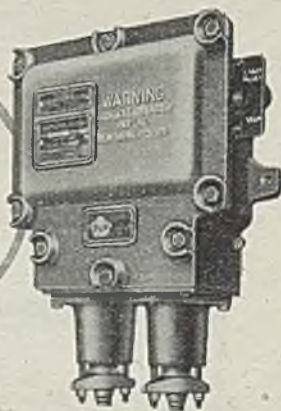


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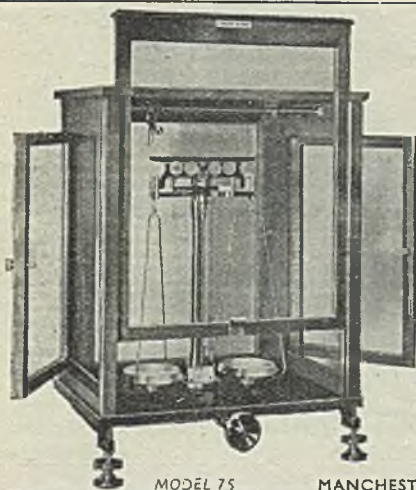
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The Severn Barrage

ANY hopes that may have been entertained that the generation of electrical power from the river Severn would lead to electricity cheap enough to enable electro-chemical industries to be developed in this country have been finally shattered by the latest report on the Severn Barrage Scheme. Several reports have been issued on this scheme, of which the most comprehensive was that of the 1933 Severn Barrage Committee. No action was then taken and the Minister of Fuel and Power set up a panel of engineers in November, 1943, to review the conclusions of the 1933 Committee.

In general, the 1943 Committee has found itself in agreement with most of the major features proposed by the 1933 Committee though with certain exceptions. These exceptions are based upon later developments in the design of hydro-electric plant, enabling fewer but larger turbine and alternator units to be installed; the great increase in the price of coal delivered to electricity power stations since 1933; the present and future necessity for conserving coal; and lastly, the great expansion in the supply and control of electricity with the development of the

grid. These modifications have given rise to certain changes in the design of the station which it is not necessary to describe here.

The principal modification is in the method of working. Tidal power is intermittent. Over each 24 hours there will be two periods of about 7 hours each during which the barrage plant would operate, leaving two periods of 5 hours each without production. The output on spring tides is much greater than on neap tides and, furthermore, high water occurs about 48 minutes later each day. Nothing can be done to smooth out the seasonal variations of the power available, and the 1933 Committee foresaw great difficulties in utilising a daily variation in power of this character. They recommended a system of pumped

storage whereby part of the power generated would be used to pump water back into storage so that the variable and intermittent power could be replaced either by constant continuous power or by power varying with the daily demand. In these circumstances the power available per year was calculated to be 1610 million units. The 1943 Committee has come to the conclusion that the varying and intermittent

On Other Pages

<i>Notes and Comments</i> ...	235
<i>Boiler Plant Maintenance—</i> <i>Mineral Wealth and Rustic</i> <i>Charm—Evanescent Ink</i>	—
<i>Royal Institute of Chemistry</i> ...	236
<i>Magnesium Production—I</i> ...	237
<i>Industrial Research</i> ...	243
<i>New Control Orders</i> ...	243
<i>Fertilisers—Iron and Steel</i> <i>Prices</i>	—
<i>Gammezane</i> ...	244
<i>Boxed Glass Carboys</i> ...	246
<i>Personal Notes</i> ...	248
<i>Parliamentary Topics</i> ...	248
<i>Seaweed Research</i> ...	249
<i>General News from Week to Week</i>	249
<i>Forthcoming Events</i> ...	251
<i>Company News</i> ...	252
<i>New Companies Registered</i>	252
<i>Stocks and Shares</i> ...	252
<i>British Chemical Prices</i> ...	254

output of the barrage could be taken up by the existing electrical grid by operating the coal-fired stations to suit the output of the barrage. By this means pumped storage is avoided, barrage current will be cheaper, and the energy available will be increased by approximately 2100 million units per annum.

Our reading of the report is that since the power output is increased and the capital cost materially decreased by eliminating the pumped storage system, the Committee has adopted this proposal as a means for reducing the cost of the current, and that without this change there would be no economic basis for the construction of a Severn barrage.

Coal-fired stations supplying current to the grid are restricted in that output from any one source is limited to a reasonable proportion of the total demand on the system at any time. This limitation in the case of the Severn barrage is to be 20 per cent. of the demand. On this basis and on 1944 prices it is concluded that between the year 1955, when the barrage could be in operation, and 1970 the cost of current at reception points would be 0.275d. per unit, falling to 0.262d. after 1970, by which time the restriction would cease to operate. The cost at barrage substations would be 0.209d./kWh; with coal saved at the average rate of 1.046 lb./kWh, the average cost of coal delivered to coal-fired station bunkers would have to be 37s. 3d. a ton to justify this figure of 0.209d. on purely economical grounds.

The Committee has considered what use can best be made of electrical energy of this intermittent character. It was hoped that some direct industrial use might be found by the erection of suitable factories in the neighbourhood of the barrage, but this was ruled out since it was found that no industry is at present equipped to utilise intermittent, variable, and progressive energy in accordance with the tidal cycle. It was thought possible that such processes might be devised in future and particular reference is made to the manufacture of magnesium oxide or the production of hydrogen and oxygen by the electrolysis of water. It does not appear, however, that there would be anything like sufficient demand to absorb the barrage output, at any rate for some time. Other methods of utilising the current were investigated, such as

district heating, co-operation with other tidal schemes which might operate when the Severn barrage was out of commission, similar co-operation with hydro-electric stations, and pumped storage as mentioned previously. For various reasons all these solutions were rejected, and it was decided that the only feasible method was to couple the barrage plant to the grid system and to regulate the output of coal-fired stations so that they might, together with the barrage, give an output varying with the daily fluctuation of demand.

Under these conditions the decision whether to build the Severn barrage station or not is one of extreme difficulty because, since the barrage current is not produced at the same time each day owing to the daily recession—some 48 minutes—of the time of high water, the same capacity of coal-fired stations must be built and maintained whether the Severn barrage is constructed or not. We thus have (1) a huge expense in building the barrage, estimated at £47,000,000; (2) a reduced efficiency in lb./kWh for the coal-fired stations, which must work intermittently or at least at lower output, in order that the grid may accept the barrage current; (3) an increased capital cost per kWh for coal-fired stations, since their load factor will certainly not be improved. On the other hand, it is shown in an appendix to the report that "tidal energy can under certain conditions, dependent on capital charges, working costs, and price of coal, be supplied at a cost not greater than the average cost of energy from coal-fired stations and in so doing saves the consumption of coal that would be necessary if it were supplied from such stations."

Whether the barrage should be built or not, therefore, depends on three factors. On the strictly economic side the factor is the price of coal. It is suggested in the report that the already high price of coal will not decrease, but on the contrary will continue to increase. The average price of coal (presumably delivered to the Central Electricity Board Stations) rose from 14s. 8d. in 1933 to 16s. 10d. in 1936 and to 42s. 2d. in 1944. Concurrently with the prophecy of the increasing price of coal the report also prophesies a decreasing quantity of coal required per kWh at coal-fired stations,

down to a limit of 0.54 lb. coal/kWh which, it is reckoned, will be reached in or about the year 2035. Under these conditions, admittedly problematical, it is computed that the Severn barrage would be economic over an 80-year amortisation period if the price of coal were 49s. 1d. in 1962, 49s. 7d. in 1970, rising steadily to 90s. 6d. in 2035. It must not be forgotten that the present price of coal is abnormal and that the Minister of Fuel has appointed a Technical Committee on Coal Mining (which should report soon), the object of which is to decrease the cost of coal by appreciably increasing the output per man-shift.

The second factor is the necessity for conserving coal. It is quite evident from the figures given that we are not going to get current any cheaper (to say

the least) during the first 80 years of the life of the Severn barrage than we should if the barrage was not built. Is it worth while building the barrage in order to save a quantity of coal which is estimated to be about 1,000,000 tons a year in 1955, decreasing to just over 500,000 tons a year by 2035?

The third factor is the contribution which the building of the barrage would make to employment in the difficult post-war period that is so nearly upon us. It is estimated that during the eight years of construction there would be an annual average of 11,727 men employed in this work. Clearly, the decision is not going to be easy. Whatever is decided, it is fully apparent that we cannot establish cheap power industries on the basis of the Severn barrage.

NOTES AND COMMENTS

Boiler Plant Maintenance

ON previous occasions we have made reference to the merits of maintenance engineers, whose branch of work has suffered heavily during the war from shortage of man-power. We are therefore all the more glad to hear of the issue of a booklet which will be of assistance to them, at any rate to those who are charged with the maintenance of boilers. Officials of the Ministry of Fuel, whose Fuel Efficiency Committee has produced the pamphlet (Fuel Efficiency Bulletin No. 38), inform us that they have searched technical libraries and bookshops in vain for a reliable guide to the practical side of boiler plant maintenance, though boiler plant operation is dealt with adequately. No doubt this lack of guidance has something to do with the poor state of much industrial boiler plant to-day. The close scrutiny which steam generation and boiler plant performance have been given on a national scale under war conditions has shown the extent to which maintenance of plant had been neglected. "In many instances," the Ministry points out, "the condition of the boiler plant was found to be such that efficient operation was impossible, the most elementary principles of boiler maintenance having been ignored." All efforts to raise performance to a high

level must, of course, fail if the plant is not in a good state of repair. If the plant is well maintained good results are more easily got from inferior fuels and the demands on boiler-house labour are eased. A special advantage of this Bulletin No. 38 is that, although there is in it a wealth of really useful facts and suggestions, these are set out in such a manner that the information is quickly grasped.

Mineral Wealth and Rustic Charm

THE decision of the Minister of Town and Country Planning to permit the construction of a cement works at Caudon Low, Staffordshire, appeared to set a term to the controversy about the amenities of the Manifold Valley. The decision lays down that the exploitation of Britain's natural wealth must take precedence of the rural *status quo*, provided that due arrangements are made about manufacturing and working methods and suitable landscape treatment. As a result of representations made by the C.P.R.E. and other bodies it has been laid down that quarry waste must be carted away, that trees must be planted on land spoilt by quarrying, and that smoke and dust must be reduced to a minimum, and the Minister said that he had taken geological and economic factors into account, as well as questions of amenity. It comes all the more

as a surprise, therefore, to learn that a rich seam of coal has been discovered in the vicinity of Cauldon Low. This indeed puts a new complexion on the matter, and the main economic advantage of opening the cement works disappears in a flash. For there is no doubt that the opening of a new colliery would suit the unemployed miners of Cheadle far better than could a cement works. Those who fought for preserving the attractiveness of the countryside will be the better pleased, too. For to-day the opening of a pit no longer means the devastation of a wide area, as the colliery at Calverton, in rural Nottinghamshire, bears witness. It looks as though bounteous Nature has sprung a pleasant surprise on both parties to the controversy.

Evanescent Ink

REFERRING to the letter from Mr. Mathews in our issue of March 3 (p. 205) on the subject "Waste Paper and the Chemist," a correspondent recalls a note published in the weekly journal *Prometheus*, edited by the distinguished dyestuffs chemist, Professor O. N. Witt, and published in Germany in the closing years of the 19th century. The scope of the journal was to enlighten the public about scientific and technical developments, and one of the editor's weekly articles dealt with this very problem of de-inking paper. This was at the time when newspaper printers, especially in France and America, were in the habit of using aniline dyes for printing; these were easily removed by bleaching, thus greatly facilitating the de-inking of used paper. Dr. Witt was strongly in agreement with this practice, and asked "Why should one print evanescent news on perishable paper with imperishable ink?" The problem to-day is much the same, and our correspondent asks why easily removable or bleachable dyestuffs are so little in use in the printing industry, even for newsprint, which normally does not have so long a life as documents, books, and the like.

Peru's portland cement production increased from 285,000 barrels in 1928 to 1,227,000 barrels in 1943 and the opening up of further limestone deposits is under consideration.

Royal Institute of Chemistry

The President's Address

AT the 67th annual meeting of the Royal Institute of Chemistry held on March 12, Professor Alexander Findlay, the president, emphasised the growing opportunities for men of science to bring about a better balance between science and politics and between knowledge and power. The tasks of government and the formation of a national and international policy which will secure the fullest and most complete development and expression of human nature, when beauty and goodness merge and blend together with truth, depended in part on values other than the scientific, and involved problems which could not be solved merely by the application of the laws of natural science. However, in securing the material well-being of the people and in advancing industrial prosperity, science was all important and representatives of scientific institutions on the Parliamentary and Scientific Committee were playing a particularly important part in keeping the Government informed about the discoveries and applications of science and in providing a scientific method of approach to the problems of national administration, a method infused with the spirit of truth rather than of prejudice or party partisanship.

The roll of membership of the Institute had increased by 523 to 9227 and the register of students by 205 to 1225. The local sections had been active in maintaining the scientific interests of the members by means of lectures and discussions.

New Charter Suggested

The president noted with satisfaction the greater collaboration among the various organisations of chemists and the better co-ordination of their activities, in which representatives of the Institute had continued to play their part. He congratulated the Chemical Council on having gained from industrial firms and private subscribers greatly increased financial support for chemical publications. It was 60 years since the Institute was incorporated by Royal Charter. Its membership had increased twentyfold and there had also taken place remarkable expansion of the activities of chemists in both range and variety. It was a tribute to the foresight of those who were responsible for drawing up the Charter that the Institute had so successfully adapted itself to changing conditions, but the time had come to reformulate its aims and interests and to adapt its organisation so as the more effectively to achieve its aims and fulfil its responsibilities. Proposals for modifying the Charter and by-laws would be laid before the members in due course.

Magnesium Production—I

Developments in Thermal Reduction Processes

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

WAR-TIME demands on the supplies of practically every metal of commercial value have forced increased production. Outstanding in this increased production is the significant new record output of magnesium. In the United States of America in 1939 the annual production of magnesium was about 3500 tons, while five years later the figure had risen to 250,000 tons. In Britain production figures just disclosed¹ show that the output of magnesium rose from 5000 tons in 1939 to 23,000 in 1943, almost a 500 per cent. increase. In view of the lack of hydro-electric power and the strained fuel position in this country the figures noted constitute a remarkable achievement.

Grant² states that about half a ton of magnesium is incorporated in every bomber and fighter plane produced in the United States, the greater percentage of the magnesium output being absorbed in aircraft structural parts. The main structures of machine-gun turrets in American planes are made of magnesium sheets and castings, while practically every type of military aircraft, from large four-engined bombers to small training planes, is fitted with magnesium wheels. Extruded magnesium I-beams are being employed in the floor construction of the newer types of Douglas cargo planes. An associated war-time use of the metal—the manufacture of incendiary bombs—also calls for large tonnages. A 500-lb. incendiary bomb known as a "block burner" is composed largely of powdered magnesium.

Post-war developments in engineering as applied to transport, whether by air, land, or sea, are certain to employ magnesium to a greatly increased extent. In view of the war-time expansion of the industry, supplies of the metal will be available on a large scale and almost certainly at keen prices. A great opportunity will be afforded to designers to break away from traditional features and to strike out boldly along new lines. The extensive employment of the light metals need not be restricted to transport engineering only; household fittings and appliances offer fields of use for these metals with great accruing benefits to households.

The Price of Magnesium

Magnesium produced in the United States is priced at present at about 20 cents per lb. (roughly 1s.), and it is practically certain that this figure will show a reduction in post-war years. This low price constitutes

a real challenge to the magnesium producers in this country. Considerable investigation and research, with real plant development, have taken place in Britain during the war years, but will the technical skill required, combined with the modern and efficient plant, allow magnesium to be produced at prices comparable with those obtaining in the United States?

Modern methods for the production of magnesium originated in the experiments of Bunsen in 1852, when he obtained pure magnesium by the electrolysis of the fused chloride. The Stassfurt deposits in Germany yielded a double chloride of magnesium and potassium (carnallite) which proved the most suitable material for the production of magnesium by electrolysis. In 1886, the first electrolytic magnesium plant began to operate at Bremen and until 1917 Germany had almost a complete monopoly of the sale of this metal. As a result of the rise in price of magnesium during the First German War, some American firms entered the field, the Dow Chemical Company building quite a large plant in Michigan in 1917. Consumption of magnesium in the United States in 1918 was 284,000 lb., so that to-day's consumption is about 2000 times that of 26 years ago.

Electrolytic Processes

Electrolysis of fused baths of magnesium chloride proved the only important commercial method of production for many years. Magnesium oxide is extremely difficult to reduce and in treating magnesite ores the chloride is formed by interaction with carbon and chlorine at high temperatures:

$$\text{MgO} + \text{Cl}_2 + \text{C} \rightarrow \text{MgCl}_2 + \text{CO} \dots\dots (1)$$

Subsequent electrolysis releases the chlorine, which is recycled for further use, while the metal is set free in the molten form.

Various difficulties are encountered in the electrolytic process: *e.g.*, the formation of anhydrous magnesium chloride; the corrosive character of the chlorine gas which must be handled in large quantities; losses of chlorine; and the intricate design of the electrolytic cell. Many attempts have been made to devise thermal reduction processes for the production of magnesium but until very recently these had met with but little success and virtually the entire magnesium output was obtained by the electrolysis of fused chlorides.

In the development of thermal reduction processes some serious difficulties are encountered, centring mainly around the price

of the reducing agent, the temperature at which reduction occurs, and the highly pyrophoric nature of magnesium vapour and dust. As magnesium boils at 1097°C ., the reduced metal is liberated in the vapour form, and the condensation of the vapour and collection of the dust present tricky problems. A wide choice of reducing agents exists: carbon, silicon, aluminium, ferro-silicon, calcium carbide, and silicon carbide. Although carbon is obviously the cheapest reducing agent, a carbon-arc furnace is necessary for the reaction, the reduction temperature being in excess of 2000°C . Much lower temperatures are possible with the other reducing agents but the cost of these substances militates against the successful development of the processes. In actual fact only two thermal processes for magnesium production have been successful on a full-scale plant: the Hansgirg process using carbon, and the Pidgeon process using ferro-silicon as reduction agent.

As an example of a process developed on a large scale under the stress of the present war a brief outline may be given of that

adopted by International Alloys, Ltd., in this country with aluminium powder as the reducing agent. Desch³ indicates that the process employed magnesia obtained from sea water.

International Alloys' Process

A mixture of magnesia with powdered aluminium formed into briquettes under high pressure is charged into specially designed crucibles in which it is preheated to 400°C . The crucible is a partitioned chamber with a central duct leading downward to the condenser arranged underneath it. Assembled compactly together into a portable unit the crucible and condenser are pushed upward into a vertical cylindrical furnace heated electrically. After making good the joints, the furnace is evacuated down to a pressure of less than 4 mm. of mercury. Resistance elements heat the crucible to a temperature of $1100^{\circ}\text{--}1250^{\circ}\text{C}$. Magnesium vapour begins to distil off, passing downward into the condenser which is maintained at a much lower temperature by water-cooling. The vapour condenses in the form of masses of flat crystals. After a period of about twelve hours the temperature is reduced and the vacuum broken. The portable unit comprising condenser and crucible is withdrawn from the furnace, and the deposit of magnesium is removed from the condenser and transferred to a remelting furnace. Although offering the great advantage that the condenser magnesium was in a non-pyrophoric form and could be handled safely in air, this process was completely uneconomic from the cost of the reducing agent. The Report of the Select Committee on National Expenditure gives the production cost as 3.11d. per lb.⁴

Before the plant was shut down a continuous vacuum furnace was designed⁵ on the tunnel-kiln principle, the portable units of crucible and condenser being pushed through the furnace by a hydraulically operated ram. The design of the crucible/condenser unit is shown in Fig. 1. Special loading and unloading chambers were provided, which were separated from the main furnace by vacuum-tight doors and evacuated by separate pumps.

According to the patent claims⁵ other reducing agents such as silicon or ferro-silicon may be used in place of aluminium. If these claims are substantiated there may be a future for the process. The actual plant and chemical engineering technique involved are of a very high order. Operation of the large furnaces employed at the high vacua and temperatures constitutes a really notable achievement.

Reduction of magnesia by carbon offers two difficult problems in actual practice: first, a temperature of 2200°C . is required, and second, the reaction $\text{MgO} + \text{C} = \text{Mg}$

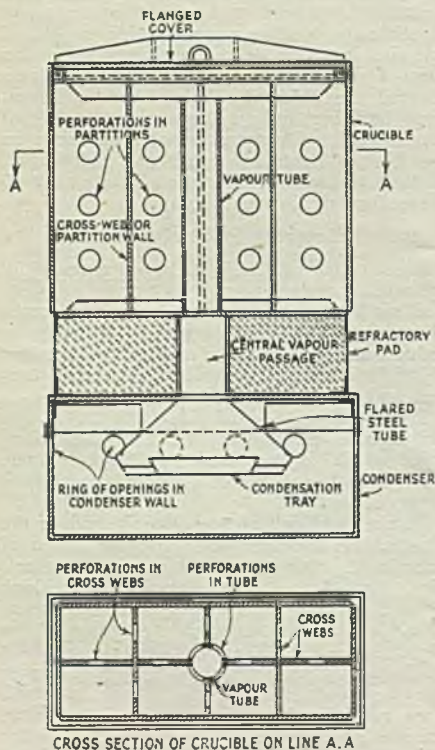


Fig. 1. Arrangement of crucible-condenser unit of rectangular cross-section, as used by International Alloys, Ltd. (B.P. 545,312).

+CO is reversible, so that as the temperature falls magnesium oxide is reformed. An electric arc furnace affords the necessary temperature for reduction, but means must be provided to cool very rapidly the mixture of gases escaping from the reduction furnace.

The Hansgirk Process

At Radenthein, in the magnesite-producing region of Austria, Hansgirk brought to a commercial success a process for the reduction of magnesium oxide by carbon using large volumes of hydrogen as the rapid (or "shock") cooling medium. According to Landis¹ the briquetted charge contains finely crushed magnesite and anthracite in the proportion of approximately three to one. A screw conveyor takes the charge to the ram feeder at the base of the furnace. Reduction is effected in a cylindrical electric furnace, power being supplied to three 10-in. carbon electrodes from a 3000 kVA transformer. A hydraulically operated ram pushes the charge upwards into the space between the electrodes, through an aperture provided in the carbon block base of the furnace. The furnace, composed of a welded steel casing lined with carbon blocks, is tight against an internal pressure of several inches of mercury. Hydrogen at 50 mm. pressure is introduced just below the oil-cooled glands on the electrodes to prevent metal vapour condensation on the cooler parts.

Escaping from the reduction furnace the gaseous mixture of magnesium metal vapour and carbon monoxide passes through an oil-cooled cone into the condenser. Large volumes of under-cooled hydrogen for "shock" cooling are introduced through numerous slots in the cone, and the length of passage from the arc in the furnace to the mouth of the cone must be as short as possible. Some 40-50 volumes of hydrogen are injected per volume of magnesium vapour, so lowering the mixture of gases almost instantaneously to a temperature of $150^{\circ}\text{--}200^{\circ}\text{C}$. This sudden cooling produces a condensate of magnesium in the form of a very fine powder. Some idea of the construction of the furnace and the cone may be obtained from Fig. 5, although the particular design illustrated utilises oil as the shock-cooling medium.

An oil-cooled welded steel cylinder arranged horizontally constitutes the condenser which contains only a rotary scraper to remove large particles of precipitated magnesium, and a poking rod to keep the cone free of deposited metal. Two outlets are provided in the condenser, the upper taking off the greater proportion of the magnesium dust in suspension in the gases, and the lower to recover coarse precipitated particles of magnesium. The solids produced in the condenser carry 50-60 per cent. magnesium

metal, 15-25 per cent. of magnesium oxide, and unburned carbon.

The mixture of hydrogen and entrained magnesium dust leaving the top of the condenser passes through two oil coolers which

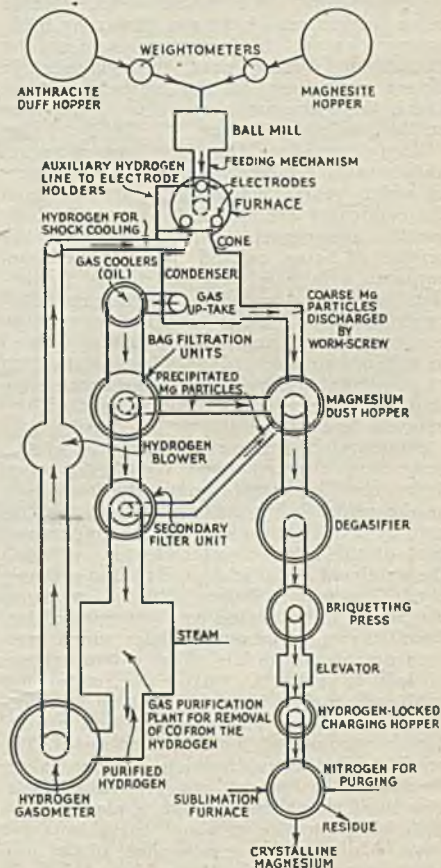


Fig. 2. Flow-sheet of the Hansgirk carbon-reduction process, constructed from published data. All parts in the sequence of operations indicated by \equiv are carried out in an atmosphere of hydrogen.

reduce the gas temperature to about 60°C . From the coolers the mixture of gases passes to bag filtration units in which practically all the magnesium dust is deposited. Mechanical shaking gear removes the magnesium dust from the inside of the bags, the deposited material falling down into the conical base of the unit from which it is withdrawn by a screw conveyor.

Hydrogen from the filtration unit now contains a quantity of carbon monoxide, from which it must be purified after each cycle. Carbon monoxide may be removed

partly by an activated adsorbent after the hydrogen has been passed through a refrigerator. The Austro-American Magnesite Co., Ltd., has patented a process for the conversion of carbon monoxide by steam under pressure, the resulting carbon dioxide being washed out of the gas stream by high-pressure water. After absorption of carbon dioxide the gases pass through electric dryers and then to the gasholder from which the hydrogen is recycled to the cone on the reduction furnace.

Magnesium dust from the bag filtration unit is taken by screw conveyors to hoppers to which coarse magnesium particles from the condenser are also fed. From the hopper the dust passes to briquetting rolls, the briquettes being carried by a bucket conveyor to a hopper from which the distillation furnaces are fed. Magnesium dust produced at this stage contains about 50-60 per cent. magnesium metal, and is treated in sublimation furnaces to effect purification of the metal and to convert the magnesium into a form in which it may be handled and exposed to the air.

Sublimation furnaces, vertical steel retorts, are charged from hoppers through hydrogen-tight flexible joints, the lower part of the retort being charged with briquettes and heated electrically. In the upper cool part of the retort is a condenser on which the sublimed metal is deposited in a strongly crystalline form. Before sublimation begins the retort is evacuated to a pressure of less than 0.5 mm. of mercury, under which pressure magnesium distils off at a temperature of less than 750°C. After the metal has sublimed, the retort is brought up to atmospheric pressure with nitrogen and opened for the removal of the deposited metal. The product of the sublimation furnace is remelted in the foundry and cast into billets. The total metal output from a plant with a 3000 kVA furnace is about three tons per day. A diagrammatic flow sheet of the process, constructed from the published data, is shown in Fig. 2.

Modified Hansgirg Plants

Plants operating on the Hansgirg process have been established in Britain, in Japan, and at Permanente, California. Kirkpatrick states that the important modification incorporated in the Permanente plant is the use of natural gas as the shock-cooling medium in place of hydrogen. From the published description, the plant appears in all essentials to resemble closely the original process as practised at Radenthein with one or two minor changes.

Ore, obtained by the calcination of magnesite or brucite from Nevada, together with magnesia from seawater, is mixed with petroleum coke, and briquetted, using pitch as a binder. Smelting is effected in electric arc furnaces, the first to be installed being

8000 kVA, while four later models of the same size are now in use. Hydrogen is injected below the electrode glands to prevent condensation of magnesium metal. The cone leading from the smelting furnace to the condenser is made of stainless steel, natural gas being injected into the mixture of magnesium vapour and carbon monoxide in the ratio of 25 volumes for each volume of furnace gases (*i.e.*, about 50 volumes for each volume of magnesium metal vapour). To agglomerate the fine particles of magnesium carried by the gases from the condenser an electrostatic plant is employed, agglomeration of air-borne particles being a recent application of electrostatic precipitation which is being used on quite an extensive scale. From the agglomerators the gases pass to the woollen bag filters in which the magnesium dust is separated.

Of the total volume of natural gas circulated per cycle, about 25 per cent. is withdrawn after passage through the bag filters and pumped to an adjacent cement plant in which the gas is used as fuel. After making up the circulating gas load with fresh natural gas, the carbon monoxide content is reduced to the safe limits. In this way the quite elaborate gas-purification plant outlined earlier is rendered unnecessary, although facilities have been provided for carbon monoxide purification by treatment in solutions of copper ammonium salts under pressure.

Magnesium dust from the bag filters, together with the coarser particles from the condenser, is compressed into tablets, which are lifted to hoppers and discharged through gas-tight flexible rubber joints to the sublimation furnaces. As already described, the sublimation furnaces comprise an electrically-heated lower half with an oil-cooled steel condensation shell in the upper part. Volatilised from the briquettes at a temperature of about 750°C. under a pressure of less than 0.5 mm. of mercury, the magnesium condenses on the cooled shell in coarsely crystallised form. Each retort, operated on a batch basis, contains sufficient magnesium to yield about 1 ton of magnesium metal per 72 hours. When sublimation is complete the shell is withdrawn by the overhead crane and the metal removed, remelted, and cast into pigs. The capacity of this American plant is now believed to be about 2,000,000 lb. per month.

Operating Difficulties

Operating difficulties with the Hansgirg process are considerable, most formidable of all being the necessity to maintain an atmosphere of hydrogen over the magnesium dust throughout the process. From the bag filtration plant the dust is degasified by pressure and briquetted under hydrogen, while special flexible rubber joints must be fitted

between the charging hoppers and the top doors of the sublimation furnace. Access to the base of the smelting furnace is achieved through a small steel-backed door, the hydrogen being allowed to burn around the edges of the aperture. Opening up any

pared with the horizontal type, may be opened and cleaned with a much greater degree of safety. A nitrogen purge is employed in other parts of the plant, particularly in the sublimation furnaces.

Little definite evidence is available re-

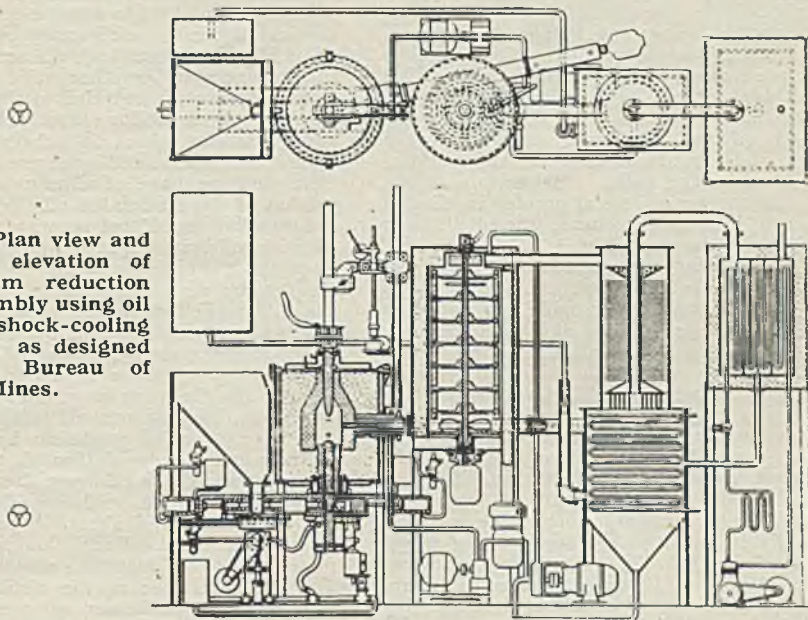


Fig. 3. Plan view and sectional elevation of magnesium reduction unit assembly using oil as the shock-cooling medium; as designed by U.S. Bureau of Mines.

other part of the plant is, however, attended with considerable risk, especially the condenser. Sprays are fitted and oil under pressure is pumped over the interior surfaces to minimise the pyrophoric nature of the dust before the admission of air.

According to a recent report by Kirkpatrick,⁸ considerable modifications in condenser design have been effected at Permanente. In the older type of condenser the poking mechanism was fabricated from stainless steel and was cooled by oil circulation. Failure of the poker, with leakage of oil into the condenser, was quite frequent. In the new type of poker a heat-resisting cast alloy is employed with inserted cutting edges of very hard carbide.

A vertical design of condenser replacing the large horizontal type has offered a number of distinct advantages. Any coarse dust which may precipitate in the condenser falls by gravity to a hopper base from which it is removed by a screw conveyor. In this way the scraping mechanism may be dispensed with. Also, by installing a spool and a gate valve between condenser and furnace and also at the off-take pipe, the condenser may be shut off from the remainder of the gas system. This vertical condenser, considerably reduced in size as com-

paring the economics of the process, but it is claimed that in actual fact it is cheaper than the electrolytic or ferro-silicon processes. According to Landis⁹ the total power consumption is 18 kWh per kg. of metal (8.2 kWh per lb. of Mg.) of which 14.5 kWh per kg. (6.6 kWh per lb.) is expended in the reduction furnace. In Britain, where the cost of electric power is rarely less than 3d. per unit under war conditions, the electric power cost for even a comparatively small plant producing 200,000 lb. per month is £5000. In the U.S.A., with power commonly available at less than 1/4d. per unit (0.4 cents per kWh), it is easily possible to sell the refined metal at 20 cents (say 1s.) per lb. Landis⁹ quotes furnace efficiency figures as 85-90 per cent., giving, with sublimation losses, an overall metal recovery in excess of 80 per cent. Even if 85-90 per cent. furnace efficiency proves difficult to attain in practice, an overall recovery of 75 per cent. or better is believed to compare very favourably with the electrolytic process.

Oil for Shock-Cooling

To replace hydrogen as the shock-cooling medium by a less dangerous material, and so minimise the pyrophoric nature of mag-

nesium dust, has been the aim of all modifications of the Hansgig process. The most obvious substitute for hydrogen is oil, several patents having been granted in this connection. In addition, the U.S. Bureau of Mines has operated a semi-scale plant using oil as the shock-cooling medium.⁹ According to the description by Doerner, Holbrook, Dilling, and Harris⁹ the apparatus consists (as shown in Fig. 3) of an electric arc furnace connected through an orifice with a shock-cooling flue, together with a centrifugal separator for the recovery of liquid oil and condensed solids from the gases and vapours, a scrubber, and refrigerated condensing coils. Separation of the oil and magnesium metal powder is effected in two horizontal retorts, the distillation unit being shown in Fig. 4.

By flotation concentration a magnesite concentrate is produced containing about 45 per cent. magnesium oxide and not more than 1.5 per cent. silica and yielding, after calcination, a material containing about 90 per cent. magnesium oxide. After mixing with 23 per cent. of low-ash carbon, the material is ground in a rod mill and fed automatically in controlled quantities to the electric arc furnace. Emerging from the furnace orifice at a temperature of about 2000°C., the gaseous mixture of magnesium metal vapour and carbon monoxide is cooled rapidly by an atomised spray of light fuel oil to below 200°C., a considerable proportion of the oil being evaporated simultaneously. The rate of oil fed to the atomising sprays is regulated so that the unvaporised portion is just sufficient to form a fluid sus-

and carbides produced from the ore all in suspension in oil, the vapour phase consisting of oil vapour and carbon monoxide, together with hydrogen and methane produced by thermal decomposition of the oil.

Separation of the liquid and vapour phases is effected in a centrifugal device, the vapour passing first to a water-cooled scrubber and thence to refrigerated condensation coils. Liquid oil from both the scrubbers and the refrigerator, together with any additions necessary, is recycled to the reduction furnace shock-cooling flue. Final exit gases, carrying about 50 per cent. carbon monoxide, 30 per cent. hydrogen, and 20 per cent. methane, have a fuel value about equal to that of the dissociated oil.

From the centrifugal separator the liquid oil with solids in suspension flows by gravity to a pump, which elevates it to the hopper feeding the distillation unit. Removal of the oil is effected in the upper horizontal retort of the unit, which is heated to 500°C. The liquid suspension is moved through this upper retort in pans attached to continuous chains. As the pans move through the retort, the oil is evaporated, being swept out into a water-cooled condenser by a current of hydrogen circulated through the system. Evaporation of the oil from the suspension leaves a residue of small, dry, porous cakes of solid containing about 50 per cent. of magnesium metal. From the upper retort pans these cakes drop into a sealed hopper. The lower member of the distillation unit consists of a horizontal alloy steel retort heated to over 1000°C. by external electric resistance elements. In the upper, heated

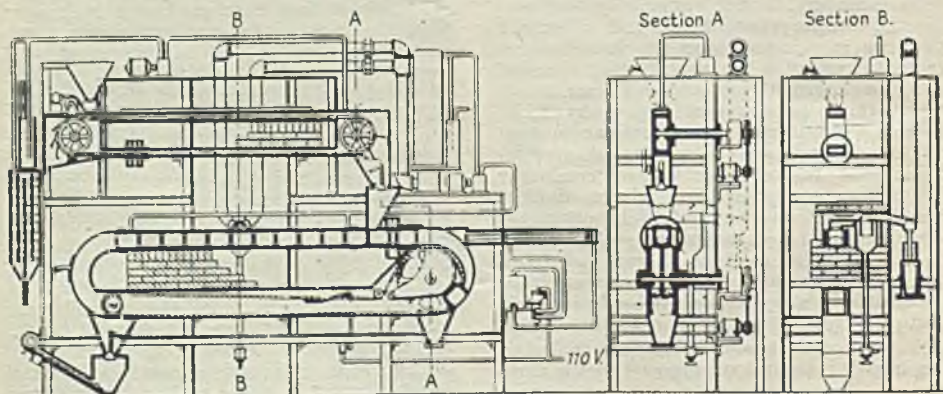


Fig. 4. Two-stage continuous distillation unit in which oil and magnesium are recovered separately, in process designed by U.S. Bureau of Mines.

pension with the metal condensate, the amount required being controlled according to the temperature of the liquid/solid suspension. From the shock-cooling flue a liquid and a vapour phase are obtained, the liquid phase consisting of particles of magnesium metal and oxide, carbon, silicides,

part of this retort are housed a number of alloy steel cages, which are moved through the retort by an electrically-driven ram operating through a sealed gland. Return movement of the cages to the feed entry point is effected by a drag chain and lifting wheel. Cakes of solid from which oil has

been evaporated are fed into the cages from the sealed hopper. As the cage is pushed by the ram into the zone at 1000°C., the magnesium metal distils off and is carried by a current of hydrogen to a condenser from which the molten metal is tapped. At 1000°C., magnesium has a pronounced vapour-pressure, and a considerable partial pressure of hydrogen may be employed without affecting the distillation.

According to the report,⁹ results obtained show that it is practicable to use oil as a shock-cooling medium, and when atomised in a nozzle of correct design it is as efficient as hydrogen. In addition, the very large gas-handling equipment is practically eliminated while the oil film on the magnesium particles prevents spontaneous oxidation. Light stove oil has proved satisfactory, 25 lb. having the same cooling effect as 1000 cu. ft. of hydrogen. At 180°C. the total volume of gas and oil vapour to be handled is 150 cu. ft. (at N.T.P.), compared with ten times this volume when hydrogen is employed.

In the following table are given average operating data for a reduction unit using oil for shock cooling:

Capacity (lb. of Mg. per hour) ...	7.11
Conversion (per cent.) ...	76.8
Power consumption (kWh per lb. of Mg.) ...	12.3
Oil consumption (lb. per lb. of Mg.) ...	0.75
Electrode consumption (lb. per lb. of Mg.) ...	0.18*
MgO in condensate (lb. per lb. of Mg.) ...	0.50
Carbon in condensate (lb. per lb. of Mg.) ...	0.62
By-product gas (CO, H ₂ , CH ₄) (cu. ft. per lb. of Mg.) ...	26.5
Energy consumption is 40.50 per cent.	

higher than that claimed for the Hansgirg process, but the small size of the unit must be taken into account.

So far as distillation is concerned, the authors⁹ believe that a unit which has a capacity of 100 lb. of metal per hour could be produced with an energy input of 150-200 kW. Assuming a radiation loss of 10 per cent., it is estimated that the unit would require 0.57 kWh for oil distillation and 1.16 kWh for magnesium distillation, a total of 1.73 kWh per lb. of magnesium produced.

(To be continued)

Liquefied petroleum gas used for chemical manufacturing in the U.S. is estimated to have increased by about 5,000,000 gallons in 1944 to a total of 60,000,000 gallons—representing 7.7 per cent. of aggregate sales—according to G. G. Oberfell and R. W. Thomas, of the Phillips Petroleum Company. These figures do not include butane or butenes used in the production of butadiene for synthetic rubber.

Industrial Research

Dr. Smith Demands a National Inquiry

SPEAKING at Scunthorpe last week, at a joint meeting of the Institution of Chemical Engineers and the Royal Institute of Chemistry, Dr. E. W. Smith, president of the Institute of Fuel, advocated a national inquiry into every aspect of research in industry. He could vouch for the quality of scientific research in this country, he said, but, unfortunately, the volume of it was negligible.

He believed that if all the knowledge and fruits of research locked away in private files of institutes, companies, and individuals, for all practical purposes lying dormant for decades, could be brought to light and tabulated, much useless expenditure in time and money could be avoided in experimental phases after the war. Dr. Smith expressed the opinion that legislation should be introduced to prohibit industrial groups from paying university professors retaining fees as consultants, thus denying their knowledge to the community as a whole.

New Control Orders

Fertilisers

MAXIMUM prices for a new fertiliser, "Silico Phosphate," are established by the Control of Fertilisers (No. 30) Order, 1945 (S. R. & O. 1945, No. 234), effective from March 12. "Silico Phosphate" is defined as "any ground phosphate rock sintered with an alkaline material in the presence of silica." The standard price in Great Britain for 6-ton lots d/d nearest station is £9 6s. per ton. *Deductions* are made, at the rate of 1s. 6d. per ton per month, for deliveries made before March, with a maximum deduction of 12s. per ton for July deliveries. *Additions* are made for lots of less than 6 tons, up to 20s. per ton for lots smaller than 1 ton.

Iron and Steel Prices

The Control of Iron and Steel (No. 40) Order, 1945 (S. R. & O. 1945, No. 239), which came into force on March 12, alters the maximum prices for certain iron and steel products, the principal changes being reductions in prices for forging ingots and alloy steel and increases for pig iron, tubes, certain classes of steel wire and wire rope, and certain iron castings. The hematite pig iron basis prices are raised by 15s. per ton, while alloy steel billets and bars are lowered by from 13s. to 15s. 9d. per ton. Maximum prices are also provided for the first time for hot finished and cold drawn tubes to Admiralty specifications and for cast iron brake drums. A list is appended of the altered related schedules.

Gammexane*

An Insecticide with Outstanding Properties

UNTIL recently the principal insecticides in commercial use were pyrethrum, derris, nicotine, hydrocyanic acid, paradichlorobenzene, various organic isocyanates, and the well known poisons discovered by the alchemists, arsenious oxide, arsenites and lead salts. The use of the inorganic poisons is to be deprecated because they are so poisonous to animal life and therefore dangerous if they get on to food such as fruit. Of these insect poisons hydrocyanic acid and the active principles of pyrethrum and derris, namely the pyrethrins and rotenone, affect insects in the smallest doses, and the pyrethrins and rotenone are not dangerous to mammals.

Since pyrethrum and derris are expensive to produce, and the supply is limited, investigators have for some years been looking for chemicals easily synthesised which would be as effective as the pyrethrins and rotenone. From 1934 over a period of five years we, in I.C.I., investigated several thousand organic and other chemicals prepared in our various laboratories. These were tested by Dr. O. B. Lean and his staff at the I.C.I. Hawthorndale Laboratory at Jealott's Hill. The general method of investigating the toxicity of chemicals was to determine the concentration necessary to obtain a 50 per cent. kill on a series of standard insects. Among the insects used were grain weevils, flies and locusts, mosquitoes and certain aphids.

A Promising Discovery

Five or six years ago we changed the method of attack and instead of testing large numbers of chemicals we selected certain insect pests and sought for the chemicals and methods best suited to fight them. Early in 1942, looking for a substance to kill the turnip flea beetle, we tried several chemicals, including heptachlorocyclohexane (monochlorobenzene hexachloride) and octachlorocyclohexane (orthodichlorobenzene hexachloride). A sample 1.2.3.4.5.6. hexachlorocyclohexane (benzene hexachloride, the chemical formula of which is $C_6H_4Cl_6$ or 666 for short) was also tested and this was found by F. J. D. Thomas to be promising. This sample of benzene hexachloride or 666 was made in 1942 by F. D. Leicester (one of the few chemists in the Widnes laboratory whose service dates back to the days of the United Alkali Co.) by chlorinating benzene in the presence of light and crystallising the product from

benzene. The results of trials against a number of insect pests both in the laboratory and on the small field scale were most encouraging, but the results were not as consistent as we expected.

We investigated the inconsistent action of different samples of 666 and K. C. Webster examined both the possibility of an impurity being the active principle and also the toxicity of the various isomeric forms of 666, the existence of four of which was established by Van der Linden in 1912.

Late in 1942 pure specimens of the α - and β -isomers were prepared by J. C. Smart and their toxicity to insects was investigated by F. J. D. Thomas. It was found that both isomers were relatively inactive to weevils, the β -isomer being practically non-toxic. Early in 1943 the γ -isomer was isolated and found to be more toxic to weevils than any substance which we had ever tested. It was thus established that the insecticidal action of 666 was due almost entirely to the presence of γ 1.2.3.4.5.6. hexachlorocyclohexane which I shall call Gammexane. This, the active principle of 666, is present to the extent of 10-12 per cent. in the crude material.

Preparing Pure Isomers

In Smart's method of preparing pure isomers, the crude material is treated with a limited amount of methanol, in which the α - and β -isomers are relatively insoluble. Separation of the solid product (I) leaves a solution containing the γ - and δ -isomers and other highly soluble chlorinated bodies, very little α and some β . On evaporating the solution a small crop of practically pure γ (II) is thrown down; as evaporation is continued, the next crop of crystals contains γ and some β . A later crop contains γ , a trace of β and some δ (III). Pure α and pure β may be readily isolated from (I) by taking advantage of the low solubility of β in practically all solvents. Pure γ may be readily prepared from (II) by recrystallisation from chloroform. Pure δ may be prepared with more difficulty from (III) by selective precipitation of a methanol solution with petrol ether, followed by recrystallisation from chloroform.

The hexachlorocyclohexanes possess considerable chemical stability. In the process of manufacture they are exposed to the action of hot water and light for a considerable period. They can be crystallised from hot concentrated nitric acid. Hence these materials will be unaffected by continued exposure to the atmosphere. In the presence of alkalis, such as lime water at 60°C. or even at ordinary temperatures, hydrogen

* Extracted from the Hurter Memorial Lecture, delivered by Dr. Roland E. Slade, M.C., D.Sc., F.R.I.C., M.I.Chem.E., on March 8 before the Liverpool section of the Society of Chemical Industry.

chloride is removed from the benzene hexachloride molecule, giving a mixture of the isomers of trichlorobenzene. This effect may also be brought about by mixing 666 with dry lime. Dehydrochlorination does not take place with ground limestone or chalk at room temperature or at 60°C. either dry or in the presence of water. So 666 is stable in natural waters.

In the pure state the isomers of benzene hexachloride are well-defined, colourless crystals, practically insoluble in water, soluble in organic solvents, practically inodorous and possessing bitter tastes. The sharp melting-points of highly purified samples are given in Table I.

TABLE I.

Isomer	m.p. °C.
Alpha	157.5-158
Beta	309
Gamma	112.5
Delta	138-139

The approximate composition of the crude material was established by three independent lines of work. In the first place the extraction of the isomers by selective solvents in the manner already described gave fairly accurate figures, especially for α and β . Secondly, comparison of the biological activity of the crude material with that of the pure γ -isomer enabled the γ content of the crude material to be defined approximately when it had been demonstrated that the remaining constituents did not contribute appreciably to the toxicity. In the third place, and at a later date, the composition of the crude material was directly determined by infra-red spectroscopy by Dr. Thompson at Oxford.

Examination of the solubilities of the pure isomers brought to light the consistently low solubility of the β -isomer and also the higher relative solubilities of the γ - and δ -isomers. The latter, when present with the impurities in the crude material, forms syrups with solvents, making crystallisation extremely difficult.

Toxicity

The toxicity to animals has been investigated by Dr. H. Taylor, who found that the following quantities per kg. of body-weight were necessary to obtain a 50 per cent. kill (in seven days) of rats when introduced into the stomach.

TABLE II.

Isomer	Toxic dose
Alpha	1.7 gm./kg.
Beta	No animals killed
Gamma	0.19 gm./kg.
Delta	1.00 gm./kg.
Mixture of isomers	1.25 gm./kg.

Experiments on the chronic toxicity showed

that rats could be fed 10, 20 or 30 mgm. of gammexane per day for five weeks without effects of any kind being produced, and 100 mgm. of the mixture of isomers was fed daily with the food for two months to rats without producing any effect. These experiments are still going on, as are tests of the effect of painting the skin. The subcutaneous injection of 100 mgm. of gammexane per kilo body-weight killed 25 per cent. of the rats. The rest were severely affected but recovered in three days. Of the mixed isomers 600 mgm./kg. were injected without producing any effect. The α - and β -isomers at saturated concentration did not affect goldfish. The δ -isomer slightly affected the fish at saturated concentration of 10 to 12 parts per million. Gammexane was distinctly toxic to fish at a concentration of one part per million.

Insecticidal Preparations

As a substitute for ground derris a finely-divided powder was produced, containing 20 per cent. of crude 666 and 80 per cent. gypsum, which was further diluted with selected materials to give insecticidal powders for use on crops. For some uses the material is required in solution in an organic solvent. Solvents used in practice include methanol, xylene, carbon tetrachloride, perchlorethylene, and decahydronaphthalene (Dec.). Solutions containing 5 per cent. gammexane or more may be diluted for use with kerosene or other suitable oil. By the addition of an emulsifying agent such as selected Turkey Red Oil, concentrated solutions can be prepared which on the addition of water give a stable emulsion suitable for use in the field.

Another gammexane preparation designed for use with water as diluent is the dispersible powder, and suitable types may be prepared, either from crude 666 or from the solid product resulting from the removal of α -isomer from the crude, by incorporating an adequate amount of "Goulac," i.e., waste lye resulting from the sulphite treatment of cellulose.

Unlike many insecticides, gammexane has proved to be exceptionally stable to high temperatures. This enables it to be applied by volatilisation from hot plates, or by other heating methods, producing the insecticide in the form of a "smoke." By these means the insecticide may be used directly against insects or to give a toxic film on walls, etc. This method of application is being investigated further.

A wide range of insect pests including locusts, weevils, mosquitoes, and house-flies, has already been found to be lethally affected by gammexane. The median lethal dose varies considerably from pest to pest, although it is generally lower than that for other insecticides. Against certain pests

gammexane has proved more toxic in laboratory tests than any other insecticide examined.

Mode of Action

As an insecticide the product has the merit of acting as a stomach poison, as a contact agent, or as a fumigant. Since these effects may be combined, the investigation of its mode of action presents difficulties and special techniques must be employed.

In spite of the great advances which have been made in recent years in human medicine we really know very little concerning the mode of action of chemotherapeutic agents upon the life processes of the cell. However, we have a few guiding principles which have emerged from recent work and these should help us to introduce some plan into the testing of chemicals *in vivo*. One of these principles has emerged from the empirical discovery of the sulphonamide drugs, namely, that the active chemotherapeutic agent masquerades as a molecule which is essential for the life of a cell. In other words β -amino-benzene sulphonamide reacts where β -amino-benzoic acid should have been in a normal cell reaction, but is then unable to perform the next function of normal cell life.

Inositol is a metabolite which is found widespread in many types of cell and thus

we would infer from our masquerading hypothesis that if we could mock up a molecule which would be similar to it not only in molecular dimensions but also in some physical prerequisites then it should be taken up by an organism and gain general access to its cells. Dr. Olive Mooney has pointed out the resemblance between the hexachlorocyclohexanes and the hexahydroxycyclohexanes (inositols), and gammexane on this hypothesis resembles them closely. Thus it is possible that gammexane is absorbed from the outside of the insect, distributed throughout some portion of the organism to the cells where a vital reaction is blocked and the organism dies.

The specificity between chemical constitution and physiological action illustrated by the separate isomers is of interest and this fact should be borne in mind when considering the action of DDT. The latter compound may also be blocking the vital reaction which is dependent upon inositol, but it must be remembered that DDT seems to have only one-fifth the power of gammexane, and it may be therefore blocking quite a separate vital reaction. All this is very speculative, but I believe that compounds of highly specific physiological potency will be found to be of great value for the chemical investigation of vital processes in the cell.

SAFETY FIRST

Boxed Glass Carboys

by JOHN CREEVEY

SAFE means for the conveyance of dangerous chemical liquids from maker to user has developed as a result of much careful thinking. Some of the difficulties which have had to be faced in the United States were reviewed in *Industrial and Engineering Chemistry* of January 10 by Mr. M. F. Crass, assistant secretary of the Manufacturing Chemists' Association, who, with Mr. T. P. Callahan, as one-time members of the Association's Carboy Committee, was principally responsible for developing the present widely used standard for the boxed glass carboy. From the viewpoint of safety the evolution of this boxed carboy deserves attention. Whereas in 1920 a record of 913 instances of breakages of boxed carboys caused a loss valued at \$38,455, this figure had been reduced to 119 by 1931, and further to 43 by 1938. In subsequent years, war-time conditions caused a slight increase, and breakages for 1943 numbered 70, with loss valued at \$8549.

The first standard container for dangerous liquids was the subject of a specification issued by the United States Bureau of Explosives in 1911, at a time when breakages

had been particularly high. It was a boxed glass carboy, intended mainly for the shipment of corrosive liquids and, to a lesser extent, for that of inflammable liquids. These early carboy bottles were of the balloon shape, with a capacity of 5 to 13 gallons, of varying side-wall thickness, mostly imperfectly annealed. The balloon shape was, of course, fundamentally wrong, because any shock transmitted to the bottle through the walls and packing of the wooden box became concentrated at the extreme diameter of the bottle, which was not merely the weakest point, but also least protected by packing material. Moreover, these early carboys were blown either with or without the aid of a clay mould, which resulted in other imperfections such as a wide variation in strength. Apart from an effort, made as early as 1906, to avoid the use of carboy bottles of balloon shape, it was found in 1909 that improvements as regards breakages could be attained by insisting upon the use of bottles blown in moulds. The records of one user showed 590 breakages out of a total shipment of 10,607 "blown" carboys for the year, or

5.56 per cent., while in the case of "moulded" carboys there were 302 breakages, or only 0.82 per cent., in a shipment of 36,939 carboys.

In this first standard carboy specification, it was laid down that each bottle had to be annealed, both temperature and cooling time being specified, and that the bottles should have a minimum weight of glass, which, in the case of the 14-gallon carboy (United States gallon), was to be 16½ lb. In addition, a tapping test was suggested to regulate strength and wall thickness. Although there was some improvement as a result of adhering to these specifications, breakages still continued to cause serious losses, and acid shippers in particular were anxious to develop a better means for carrying their products.

Types of Packing

With a carboy bottle of substantial size, it was realised that the chances for breakage incident to shocks of ordinary rail transport were relatively large, and that no improvement could be expected unless the thickness of the glass was uniform throughout, and that all strains resulting from manufacture were removed. Moreover, the bottle should be properly suspended, with adequate cushions in its outer wooden box apart from the cushioning attained by packing material. Each packing material then in use had its disadvantages; diatomaceous earth absorbed moisture, and caked; mineral wool gradually settled down or "packed" and lost its resiliency; hay was satisfactory only for acids of a non-oxidising type, and efficient only when freshly packed. For nitric acid, a block-type packing of corrugated wood strips was extensively used, but this did not protect the glass bottles from a severe shock. Among other means were bowed steel strips, and split wooden springs; some shippers even coated the outside of their bottles with paraffined fibre to a thickness of half-an-inch.

Approaching the problem from the viewpoint of a desirable strength for the glass bottle in its wooden box, those who undertook tests were not a little perplexed by what really constituted a reasonable shock in transit; they eventually put this tentatively as shock caused by a collision speed of 8 miles per hour, for the production of which a special swing testing machine was devised. From 1923 onwards, all boxed carboys were required to pass this test at least twice a year. This requirement certainly eliminated many weak packages, for in the first year of its use, loss due to damage by rail was reduced by more than 50 per cent. During 1918, prior to the adoption of the swing testing machine, one carboy in every 130 suffered damage. However, with subsequent improvements, breakages have now been reduced to a fraction

of the last-mentioned figure; for the three-year period 1941 to 1943, one breakage was reported for every 12,000 carboys shipped, this figure being observed upon a yearly shipment of about two-and-a-half million boxed carboys.

In order to eliminate the disadvantages of the bottle of balloon shape, the makers first used clay moulds to obtain uniform wall thickness. The principal acid shippers then developed iron moulds to produce bottles with straight sides, such as would uniformly absorb any shock. By 1921, three types of the straight-sided carboy bottle were in use, and a fellowship at the Massachusetts Institute of Technology was instituted in order to carry out exhaustive tests, as a result of which the Manufacturing Chemists' Association approved of a design and issued a new standard specification. All carboys with a capacity exceeding 6½ gallons are now made according to this standard. Subsequent developments included a wire-tied vented closure, which prevented the building-up of pressure within the bottle, thus replacing the old method of sealing, in which a vitrified stopper was covered with clay, burlap-wrapped, and tied with string. Plastic materials have now been adopted for acid-proof gaskets, and new materials have superseded hay, mineral wool, and diatomaceous earth. Further, the use of carboys with chipped lips has been forbidden.

Improvement in Drums

Mr. Crass has also something to say about the metal drum. In 1940, the Metal Barrels and Drums Committee of the Manufacturing Chemists' Association initiated tests to determine the metal, or alloys, most resistant to the stronger concentrations of nitric acid. This work involved the testing of a number of metals, including welded sections, heat-treated and otherwise, at temperatures up to 130°F., with the concentration of the nitric acid varying between 95 and 100 per cent. Last year, they sponsored the production of a 14-gauge all-nickel drum for the transport of phosphorus trichloride and phosphorus oxychloride, and in the last decade they have been concerned in the improvement of drums for carrying sulphuric acid, giving particular attention to bung fittings made of pearlitic malleable iron with the object of reducing corrosion.

Merck & Co., Ltd., manufacturers of drugs and chemicals, have purchased a site of 210 acres at Valleyfield, Quebec, with a view to expanding their manufacturing facilities. It will be remembered that the company's penicillin plant was the first in the British Empire to use the deep fermentation method on a commercial scale. Construction at Valleyfield will begin as soon as conditions permit.

Personal Notes

MR. CHARLES A. MURRAY, managing director of British Tar Products, Ltd., retires on March 31, after 28 years of service.

MR. N. F. CROWDER, A.R.I.C., research chemist, Tootal Broadhurst Lee Co., Ltd., Manchester, has been elected an Associate of the Textile Institute.

SIR WILLIAM BEVERIDGE was elected a member of the executive committee of the Parliamentary and Scientific Committee at its meeting on March 13.

PROFESSOR OLE ALBERT LAMM has recently been appointed to the chair of theoretical chemistry at the Technical University of Stockholm. He was formerly a reader at Uppsala University.

SIR JOHN ABRAHAM, Deputy Under-Secretary of State in the Air Ministry, has been selected for appointment as the United Kingdom member of the Board of British Phosphate Commissioners, in succession to Sir Arthur Gaye, who is retiring on grounds of health.

PROFESSOR D. N. MACARTHUR, head of the Agricultural Chemistry Department of the West of Scotland College of Agriculture, Glasgow, has been appointed director of the Macaulay Institute for Soil Research, Aberdeen, in succession to Dr. W. G. Ogg, now director of the Rothamsted Experimental Station. Professor MacArthur has held the Chair of Agricultural Chemistry since 1928. He was for a time in charge of the Radium Laboratory at Glasgow University.

MR. H. W. CREMER, F.R.I.C., has resigned from his position of Director of Chemical Engineering Studies in the University of London, King's College, and is now senior chemical engineer with Sir Alexander Gibb and Partners, with whom he has been working throughout the war on the design and construction of Government works connected with the war effort. He is a past chairman of the Chemical Engineering Group of the Society of Chemical Industry and present hon. treasurer of the Institution of Chemical Engineers.

The following have been elected Fellows of the Royal Society of Edinburgh: DR. W. S. HALDANE, F.R.I.C., teacher of chemistry at Dunfermline High School; DR. R. E. ILLINGWORTH, lecturer on chemistry, School of Medicine, Royal Colleges; PROFESSOR S. J. WATSON, F.R.I.C., who holds the Chair of Agriculture at Edinburgh University and is Principal of the Edinburgh and East of Scotland College of Agriculture; and MR. D. C. WILSON, F.R.I.C., director of T. & H. Smith, Ltd., Edinburgh.

PROFESSOR W. M. CUMMING, holder of the "Young" Chair of Technical Chemistry at the Royal Technical College, Glasgow, has been appointed Director of the School of Chemistry.

PROFESSOR W. E. S. TURNER, who resigned from the chair of glass technology at Sheffield University on March 9, is to be succeeded by DR. HARRY MOORE. Professor Turner joined the University 40 years ago as a lecturer in chemistry.

COMMANDER K. S. MACLACHLAN, O.B.E., R.C.N.V.R. (retired), of Montreal, has been appointed president and managing director of the Standard Chemical Co., Ltd. Commander MacLachlan is a former Deputy Minister of National Defence for Canada, retiring from this post to go on active duty. Previously, he was president and general manager of the Fraser Companies, Ltd., and the Restigouche Co., Ltd., and he remains a director of both companies.

Parliamentary Topics

Use of Slag

IN the House of Commons last week, Mr. Bossom asked the Minister of Works why slag, which could be advantageously converted into foam-slag building blocks, was deposited on hillsides or into the sea at a waste-charge of between 3s. to 5s. a ton.

Mr. Sandys: Slag is being foamed up to the full capacity of existing plants. In addition, it is being put to other valuable uses apart from building blocks. Nevertheless, we have not the means of utilising the full output of this by-product. For the present, therefore, a considerable proportion must continue to be tipped.

Colonial Development

Replying to Mr. Riley, the Colonial Secretary said that the part which Government-sponsored development corporations might play in the industrial development of the Colonies was still under consideration.

Penicillin

Sir E. Graham-Little asked the Minister of Health whether he would now release some supply of penicillin for use in civilian medical practice, as distinguished from hospital practice.

Mr. Willink: Arrangements are now being made for a wider distribution of penicillin from upwards of 200 large hospitals throughout the country, which will be authorised to issue penicillin on request to smaller hospitals.

The Colonial Secretary, replying to Sir E. Graham-Little, said that it had now been possible to arrange for penicillin to be used in the Colonies subject only to the same restrictions as apply in this country.

Seaweed Research

Progress in Scotland

REPORTING on the progress of the Scottish Seaweed Research Association, Ltd., Sir Steven Bilstrand, Bart., chairman of the Association, told Press representatives in Glasgow last week that the aim of the body was to produce, from local resources, an amount of seaweed equivalent to the 15,000 tons, valued at £150,000, which before the war were imported annually from Norway, Japan, and Eire. Such an amount, besides providing employment in Scotland, would feed industry in Britain generally, and would create a crofting industry of the type indigenous to the Highlands and Islands. The drying and milling of the seaweed would be carried out in coastal areas, but the chemical work would be performed in Edinburgh.

Sir Steven said that seaweeds fell into two main groups: submerged weeds growing in areas with depth down to five fathoms, and rock weeds, which were found between low tide and high water mark. Submerged weeds presented the more difficult problem, but surveys had been made of the Sound of Mull and in the sea lochs of Etive, Creran, Feochan, and Melfort. The Association's

vessel *Prospecto* was specially designed for survey work and the harvesting of submerged weeds.

Mr. E. D. MacPhee, a director of the Association, said that the largest single unit in this country using seaweed was located in Ayrshire, but smaller units were situated throughout Scotland and England. The use of seaweed in the agricultural industry and for medical supplies was well known, but there were other possibilities. Seaweed in microscopic quantities was employed in the manufacture of ice cream, toothpaste, and cosmetics. It could be made into transparent paper, and the manufacture of silk stockings from seaweed was not an impossible idea of the future.

Mr. MacPhee said that the collection of seaweed at present was undertaken by crofters as a part-time winter task. Some crofters in the past year earned money at the rate of £1 per day and obtained possibly £50 for their season's work.

It was stated that an experiment had been begun to determine whether the sea bottom could be altered to provide a holdfast for seaweeds. The method was to sow suitable stones—not seeds, as in agriculture—at the proper season in selected areas where silting has hitherto prevented growth.

General News

In North Staffordshire, coal production has been started in a virgin area, south of Millbank Fault, likely to yield coal for 100 years.

Personal estate in Great Britain left by Mr. W. D. G. Menzies, former chairman of the Distillers' Co., Ltd., who died on October 24, was valued at £1,446,813.

The Anglo-Swedish monetary agreement, published in form of a White Paper on March 8, has cleared the way for imports of timber, pulp, and other cellulose products, and possibly iron ore.

Increased financial help for both the universities and the students is called for in a memorandum by the Association of University Teachers. The number of State scholarships and bursaries, it is suggested, should number 10,000 a year.

The meeting of the Agriculture Group of the S.C.I., which is being held on March 27 (as recorded in our Calendar of Events), is regarded as of such importance that it is being thrown open to all interested in the problem of maintaining a balanced national agriculture. Not only will visitors be admitted, but they are invited to take part in the discussion that will follow the symposium.

From Week to Week

The Executive Committee of the Parliamentary and Scientific Committee, at its meeting on March 13, considered the question of the salaries of Civil Service scientists, on the basis of a memorandum agreed by the Parliamentary Action Subcommittee, and also a letter from the Foreign Office on the appointment of scientific attachés.

Birkbeck College Students' Union is holding a conversation at the College (Bream's Buildings, London, E.C.4) on March 25 from 3 to 9 p.m. The conversation, which is open to the public, will include exhibitions and demonstrations staged by various departments; a series of talks, including Professor P. M. S. Blackett on "Science and Reconstruction"; a light musical entertainment; and a mock parliamentary election.

The new Bristol and South-Western Section of the B.A.C., the formation of which was confirmed at the Council meeting last December, is showing healthy signs of vitality. Two committee meetings have already been held this year, and a very active students' section has been formed. Full particulars can be obtained from the hon. secretary, Mr. D. Jackson, 66 Coldharbour Road, Bristol, 6.

At the annual meeting of the Yorkshire Section of the Institute of Fuel, held on March 8, it was reported that, although formed only last year, the section, with a membership of 202, was now the second largest of the provincial sections.

A sum of £1168 has been handed to the Scottish Red Cross for Scottish Prisoners of War by the Paint and Oil Section of the Glasgow Chamber of Commerce, which includes members from Aberdeen, Dundee, and Leith. The section has raised £4074 for the fund during the past three years.

Sheffield University Council has received the following gifts: £1060 from Messrs. Jackson Bros. (Knottingley) to found a Tom Jackson travel fund for students in glass technology; 100 guineas from Mr. F. G. Foster to establish a research prize in the same subject; while Messrs. Redfearn Bros., Ltd., Barnsley, have contributed £2000 towards the cost of erecting a laboratory of glass engineering.

A discussion of the vulcanisation characteristics of G.R.S. followed by an evaluation of various accelerators, as well as of non-sulphur vulcanisators, are contained in Manufacturers' Memorandum No. M.14 published by the Services Rubber Investigation, based on research by I.C.I. (Dyestuffs Division). Inquiries should be addressed either to the M.O.S. (C.R.D.46), Berkeley Court, Glentworth Street, N.W.1, or to Dr. W. J. S. Naunton, Hexagon House, Blackley, Manchester, 9.

The Royal Institute of Chemistry (Midlands Section) received applications for more than twice the available places in its post-graduate course in Colloid Science to be held at Cambridge University from June 23-30. Because of this demand, the University Departments of Colloid Science and of Physical Chemistry have agreed to provide a duplicate course from June 30 to July 6. Applicants, who will be advised which course they can be offered, represent Government departments, research institutions, colleges, and industrial laboratories from all parts of Britain.

Birmingham Electric Furnaces, Ltd., of Tyburn Road, Erdington, Birmingham, inform us that they have decided to change their name to Birlec, Ltd. Their trade mark "Birlec" has been established for many years, and it is felt they are already more widely known by this shortened title. The company, a subsidiary of The Mond Nickel Co., has been a pioneer in all types of industrial electric heat treatment and melting furnaces in this country, and, in addition, manufactures specially designed gas furnaces, induction heating apparatus, and drying equipment. We are informed that policy, management and personnel will not be in any way affected by the change.

Applications for the official approval of petroleum oil washes, nicotine preparations, proprietary lead arsenate powders and pastes, lime sulphurs, tar-oil winter washes, organo-mercury dressings, copper preparations, and derris and lonchocarpus insecticides and wetters and spreaders may now be made. Application forms are obtainable from the Secretary, Advisory Committee, Plant Pathology Laboratory, Milton Road, Harpenden.

Foreign News

A revised mining law is soon to be promulgated in Venezuela.

The five-hundred-millionth gallon of 100-octane aviation fuel was produced at Abadan on January 9.

"Arksilit" is the name of a new plastic developed in the Soviet Union and applied extensively under Arctic conditions.

The Mörs synthetic oil plant, the first to be captured on the Western Front, is being examined by a group of British and American experts.

Argentina is now second to the United States in production of vitamin A. Production last year amounted to about 20 trillion units. There are 20 factories, mostly U.S. financed, processing shark livers.

The Monsanto Chemical Co. plans to construct a new sulphuric acid plant, with a yearly capacity of 72,000 tons, in the plant area of Monsanto, Ill., at a cost of about \$700,000.

A large plant has been built at Girard, Ohio, U.S.A., by the General Paint Corporation for the production of pipes with protective coatings, to be used for petroleum and natural gas as well as for water and sewage disposal.

New industrial plants, projected or under construction in Venezuela, include a sulphuric acid plant, an asbestos-cement plant, and a tannery at Puerto Cabello. The production of powdered milk has also begun.

Two interesting and highly informative lectures on die casting and permanent mould casting (i.e., gravity die casting), recently delivered before the Stevens Institute of Technology by Mr. Alfred Sugar, have now been published as a booklet by the American Metal Co., Ltd., 61 Broadway, New York, 6.

The Du Pont Company is reported to have developed an instrument providing constant analysis of atmospheric conditions in manufacturing plants, based on the phenomenon of light absorption of gases. Most gases absorb light of some particular wave-length, casting a shadow where that particular wave-length line would otherwise have fallen. The instrument operates on a comparison basis and instantly shows any variation from pure to contaminated air.

Small-scale production of penicillin for local needs is reported from the Belgian Congo, where the Institut National pour l'Étude Agronomique au Congo Belge has experimented with various moulds.

The design, structural features, and operating facilities of coke ovens are incorporated into a booklet published by the Wilputte Coke Oven Corporation, 40 Rector Street, New York, 6, which is fully illustrated with cross-sections, flow sheets, and views of recent installations.

American experts, the *India Rubber Journal* reports from Paris, are studying German methods of producing synthetic rubber. Many factories were established during the occupation and are said to have reached a high efficiency. The French railways are reported to be studying how to use rubber tyres on long-distance trains.

Commercial production of DDT is to be taken up by the A/B Mo och Domsjö at its Domsjö plant. This follows the report, given for the first time in this country in *THE CHEMICAL AGE* of November 4, 1944, that the manufacture of this insecticide may be undertaken in Sweden. The manufacture of a new cellulose glue, called "Alcasit," is also announced by the concern.

Work on the Mexican Government's new 100-octane aviation gasoline refinery at Atzacapotzaleco, near Mexico City, is proceeding rapidly. Construction is in the hands of an American engineering firm under the supervision of a U.S. oil company, acting as consultant to Petroleas Mexicanos. The U.S. Government will have the first right to purchase part of the output. The refinery is to be completed by the end of this year.

Venezuela's iron ores will soon be exploited by the Iron Mines Co., of Venezuela, a subsidiary of a leading U.S. steel concern, which has acquired concessions on the Orinoco, near San Felix. The ore is chiefly hematite, reported to contain 68 per cent. iron with small amounts of phosphorus and sulphur. Reserves are said to exceed 60,000,000 tons. A Canadian company also owns an iron ore concession in the district, while another U.S. concern is determining the development possibilities of garnierite deposits at Lomo de Hierro.

Forthcoming Events

March 17. The Institution of Chemical Engineers (North-Western Branch). The College of Technology, Manchester, 3 p.m. Messrs. J. P. V. Woollam and A. Jackson: "The Removal of Oxides of Sulphur from Exit Gases."

March 20. Society of Chemical Industry (Plastics Group). Waldorf Hotel, Aldwych, London, W.C.2, 6 p.m. Mr. N. J. L. Megson: "Plastics at War."

March 20. Royal Society of Arts. John Adam Street, Adelphi, W.C.2, 1.45 p.m. Dr. A. C. Thaysen: "Food Yeast: Its Nutritive Value and its Production from Empire Sources" (with lantern slides).

March 20. The Chemical Engineering Group (S.C.I.) and The Institution of Chemical Engineers. Rooms of the Geological Society, Burlington House, Piccadilly, W.1, 2.30 p.m. Discussion: "Industrial Research." Opener: Dr. E. W. Smith.

March 20. Royal Institute of Chemistry (Huddersfield Section). Field's Café, Huddersfield, 6.30 p.m. Annual general meeting. Mr. J. R. Rowlands: "The Training of an Organic Chemist"; and Mr. R. J. S. Thompson: "The Removal of Hydrogen Sulphide from Coal Gas."

March 21. Society of Chemical Industry (Newcastle Section) and Food Group. King's College, Newcastle-upon-Tyne, 6 p.m. Professor R. H. Hopkins: "Biochemistry Applied to Brewing."

March 21. Royal Institute of Chemistry (London and South-Eastern Counties), and the Institute of Physics. Royal Institution, Albemarle Street, London, W.1, 2.30 p.m. Professor H. T. S. Britton: "The Mechanism of Electrode Measurements."

March 22. Chemical Society. Chemistry Lecture Theatre, Manchester University, 6 p.m. Professor E. K. Rideal: "Reactions in Monolayers." (Liversidge Lecture).

March 22. Newcastle Chemical Industry Club, 18 Lovaine Place, Newcastle-upon-Tyne, 2, 6.45 p.m. Mr. A. P. Allcock: "Explosives in Mining and Quarrying" (with lantern slides).

March 23. Society of Chemical Industry (Birmingham Section). Chamber of Commerce, Birmingham, 6.30 p.m. Professor D. T. A. Townend: "The Present Era in Combustion" (Jubilee Memorial Lecture).

March 23. Oil and Colour Chemists' Association (Manchester Section). Engineers' Club, Albert Square, Manchester, 2 p.m. Mr. F. J. R. Bowman, A.R.I.C.: "Some New Bakelite Resins for Consideration by the Post-War Paint and Varnish Industry."

March 24. The Association for Scientific Photography. Royal Society of Arts, 16 John Adam Street, Strand, W.C.2, 2.30 p.m. Mr. J. H. Ridley: "An Experimental Approach to Time Lapse Cinematography."

March 24. British Association of Chemists (St. Helens Section). Y.M.C.A., St. Helens, 7.30 p.m. Mr. L. Woods: "Micro-Chemical Analysis."

March 26. Royal Institute of Chemistry. London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, 5 p.m. Dr. Harold Moore, C.B.E.: "Industrial Non-Ferrous Alloys."

March 26. Electrodepositors' Technical Society. Northampton Polytechnic Institute, St. John Street, E.C.1, 5.30 p.m. Symposium on "Powder Metallurgy." Dr. G. E. Gardam: "The Preparation of Copper Powder by Electrodeposition."

March 27. Society of Chemical Industry (Agriculture Group), Burlington House, Piccadilly, W.1, 2.30 p.m. Symposium: 1. "The Supply of Protein for Animal Feeding"; 2. "The Extraction of Protein Foods from Plant Materials"; 3. "The Nutritive Value of Protein and Non-Protein Nitrogen for Ruminants." Contributors: Dr. A. B. Fowler, Dr. R. E. Slade, Dr. D. J. Branscombe, Mr. J. C. McGowan, and Dr. J. A. B. Smith.

March 28. The Institute of Fuel (Midlands Section). James Watt Memorial Institute, Birmingham, 2.30 p.m. Mr. F. Scarf: "The Fuel Research Coal Survey."

March 28. The Association of British Chemical Manufacturers, Lecture Hall, Royal Society of Tropical Medicine and Hygiene, Mansion House, 26 Portland Place, W.1, 2.30 p.m. Fuel Efficiency Technical Discussions (5th London meeting). Mr. G. Arrowsmith: "Thermal Compressors" (postponed from March 21).

Company News

Savory and Moore, Ltd., report a net profit for the year to March 31, 1944, of £38,124 (£42,554). No dividend on ordinary.

International Paint and Composition Co., Ltd., announces a net profit for 1944, of £241,603 (£218,142). The dividend is again 20 per cent.

Canadian Celanese Corporation has made a net profit for year to December 31, of \$1,642,571 (\$1,693,308). The dividend on common remained at \$2.

Worthington-Simpson, Ltd., have declared an ordinary dividend of 8 per cent. (7 per cent.) for the year 1944. The year's profit, after taxation, etc., was £23,092 (£21,106).

Celanese Corporation of America reports a new sales record of \$101,655,680. Consolidated net income for 1944 was \$7,235,190 (\$6,275,593). Taxes amounted to \$13,518,325 (\$11,945,962). The regular preferred dividends are declared for the current quarter and also a common of 50 cents.

This week, shareholders will be asked to authorise an increase in the capital of **English Clays Lovering Pochin and Co., Ltd.,** from £3,119,114 to £3,161,448, by the creation of 43,334 £1 5½ per cent. cumulative first preference shares in connection with the acquisition of another company, the name of which has not been disclosed.

Borax Consolidated, Ltd., for the year ended September 30, report a profit of £396,333 (£398,453), and have declared the following dividends: preferred, a final of 3 per cent., making 6 per cent. (same); deferred, 7½ per cent. (same).

New Companies Registered

Smith, Saville & Partners, Ltd. (393,773).—Private company. Capital, £1000 in £1 shares. Manufacturing, research, dispensing and analytical chemists, etc. Directors: Hubert Etherington, Willshaw Street, S.E.14; G. J. L. Leidig; W. R. Crowe; J. D. Evans; J. M. Sandford-Smith.

Megatron, Ltd. (393,624).—Private company. Capital, £2000 in £1 shares. Manufacturers of and dealers in selenium photo elements and rectifier plates, electrical, chemical and scientific apparatus, etc. Directors: Lajos Biro; F. Pyleman. Registered office: 16 Pall Mall, S.W.1.

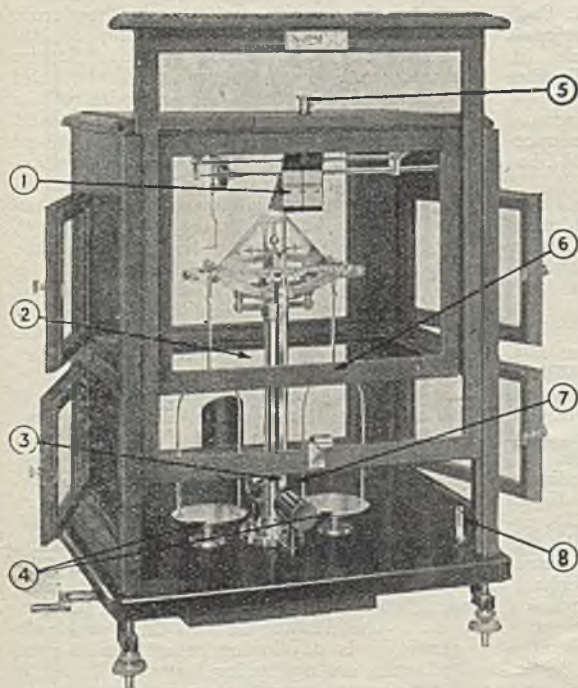
Shell Chemical Co., Ltd. (393,474).—Private company. Capital, £100,000 in £1 shares. Merchants, manufacturers and concessionaires in connection with goods, wares and merchandise involving chemical or scientific preparations; general merchants and agents, etc. The subscribers (each with one share) are: J. B. A. Kessler; F. Godber. (The signatures are witnessed by a clerk to the Anglo-Saxon Petroleum Co., Ltd.) Solicitors: Waltons & Co., 101 Leadenhall Street, E.C.3.

Chemical and Allied Stocks and Shares

FIRMNESS has continued to rule in stock markets, which, however, were not very active, reflecting the disposition to await the war news. British Funds have been well maintained and industrial shares showed small movements with gains predominating. Speculative activity was more in evidence in European bonds, particularly German 7 per cent. and 6½ per cent. Potash issues, which rallied after their recent decline.

Imperial Chemical were firm at 39s. 3d., with British Oxygen good at 88s. 6d. on hopes of a moderately higher dividend. Among plastics, De La Rues continued prominent, but receded after reaching the new high level of £11½; this is another instance where there is talk of an increased dividend. British Industrial Plastics 2s. ordinary were 6s. 7½d., and Erinoid 5s. ordinary active around 12s. 3d. Sooner or later the two last-named companies are likely to raise further capital, and it is expected in the market that this will take the form of additional shares offered to shareholders on favourable terms. From 50s. Dunlop receded to

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49s. 9d., and Radiation eased to 61s. 3d. on the lower profits, after rising to 62s. Following the maintenance of the dividend at 7½ per cent., Borax deferred receded to 40s.

Pinchin Johnson have been around 41s. 3d. awaiting the dividend announcement, and Wall Paper Manufacturers deferred strengthened to 43s. Elsewhere, British Aluminium eased further to 45s. 6d., pending the results and chairman's annual statement. Birmid Industries were 90s. 6d., Imperial Smelting 13s. 9d., and Amalgamated Metal 17s. 9d., while General Refractories have been firm at 16s. 10½d. Metal Box were 90s. 7½d., and Turner & Newall continued steady at 85s. 6d.

British Drug Houses kept at 30s., B. Laporte changed hands up to 88s. 9d., and Cellon 5s. ordinary up to 25s. W. J. Bush were 75s., Monsanto Chemicals 5½ per cent. preference 23s., and Greeff-Chemicals 5s. ordinary were maintained at 9s. Textiles generally became less active, with Bradford Dyers showing small fluctuations around 25s. 6d. awaiting the dividend announcement. Courtaulds were firm at 55s. 3d., but British Celanese eased to 31s. 9d.

Among iron and steels, United Steels continued active around 27s., with Hopkinsons firm at 80s. on market hopes of a higher dividend. Dorman Long strengthened to 27s. 3d., Davy & United to 33s. 9d., but Stewart & Lloyds eased to 57s. 7½d. On the other hand, Tube Investments firmed up further, changing hands slightly over £5½. Guest Keen were 38s. 6d., Babcock & Wilcox 53s. 6d., with Allied Ironfounders at 52s. 6d. also well maintained. Consett Iron 6s. 8d. units became firmer at 8s. 3d. Valor ordinary shares were 53s. 9d., Fisons 50s. 6d., and elsewhere Westinghouse ordinary marked 79s. At one time, International Combustion shares rose further to £7½, reflecting the good impression created by the statements at the meeting. Building shares have been little influenced by the emphasis on permanent houses in Government housing plans. British Plaster Board have been active around 38s. 9d., with Associated Cement 61s. 9d., and Tunnel Cement 48s. 9d. British Steel Constructions eased to 16s., later strengthening to 16s. 3d. In other directions, Barry & Staines were higher at 54s. 3d., also Nairn & Greenwich at 80s.

Boots Drug have been steady at 56s., with Timothy Whites 41s. 3d., Sangers 31s. 6d., and Beechams deferred 18s. 7½d. Levers kept at 47s. 6d., and Triplex Glass were

43s. 6d. Oil shares became easier, with Anglo-Iranian 110s. 7½d., Burmah Oil 87s. 6d., and Shell 81s. 3d.

British Chemical Prices

Market Reports

THE London general chemicals market displays an even tone throughout and a moderate amount of new business is reported with values in most sections firm. Deliveries under existing contracts are well up to schedule. An active market exists for the majority of the soda compounds, and a steady trade is passing in industrial refined nitrate of soda, with solid caustic soda and caustic liquor in good demand. Chlorate of soda is a good market and a moderate volume of inquiry is reported for acetate of soda and percarbonate of soda. Strong markets and limited supplies are the chief features of the potash section, with yellow prussiate of potash scarce, and caustic and carbonate of potash in good call. Acid phosphate of potash is steady and permanganate of potash remains active. An increase in activity is reported in the coal-tar products section this week, with pitch in moderate call for home trade, while some export business is reported. Creosote oil is in good demand and a brisk inquiry is being made for the toluols and benzols. A fair trade is passing in the pyridines and the xylols.

MANCHESTER.—Prices have been steady throughout the range of chemical products on the Manchester market during the past week and not much in the way of actual movement falls to be reported. The dyeing, bleaching, and finishing trades are taking fairly good deliveries of "heavies," as are also the West Riding textile industries, while other industrial users are maintaining the demand at around its recent level. The alkalis, as well as the ammonia and magnesia compounds and the acids, are prominent. The demand in the fertiliser trade generally is developing steadily and good deliveries are now going forward. There is a satisfactory contract movement of tar products, especially of the lighter classes.

GLASGOW.—In the Scottish heavy chemical trade business during the past week has maintained its steady day-to-day transactions. Inquiries for export are also more numerous. Prices remain very firm, with no actual changes to report.

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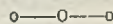
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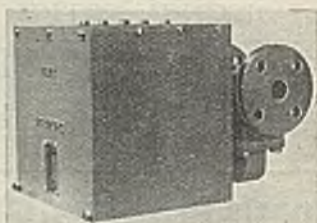
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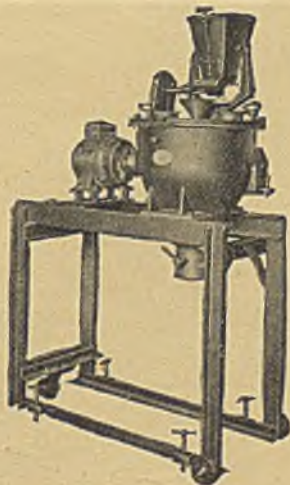
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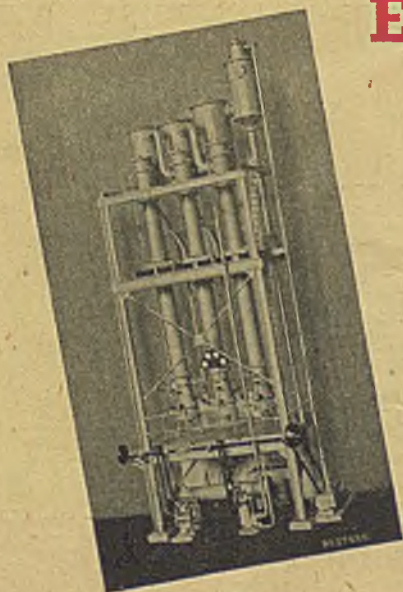
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