THE
ELECTRICIAN

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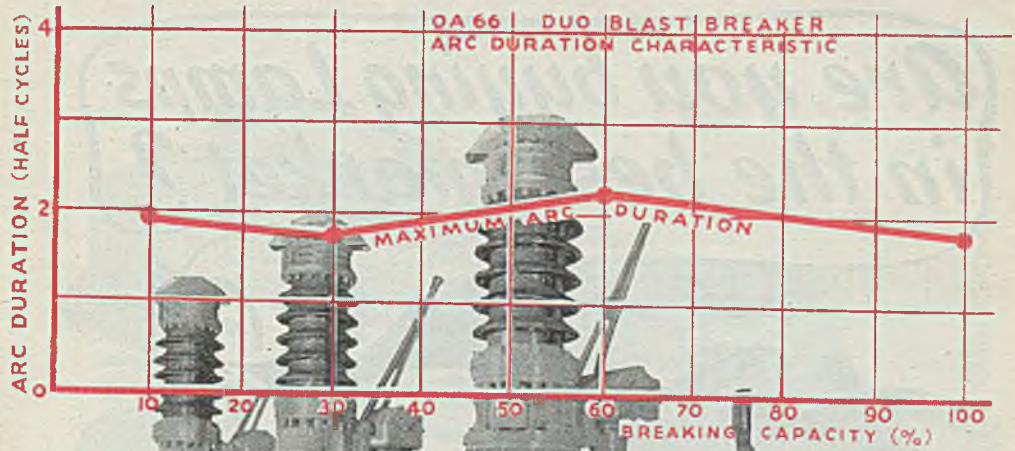

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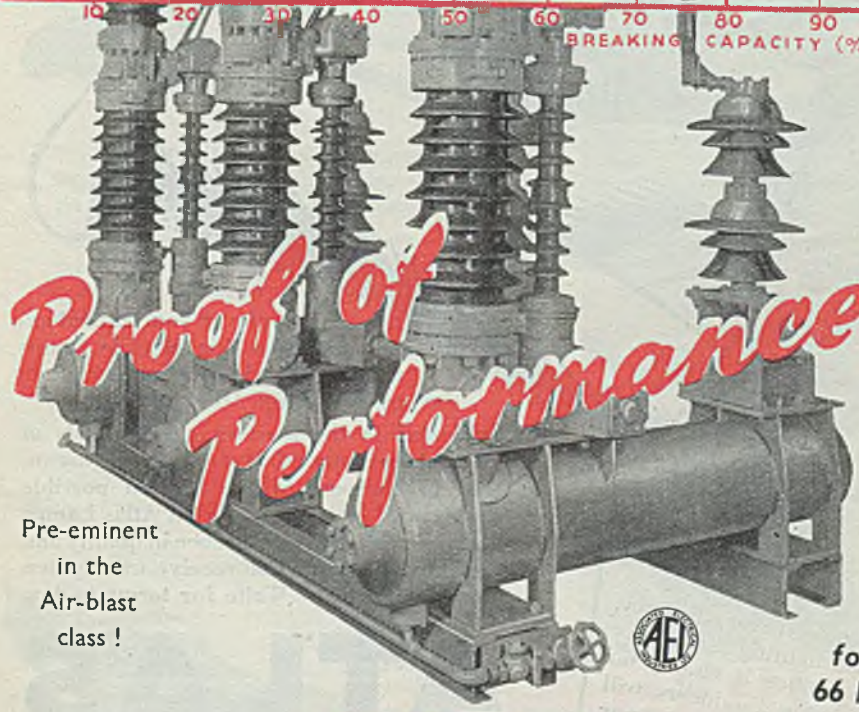

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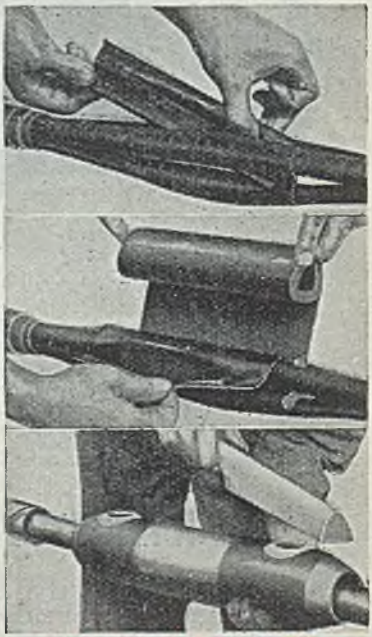

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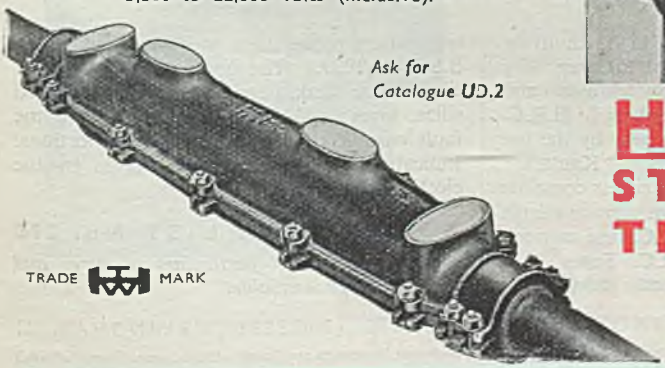

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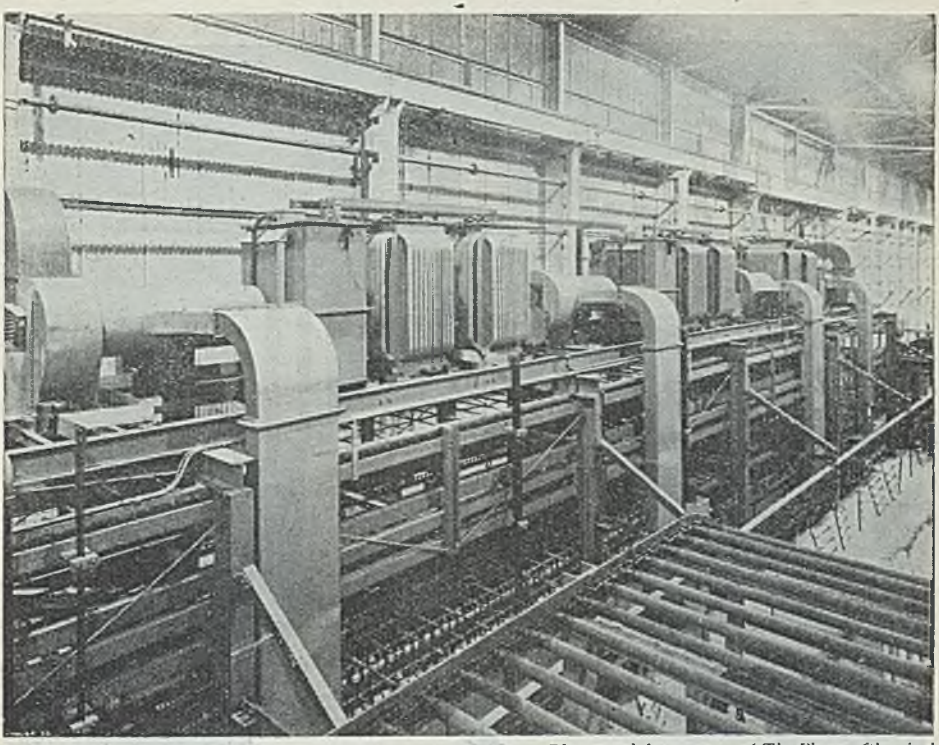

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CHIEF CONTENTS OF THIS ISSUE

Controls

THE rapidity with which American industry is being freed from the fetters of Government legislation is in striking contrast to experience in this country. It is, too, giving concern to those of our manufacturers who are ready and anxious to resume their attacks on the export markets.

Last week, Mr. DALTON, in his first parliamentary speech as Chancellor of the Exchequer, proclaimed the urgency for a rapid expansion of our overseas trade, and though he gave a pledge to remove as far as possible any restricting formalities, there was nothing in his speech which suggested real appreciation of the strangling effect which the present governmental controls are having upon our trade. It may be that the speed of America's abandonment cannot be attempted here, but the pace set so far appears to be unduly limited, and represents too great a handicap if British industry is to enter into competition with the rest of the world.

The winning of export trade is largely a matter of initiative and enterprise, and those industrialists whose business it was before the war to lead the country in this trade should now be consulted on ways and means of re-establishing that lead. The position as we see it is that the Government has assumed the right to dictate to industry, but in our view the official mind—hampered as it is by civil service procedure—is in no way qualified to hold out against the scorching flame of competition kindled, let us say, in that land of private enterprise, the United States, to name only one competitor.

In other spheres of operation controls are, too, proving unequal to the tasks ahead, for, *inter alia*, there is considerable dissatisfaction among a number of the engineering profession with the way in which the Central Register is operated. Most of the criticism of this body comes from the graduates of our universities who, armed with a degree in science and the offer of employment by leading manufacturers, find themselves waiting in idleness until the Ministry of Labour sanctions their absorption by industry. The period of waiting between acceptance of employment and official sanction to take up that employment appears to be longer than it is reasonable to expect, and many of our young men, eager to enter the ranks of industry, are growing impatient in consequence.

With the war in the Far East at an end, it might be argued that there ought to be some relief from the inconveniences attaching to at least some of the governmental directions, but apart from a few minor relaxations, industry and its personnel are still the playthings of officialdom. The latest example of this is to be found in the text of the proposed Supplies and Services (Transitional Powers) Bill, which provides for certain

legislation and controls to remain, if need be, in force for five years, and a further year thereafter if thought necessary.

Reluctant Bureaucracy

SOME of those controls may, it is admitted, be advisable for a time, but there is in industry a feeling that bureaucracy is reluctant to relinquish the authority it has enjoyed for so long, and the number of controls enumerated in the latest Supplies and Services Bill is unnecessarily large in consequence. Officialdom will not easily part with its present privileges, but it should realise that in the interests of the nation it must renounce its war-time habits. The difficulties facing the new Government are fully appreciated, but the continuance of so many controls instead of the promotion of new enterprises, as a solution to the problems, is, we suggest, likely to lead to disaster.

Electrical Accidents

ALTHOUGH the use of electrical equipment in industrial premises has increased tremendously during the war years, fatal accidents last year were fewer than in any year since 1940. This encouraging fact is given in the report, "Electrical Accidents and their Causes," for 1944, published by the Factory Department (Electrical Branch), extracts from which are given on another page. For some reason the total of 157, under the heading "Fatal Electrical Accidents," includes three suicides, so that actually the record for the year is better than the official figures indicate. Accidents reportable under the Factories Act were also fewer, numbering 1 072, of which 31 were fatal, compared with 1 255, with 58 fatal, in 1943. There were also notified 45 accidents, 13 fatal, which were found to be non-reportable, and, in addition, 113 electrical fatalities occurred in places other than factory premises. Of the reportable accidents the largest number —185 (six fatal)—was associated with switchgear. There were 174, with five fatalities, in relation to cables and flexibles, and of 78 accidents with portable electric apparatus six were fatal.

Planning of Investment

ATTEMPTS to understand what lies behind "the effective planning of investment" mentioned in the King's Speech, have so far met with little success. Last week Mr. CHURCHILL renewed his quest for information by asking the Chancellor of the Exchequer whether the proposed planning would extend to the control of the spending by limited companies of their own cash resources, and to the control of their power to borrow. Mr. DALTON'S reply was not, however, particularly instructive in that the Chancellor contented himself with a statement to the effect that investment planning had two aspects, the physical and the financial. On the physical side, the Government's policy is "to secure that the available labour and materials are used in accordance with whatever plans may from time to time be required for the purposes of employment policy and national development. On the financial side the control of demands on the capital market will be exercised according to the same principles. But there is no intention of compelling anyone to invest his resources in one way rather than another. In particular, the proposed legislation will not provide for the exercise of financial control over the use by business undertakings of their own cash or other existing resources." From this reply it appears that the Government has it in mind to direct labour and materials as may be considered necessary to ensure full employment. Financial powers corresponding to these physical controls are already included in the Distribution of Industries Bill, but the points raised by Mr. CHURCHILL with respect to borrowing and now being discussed by industry still need elucidating.

Mr. Shinwell and the Miners

IN our issue of July 20, we drew attention to the fact that though some of the larger collieries in the Durham area had been mechanised, the results of these developments were disappointing in that the miners were not willing to co-operate. At about that time the blame for the low output of coal, not only at Durham but throughout the country generally, was laid at the feet of the coal owners, and the electrical industry, concerned at the small volume of its stocks, has since waited with interest to see what the new Government intended doing in the matter. The Ministry of Fuel and Power is now directed by a new helmsman in Mr. SHINWELL, and his first public act was to visit Durham and beg the miners to produce more coal, at a rate of nearly

10 per cent. on the present output—admitting, we submit, the fact that the miners are capable of raising production if they have a mind to. No one wishes the new Minister better luck with his campaign for replenishing our coal stocks, than the electrical industry, for on his success depends to a large extent whether or not we shall have to shed load in the coming winter months. It seems odd, however, after all that has been said, that the Minister of Fuel should suggest that the responsibility for the coal crisis is less exclusive than we, the consumers, have been invited to believe.

Street Lighting Muddle

THE appeal by the Minister of Fuel to local authorities to reduce their street lighting as much as possible, is a further indication of the unfortunate manner with which the whole fuel problem is being handled. In short, it means that some 44 millions of the public are to be inconvenienced because the Government have failed to release from the Forces sufficient miners to produce the coal, or to see that those now working the mines are winning a reasonable output. In making his proposal Mr. SHINWELL has made a mistake, for instead of penalising the public, every effort should be made to encourage and inspire the coal industry to further endeavour. The miners have been promised nationalisation of their trade and it might therefore have been assumed that they would be willing to retrieve the falling coal output; as it is, however, the position is worsening. Three months ago local authorities were encouraged to overhaul their street lighting installations and this they did in most cases at considerable expense and strain upon their labour resources. Today, with war wiped from the face of the world, those same authorities are asked to make good the omissions of the mining industry, when in point of fact, the changed conditions should by now have given indication of improvement.

Chinese National Resources Commission

THE Chinese Commission which came to this country in the "Queen Mary," includes among its delegates two electrical personalities of interest. Mr. YUN, who leads the delegation, is concerned chiefly with manufacturing, while Mr. LIU is mainly interested in the power side. The Commission, as explained elsewhere in this issue, intends visiting various works up and down the country and is making special examination of the grid system with a view to promoting a somewhat similar network in China. The prospects of British manufacturers playing their part in the reconstruction programme proposed by the Chinese Government, are in the opinion of Mr. YUN, encouraging. This we can well understand for the work of the British engineer could, before the Japanese invasion at least, be seen far and wide in Canton, Foochow, Amoy, Shanghai and cities inland less well known. This work of British engineering has been brought about by the number of Chinese students and graduates who enter our electrical engineering works as college apprentices, to return to their native China at a later date. They have in the past taken back with them full knowledge of our technical progress and in translating it into material things, orders for equipment have been passed to their former employers. Those conditions will soon be resumed.

Tummel-Garry Objections Rejected.

THE amenity and fisheries objections to the Tummel-Garry project having been rejected by the three Commissioners who conducted the public inquiry at Edinburgh four months ago, the North of Scotland Hydro-Electric Board's second constructional scheme covering the Tummel-Garry and Gairloch projects, estimated to cost £6 450 000, can now be proceeded with, if the confirming Order now before Parliament is not annulled. It is expected that the major portion will be completed by 1948. On the ground that a case of sufficient urgency was made out to overcome objections, the Commissioners declare unanimously that it is in the public interest for the scheme to proceed. They feel that the submergence of Clunie Bridge, albeit beautiful, and the conversion of a few reaches of Highland rivers into the waters of a winding lake is but a small price to pay for bringing, in some measure, the amenities of life where few existed before, and to inject new energy into the straths and glens of the Highlands. In recommending that the North of Scotland Board pay half the expenses of the inquiry, the Tribunal suggest that the Board showed unnecessary reluctance to disclose information to parties legitimately interested.

Now It Can Be Told—VI

Some War-Time Activities of the Metropolitan-Vickers Electrical Co.

A BRIEF outline of the war-time activities of the Metropolitan-Vickers Electrical Co., Ltd., was given by Sir George Bailey at a Press conference at the Trafford Park works recently, and since then some details of the company's contributions to the development of radar and the atomic bomb have been made known.

Special work by the company started in 1936, with the manufacture of sound locators for the Army for the audible detection of aircraft movements, giving location, elevation and direction of travel of suspected aircraft; searchlights for the Army; and signalling lights and fighting searchlights for the Navy. Much of the design for Navy searchlights was by M-V. engineers in collaboration with the Admiralty. For this work £70 000 worth of new machine tools were used.

In the same year, the company developed the automatic pilot device, familiarly known as " George," enabling a pilot to relax during a long flight on a straight course, and by the end of 1940, they had produced over 1 000 equipments. Originally M-V. were alone in this field.

The company's contribution to radar was mentioned in our last issue. In July, 1939, they were asked to produce 80 per cent. of all R.D.F. transmitters and in March, 1941, orders were placed with the company by the Admiralty for transmitters and receivers. Particular types of apparatus were produced for " jamming " purposes. For ship work special scanners were made.

Photo-electric Control of Missiles

Sir Arthur P. M. Fleming, director of research for the company, has been in the closest touch with all the Government departments continuously, and as each war problem involving technical considerations arose, the company's research engineers were brought into consultation, often on matters which did not call for any manufacturing work. In the early days of R.D.F. the original chain station equipments were built in the research department.

In relation to problems connected with the photo-electric control of missiles and others controlled accoustically, the company's research engineers have given considerable assistance to the research organisations of the three Services.

Auto-drills, designed almost entirely by the research department, enabled unexploded bombs to be dealt with effectively. A hole was drilled through the case of the bomb, and simultaneously another was trepanned. Steam was then injected into the bomb under pressure, disolving the T.N.T. Two sizes of auto-drills were made, the larger being used for bombs with cases of material up to 3 in. thick.

The metadyne equipment which revolutionised gun-fire control in the Navy, and is also used for other purposes, both in the Navy and the Army, was disigned by the company in 1940.

In May of that year the King and Queen visited the works at Trafford Park.

Factory Bombed

The company completed its first Manchester bomber in November, 1940. This machine was destroyed, and twelve others, partly completed, were wrecked when the factory was hit during an air raid in the following month. At the same time part of the main works was destroyed by fire. Various dispersal works and offices were taken over, and later in 1941, extensive additional factory accommodation was built in the area of the main works.

Working with material supplied by I.C.I., the company developed a method of moulding polythene which solved certain insulation problems related to radar and also effected a considerable saving of money.

Just before the war the Air Ministry had requested the company to build a few 500 W, 1 200/2 400 cycles, 80 V alternators, to be driven by the main engines of aeroplanes, to supply the necessary electrical energy for airborne R.D.F. equipment. The machines were designed in co-operation with the Royal Aircraft Establishment, and the work was undertaken at the company's Sheffield works. The number produced reached a very high figure.

The year 1942, saw the beginning of the placing of a number of orders with the company by the Ministry of Supply for power station equipment for the U.S.S.R. This comprised 21 turbo-alternator sets for outputs ranging from 1 350 kW to 25 000 kW. More than 50 mobile generating stations, including 1 000 kW, 2 000 kW, and 5 000 kW sets, were also ordered.

During the whole period of the war the company produced the generating and motoring equipments for submarines of many classes. A special secret shop was established and equipped for the manufacture of ground equipment for rocket projectiles. Other special shops were devoted to development work on jet propulsion in conjunction with the Royal Aircraft Establishment, Power Jets and others.

Plastic Materials

By JAMES TAYLOR, B.Sc., F.R.I.C.

UREA-FORMALDEHYDE materials, as their name implies, are manufactured by the condensation, under carefully controlled conditions of urea and formaldehyde. Urea, in turn, is produced synthetically from carbon dioxide and ammonia. When condensed together, urea and formaldehyde form a syrupy liquid which consists mainly of a solution of the synthetic resin in the water of the formaldehyde. This syrup may be used, with a filler, to make a moulding powder, or its properties may be adjusted to make it suitable for use as an adhesive or cement.

The common fillers used in the manufacture of urea moulding powders are cellulose (in the form of cotton linters or bleached sulphite pulp) or wood flour. As urea resins are clear transparent or sometimes milky, a very large range of colours, both light and dark, may be obtained by the use of suitable pigments or dyestuffs. The moulding technique is practically the same as that of the phenol-formaldehyde moulding materials except that the temperature used is usually lower, about 130° C. instead of 150° C., and the pressure required is about 20 per cent. more, i.e., rather over 1 ton per sq. in.

Properties of Mouldings

Average properties of mouldings made from urea-formaldehyde materials are:—

	Cellulose filled.	Wood flour filled.
Impact Strength (BSS771)	·.25	.22
Tensile Strength	6 000 lb. per sq. in.	8 000 lb. per sq. in.
Volume Resistivity	10^{12}	10^{12}
Dielectric Strength		
at 20°C	200/250 V per mil.	200/250 V per mil.
at 90°C	60/80 „ „ „	70/90 „ „ „

Compared with phenol-formaldehyde mouldings, the water absorption of urea-formaldehyde mouldings is slightly higher, but is still quite good. For instance, table ware moulded in urea-formaldehyde will withstand reasonable washing in almost boiling water, but tends to soften and swell under prolonged immersion. On the other hand, urea-formaldehyde mouldings are much better as regards resistance to tracking between electrically live metallic inserts. Amongst the commoner electrical applications of urea-formaldehyde mouldings may be mentioned switches, switch bases, adaptors, sockets, plugs, meter cases, parts of magnetos and coils, electric light fittings and shades, ceiling roses and parts of radio sets, including radio cabinets.

Urea-formaldehyde resins, like the phenol-formaldehyde resins, are used in the manufacture of laminated sheet. Light colours, including white, can be produced, and the material finds outlet mostly in decorative work, panelling, table tops, counter and bar tops and sides, etc., but sometimes it is used for electrical purposes.

Adhesive Applications

Very large quantities of urea-formaldehyde resins are used for adhesive purposes. The method adopted in this application is that of the resin syrup being used in conjunction with a hardener which is usually a weak acid, and whose function is to accelerate the polymerisation and hardening of the adhesive. In the case of some urea glues, the hardener solution is first of all applied to the wooden surfaces to be glued. After drying, the surfaces are coated with the adhesive syrup and clamped in position. In other cases the hardener and the syrup are delivered separately by the manufacturer and are mixed just prior to use, being then applied to the surfaces to be glued. Sometimes the glues are designed for setting without the application of heat, whilst in other cases heat is applied. Again, in some cases it is possible to "dilute" the glue by adding to it a certain amount of rye flour.

Considerable variation in the speed of hardening may be effected by using different hardeners and different amounts of these hardeners. Variation in time taken to harden can also be varied by application of heat. For example, it is probable that without the use of heat joints will be made which will set overnight, but by heating to about 90° C. the glue will set absolutely hard in a matter of five minutes or so. Admittedly urea glues require careful handling, but by control of the conditions of application it is possible to produce speeds of drying, etc., suitable to the particular job.

It is also possible to prepare a urea-formaldehyde glue which is in solid form by modifying the urea-formaldehyde condensation product with zinc chloride. It is supplied as a white power which is dissolved in about half its weight of water and is then hot pressed.

Urea-formaldehyde adhesives are now used extensively in the manufacture of plywood, and, of course, plywood has several applications in the electrical industry.

Melamine as a constituent of plastic materials has come into considerable prominence since the beginning of the war.

Its use in plastics only commenced about 1939, but the amount now used is quite considerable, and would definitely be greater were it in more abundant supply.

Melamine is obtained from calcium cyanamide, passing through dicyandiamide as an intermediate product, and is therefore a derivative of the calcium carbide industry. Like urea, it is an amino compound, and it will condense with formaldehyde to produce synthetic resins. These resins possess very interesting properties and are in many respects similar to urea resins, except that their properties are superior. Compared with urea resins, they offer better resistance to heat, they are non-tracking, they are almost free from colour, they possess greater resistance to water, dilute acids and dilute alkalis.

Dielectric Strength of Melamine

They can be used for the manufacture of moulding powders, for laminated material, as varnishes, and, last but not least, as adhesives.

When made up into moulding powders, a material is obtained which can be moulded under more or less the same conditions as the urea-formaldehyde materials. The filler used is most commonly cellulose, as in the case of urea, but materials of greater impact strength can be obtained by using chopped fabric as the filler. Melamine resins possess excellent arc-resisting properties, and by using asbestos as the filler it is possible to produce a material which has really interesting arc-resisting properties, in fact better than those of any synthetic moulding material. Below is a table giving the more interesting properties of the three types of moulding material:—

	Cellulose filler.	Chopped fabric filler.	Asbestos filler.
Impact Strength (BSS771) ...	.25	.68	.3
Tensile Strength (lb./sq. in.) ...	7570	3600	5900
Volume Resistivity (ohms/cms)	10^{12}	10^{12}	10^{11}
Dielectric Strength (volts/mil) ...	340	270	535
Arc Resistance (Proposed method) ...	125 secs.	111 secs.	133 secs.

In view of their high dielectric strength, melamine moulding materials are used in mouldings in ignition systems of aircraft engines, and, of course, in circuit-breakers, terminal blocks and other electrical parts. In view of their not too abundant availability their use has been more or less restricted to direct war purposes, but there are indications of a great future in civilian applications.

When used for making laminated sheet, melamine resins produce a material which possesses good arc resistance, good resistance to heat, a very hard surface and general inertness to water, dilute acids and alkalis and organic solvents.

In America a laminated board has been produced from glass fibre cloth and melamine resins, and has been used by the U.S. Navy. This board possesses excellent impact strength and is extremely resistant to both arc and heat. It also withstands considerable rough usage and, in addition, gun blast.

Similarly, melamine resins have been adapted to adhesive manufacture. They possess exceptional water-resisting qualities. Also they have been used for the manufacture of varnishes to induce resistance to water, abrasion, and also to reduce tracking. They are similar to urea resins in this respect. When used in varnishes they may either be employed alone or in combination with urea or alkyd resins.

In America, it is understood, developments may be expected in the direction of melamine resins suitable for casting, and also melamine resins in the forms of aqueous emulsions.

A War-time Development

The melamine resins are a class whose industrial application has been developed almost entirely under war-time conditions, and they afford an excellent example of the use of new materials in connection with one of the oldest acts of man, namely, carrying on war. The present war has introduced many new problems to the scientific investigator, and not a few of these problems have been solved by the use of plastic materials. Melamine's hardness and general resistance have made it a most valuable material in the war effort. Adhesives based on it have played a most important part in the construction of wooden parts of aircraft and in some of the modern all-wood aircraft. Without the use of melamine it would probably not have been possible to make the advances in wood-constructed aircraft and in small wooden craft which have been made. When it is remembered that, even in the tropics, an aircraft at great height is more or less in arctic conditions, and yet on coming down to earth will be in a hot, humid atmosphere, the wonderful properties of melamine resins will be appreciated.

Micro-Thickness Gauges.—A new publication issued by the Cambridge Instrument Co., Ltd., describes a range of Cambridge micro-thickness gauges for use on rolling mills and on calendering machines in metal and also rubber industries.

Hydro-Electric Schemes

By A. G. AREND.

IN view of a number of controversies which have arisen at the present time in connection with the benefits which may be derived from the harnessing of water-power, certain features require to be made clear, in order that a true and unbiassed criterion of the economies available can be gained. Modern industry, in almost all its forms, depends upon the acquisition of cheap electric current.

Without it, foreign competition would sooner or later exert a serious influence, and this is probably best exemplified by the extensive hydro-electric schemes which at the moment are being contemplated in South American countries Reference has already been made in this journal to schemes in Scandinavian and other northern countries, where the use of sites for high-head installations and wooden pipe-lines permit the harnessing and production of power at a mere fraction of the cost which is possible by alternative means.

Although other water sources may not be so favourably placed, the independence and permanence of the hydro. scheme in general is too well established to brook much in the way of argument. Climatic conditions are, however, important, and the matter of weather reports, which have been so improved of recent years, indicates the nature of what rainfall may possibly be contemplated. Whereas the recording of atmospheric depressions has been of assistance in other quarters, it has been of somewhat doubtful value in foretelling possible rainfall in this country. In Uruguay, where the average rainfall approximates to 50 inches a year, it fluctuates between 25 and 72 inches, and droughts are both frequent and sometimes serious.

The Rainfall Factor

Instances have been quoted where there has been no rain for months at a time, and recently Uruguay was recovering from one of the worst droughts it had experienced in 40 years. Despite this practical difficulty, which is unknown in this country, provision is being made to serve their cities with current from harnessed water schemes.

Recognising the future possibilities of this work, Chilean interests have adopted two Portland cement plants where a consumption of 600 000 tons is scheduled for 1945.

Both smelteries and chemical plants have been erected to take advantage of the cheap power which will accrue from the southern provinces of this State, where the rainfall is known to exceed 100 in. per year. The almost unbroken record of rainfall in the mountainous regions of this country, so frequently derided by intending holidaymakers, is one of the most potent factors in favour of hydro-schemes here. The drought which is so serious to such schemes in other lands has not to be suffered.

What fall in water-level exists need not necessarily involve a pumping-back of the used water, as witness the extensive surge tanks installed for the Neiderwartha pump storage power plant.

Possible Economies

The economies possible by obtaining cheap current directly at site are not always fully appreciated, as the subject is a large one, and so many different types of industries are concerned. The student is frequently given the illustration of electric steel-making practice, where the benefits of solid fuel are utilised in the initial melting process. Thus, iron is raised to molten condition in a cupola, and run into the electric hearth, where advantage is taken of the necessary high temperatures. To start the melting with cold scrap means that the great heat from the electric arc is largely dissipated in the early stages. The other side of the economy question, less frequently quoted, has also to be observed, namely, the use of electric current in preparing glass. Here, the raw materials are melted in a special arc, or resistance hearth, and then run into a gas-fired secondary hearth where the molten mass is " held " for a lengthy period. It would not be economical to carry out this " holding " process by electrical means, as the period of time eventually necessitates the consumption of too many kilowatts. For this reason, and because gas-firing is put to difficulty in initially raising a high temperature rapidly, electric heating is more cheaply utilised only at the commencement. Glass as made by the electric process appears to have enjoyed somewhat limited success, but this serves as a good example of how current costs work out.

A third illustration is that of producing ferro-manganese, where, in contradistinction to the usual conception, it is sometimes more economical to engage small hearths rather than large furnaces. Radiation losses and other associated matters usually indicate the benefits of the more capacious furnace, but as far back as the last war period it was recognised that high volatilisation losses were associated closely

with high operating voltages. In furnaces with an average input of 3 600 kW using 115 V, at a frequency of 60, one ton of ferro-manganese worked out at 4 800 kW with a power factor of 0.8 and 15 per cent. was lost by volatilisation, while another 10 per cent. passed to the slag. In certain respects, therefore, it pays to instal the small hearth in preference to the larger furnace. From an entirely different aspect, the electro-chemical industry rarely benefits by the installation of capacious cells.

Instead, a multitude of small cells have proved themselves most efficient for the large bulk of wet electrolytic processes. This has brought difficulties in its train in that great secrecy has been observed, and relatively little practical information divulged on the *modus operandi*, since a small producer might be capable of directly competing with a large chemical concern. No such conditions arose before the small electrolytic cell was evolved. The raising of heat within the cell usually means an unnecessary loss of current, and the smaller cell is more easily insulated, although in the production of several of the per-salts, resort is made to the use of hollow water-cooled electrodes. Some indication of the privacy maintained will be gathered when it is mentioned that a recognised maker of electrolytic cells was unaware that far more organic chemical compounds are prepared by electrolytic means (although in smaller actual tonnage) than inorganic salts.

Need for Cheap Current

The economical use of current has to be taken in conjunction with the convenience which it provides, since a number of chemical processes depend on its use for specific reduction and oxidation reactions only, while the remainder of the system is performed by direct chemical reaction. The production of sodium perborate necessitates the expenditure of 3 kW per pound, but there is no alternative means of making it. In converting sodium chlorate to perchlorate each pound consumes 1.7 kWh, but the conversion of potassium manganate to the permanganate condition, which lends itself to more direct per-oxidation, only involves 0.3 kWh per pound. The cost of current is thus a serious matter in preparing certain per-salts, and the same remarks apply to a number of organic compounds, since even the oxidation of anthracene to anthraquinone, which is the basis of alizarin, necessitates 1.2 kWh per pound.

Progress in the electro-chemical field has been held up by the high cost of current, and where substitute chemical methods cannot come to the rescue, there is no alternative but to pay a high price for them, which in turn restricts the expansion of their uses for preparing other connected chemical products. Nitric acid has been quoted as necessitating upwards of 14 kWh per pound, and in certain quarters, phosphorus requires 11 kWh per pound.

Antiquated Processes

Despite the advancement made in chemical sciences generally, the restriction introduced by high current costs has resulted in antiquated wet processes being persevered with. At the present time (1945), the process of distilling nitric acid from a mixture of sodium nitrate and sulphuric acid, using plant still largely made of glass, as was done a century ago, is able to compete with the modern synthetic process. Phosphorus which is important for fertilizer purposes, baking powder, matches, sugar refining, and the making of thin iron castings, etc., in its different forms, was only made in the U.S.A., by the electro-thermal process a few years prior to the war, and there were certain misgivings that the earlier blast-furnace process, which gave a less pure product, was not still the most economical. The list of chemicals in a similar category is too elaborate to deal with in limited space, but briefly the high cost of current has resulted in the continuance of ancient systems which provide impure material, and have a poor future to anticipate.

Apart from the type of chemical products formed in solution by electrolytic action, a more extreme example of the extensive possibilities which may obtain when really cheap current is available, is seen in the combined electrolytic and chemical precipitation systems.

The only one of these which at present appears to be carried out on a large scale is the production of white lead. A large factory of the Anaconda company in North Chicago makes this material as a continuous output, in place of the ancient Dutch process, which, after a period of months, gives the same product. Current consumption ranges from 0.1 to 0.15 kWh per pound. The anolyte and catholyte are operated as separate processes, wherein sodium acetate reacts with the crude lead anodes, and sodium carbonate precipitates the white lead from the solution so obtained. By this means crude lead is refined at the same time, as it is only pure lead which passes to the finished product, and all impurities such as bismuth, etc., are collected for uses elsewhere. As details of this system have appeared previously a repetition would not be justified, but it is noteworthy that this is only one of the many processes which can be operated in this manner. In other words, instead of electrolytically refining metals to their finished stage, the crude anode can be fully

electrolysed and a completed salt made simultaneously. Other examples are copper carbonate, lead hydrogen arsenate, mercuric oxide, and tin salts. These methods mean that a double use can be made of the electrolytic action, and provided cheap current is available, time is saved on two separate counts.

At the present moment in this country, the ancient Dutch process of making white lead is still persevered with, while certain makers of tin chloride dissolve pure granulated tin by slowly treating it with hydrochloric acid.

Copper oxide, Cu_2O which enjoys numerous important industrial uses, instead of being slowly prepared from other salts, is produced from metallic copper anodes in an electrolyte of sodium chloride. These represent but a few of the innumerable precipitates which can be formed from solutions which have been withdrawn by electrolysis, giving an entirely pure material, with a minimum of labour.

Reason for Tardiness

In each case, the process functions night and day, and a large number of electrolysis baths can be attended to by the one operative. Without unduly elaborating on the point, it has to be noted that the chief reason for the apparent tardiness of manufacturers here to adopt these improved systems, is that current can be obtained as cheaply from power stations at one part of the country as another.

Where large appropriate water-power schemes are available, the price of the power, when obtained directly from source, can be a fraction of that produced by alternative means. This of course, depends on a number of factors such as the closeness of the site from which the high-head installation is available, ground burdens and the amount of transmission necessary. It seems almost anomalous that any restriction would indicate that antiquated chemical and metallurgical processes should still be given preference over unequivocally improved methods.

In other directions, instead of making separate electrodes, one of the Soderberg smelting furnace processes makes provision for these to be automatically produced while the other fusion reactions are in progress. The raw carbon materials and binder are fed continuously into an upper section, which, after forming to the familiar cylindrical shape, are duly baked, and the hot-end enters the hearth proper where the smelting takes place. From another aspect, the wet electrolytic refining of copper, which is usually performed in tanks operated on the multiple system, can also be carried out by the series system. The Nichols Copper Co. Brooklyn, U.S.A., is one of the few firms which use this method and which holds the advantage that when short circuiting arises it can only affect one set of tanks. The advantages and disadvantages of such methods have been a matter of controversy, but without cheap current these arrangements would be literally worthless, as the tendency is to consume more than the usual amount of power. It is hoped the above notes will give some indication of the state of affairs peculiar to the use of current in the chemical and metallurgical lines, where, of course, the greatest consumption is in the preparation of ferro-molybdenum, other ferro-alloys, and carborundum, etc.

The subject is so large and varied that it would almost necessitate some form of economist to be engaged to assess the respective costs, but one feature stands out clear and untrammelled in any way, namely, that cheap current is the basis of success for all of these processes. Irrespective of howsoever slow may be the interest shewn in countries unused to this work the basic feature of harnessing all available water schemes is the first step in the right direction, as sooner or later, use will be made of them, and prosperity for many industries will be assured.

Notes for Contractors.—Mr. L. C. Penwill, director and secretary of the N.F.E.A., draws the attention of members to their obligation to register through the office of the association, all labour under 21 years of age coming within category 11 of the agreement of June 14, 1943. At the meeting of the Standing Committee on August 1, 1945, it was agreed that for the war period a lodging allowance of 10s. 6d. shall be paid to operatives taking their week's paid holiday, but only if they are in receipt of a country allowance in accordance with clause 13 of the National Working Rules, or clause 6, sub-clause 2(b) of the agreement of September 6, 1944. Such allowance shall be paid in respect of holidays commenced after August 17, 1945, and shall not be paid retrospectively in respect of holidays taken before that date. The question of the conditions of service for men who are required to travel abroad has been the subject of consideration by the National Joint Industrial Council, and an endeavour is being made to arrive at an agreement on the matter. In the meantime the National J.I.C. has passed a resolution expressing the opinion that labour under the age of 20 years should not be compelled to work on contracts outside the United Kingdom. Such labour should only be sent abroad if a lad, or his parents on his behalf, express willingness for him to go.

The Queen Elizabeth

Details of the Great Liner's Electrical Installation

THE world's largest liner, the "Queen Elizabeth," which recently visited her home port, Southampton, has been somewhat of a mystery boat, for she made her maiden voyage, necessarily kept a secret, in 1940, and was immediately swallowed up by the mists of war. Since then, mainly as a troopship, she has done magnificent service for the Admiralty.

Planned luxuriously for the Cunard White Star Company's Atlantic fleet, the great liner is built on remarkably graceful lines. She is ten feet longer than her sister ship, the "Queen Mary," and is easily distinguished by her two funnels, compared with the earlier vessel's three.

Two Separate Power Stations

At the time of her going into commission it was not possible to publish a description of the new liner, but we are now able to give details of the electrical installation.

Steam, as a source of energy, apart from the main propelling machinery and the electrical generating machinery, is conspicuous by its absence throughout the "Queen Elizabeth." All the deck machinery, such as steering gear, windlass, capstans, cargo, baggage, mail and boat winches, etc., are electrically operated, but the advantages offered by electricity as a power medium have not been confined to the decks. In the main engine rooms and boiler rooms all the auxiliary machinery, with one or two exceptions, is electrically operated. Electric lighting and heating on a floating hotel calls for a supply of current of no insignificant order. The entire electrical requirements of the ship are provided by two separate power stations arranged on either side of a centre line water-tight bulkhead between Nos. 2 and 3 boiler rooms. The total power which these stations can produce it 8 800 kW, which is sufficient to provide illumination for a city with about 300 000 30 W lamps, or to meet the lighting and public services of a township of nearly 150 000 people. This power is judiciously divided to ensure the reliable functioning of the ship as an hotel apart from her function as an ocean liner. Both power stations are entirely independent, but they are, nevertheless, so inter-connected that in the almost inconceivable exigency of a breakdown occurring in one station current can be obtained from the other station to carry on to a limited extent the functions of the disabled one.

In each power station there are two generator units, each of 2 200 kW capacity. While it may be necessary under certain unusual circumstances to run all these machines at the same time, under normal conditions there will always be one machine idle. Each generator consists of two dynamos of 1 100 kW capacity driven in tandem by a steam turbine through single reduction gearing. The turbines rotate at a speed of 4 500 r.p.m., but this is reduced through the gearing to 600 revolutions at the dynamo. In accordance with latest power station practice each turbine is provided with a separate condenser incorporated in the design of the set; thus, with independent vacuum maintaining pumps, ejectors and lubrication systems, each generator is practically an independent unit. To suit the general arrangement of the machines in their compartments it was found desirable to provide two condenser circulating pumps in each station, each pump being capable of circulating one condenser but suitably cross-connected.

The two power stations are similar in arrangement, each supplies both hotel requirements and propulsion auxiliaries, the one the port side and the other the starboard side and can work independently or be coupled together to function as one unit. Each compartment is 42 ft. long, 38 ft. wide and 28 ft. high, and the switchboard rooms, situated forward of the generator rooms in such a position as to provide a view of the machinery, are each 40 ft. long, 29 ft. wide and 15 ft. high.

The Switchgear

The switchboards controlling the generators are each 23 ft. long and are arranged athwartship, the feeder boards, each 24 ft. long, being placed for and aft. From these feeder boards the cables pass up to the port and starboard sides of "A" deck for the hotel service distributing system and to "E" deck for main machinery requirements. The cables are connected to 50 auxiliary switchboards and can be so connected as to form several ring mains enabling the port and starboard boards to be fed from either the port or starboard generator room. These auxiliary boards are so disposed that each watertight or fireproof section of the ship has its own board, thus avoiding as far as possible the piercing of bulkheads for the passing of cables from one section to another.

The system of control and distribution of electric power is as nearly infallible as can be imagined and every precaution has been taken to ensure a continuous supply of current under the most abnormal conditions.

The main cables forming the ring mains are of copper 1 square inch in sectional area with suitable insulation, the final decision regarding the latter being made after extensive tests on different combinations had been carried out. Sixty 1 in. cables are required to feed the ring main for hotel services and 126 to feed the ring main for machinery services. The type of cable to be used for the branch lines received as much and as careful consideration as the main cables.

Whilst by far the greatest amount of current generated in the two stations is used for power purposes, that is, for use in electric motors, the amount of current required for other purposes is of no mean order. The lighting of the ship accounts for a considerable amount of the current produced by the generators. Not only has the ship to be efficiently illuminated, but certain modern decorative schemes employ lights as a feature for giving tone and effect to the artist's conception.

Whilst the heating of the accommodation is primarily arranged in conjunction with the ventilation, electric heaters in the staterooms supplement the air heating system. Electric cabin fans under the control of the passenger will also be installed in each stateroom. The switching arrangements for the cabin lights has received very careful consideration to give the passenger every facility for controlling them from convenient points.

Electric Kitchen Equipment

The greatest load on the hotel services is that required for the galleys. All the cooking ranges, hot presses, ovens, etc., in the kitchen are electrically heated. Electricity is also made use of to an unusual extent in the kitchens to facilitate the general service. Apart from the ranges and ovens, the following equipment is provided: electrically heated fryers, each with two pans; electric salamanders; electric mixing machines; coffee grinders; ice shaving machine; burnishing machines for ranges and for silver; toasters; waffle irons; griddle plates; dish washing machines; cutting machines; orange juice extractors; dough mixing machines; dough dividing and roll making machine; ice cream machine; ice breaking machine; knife cleaning machines, etc. The current for all the equipment previously mentioned is delivered by the generators at a pressure of 220 V d.c. For many purposes throughout the ship current at a lower pressure is desirable. A low pressure electrical system is therefore provided through a motor generator taking current at 220 V and delivering it at 25 V. All stateroom call bells and indicators, loud speaking and inter-communication telephones, submerged log, fire alarm bells, electric clocks, etc., are operated from this system. In addition, two batteries of approved capacity are installed for operating this equipment, and are so arranged that they will automatically come into action should the motor generators break down.

In accordance with the requirements of the Board of Trade an emergency electric generating plant is installed in a compartment on " B " deck, remote from the main power stations. Two Diesel engine driven sets each of 75 kW capacity are installed with all the necessary equipment for quick starting and continuous running.

A detailed description of the lighting of the vessel and of the many electrical devices for the safety and convenience of operating the ship in the shape of indicators, alarms, etc., is beyond the scope of this article. There are approximately 650 electric motors ranging from ¼ H.P. to 360 H.P. in the ship and totalling in all about 16 500 H.P. The number of electric lamps required is in the region of 30 000.

The whole installation has been built up on the unique experience of the company in the equipping and running of large passenger liners and it can be safely assumed that nothing which will contribute to the safety of the ship and the convenience of the passengers has been left undone. The regulations for the electrical equipment of ships as laid down by the Institution of Electrical Engineers, the requirements of Lloyd's Register of Shipping and the Board of Trade as regards electric installations have all been more than fully met in this vessel.

Turbo-Electric Tankers.—An order has been placed by the Anglo-Saxon Petroleum Co., Ltd., for an oil tanker of 17 600 tons deadweight, with a service speed of 16 knots. This vessel will have 13 000 S.H.P. turbo-electric propulsion equipment, and turbo-generators for the auxiliary services, made by the British Thomson-Houston Co., Ltd. The arrangement of the turbo-alternators and propeller motor is believed to be novel in that the advantages of the twin-screw turbo-electric equipment are retained in a single screw vessel. This is done by having two electrically independent " half motors " mounted together in the same frame and driving on to the same shaft. Each of the two sets of windings contributes half the total shaft horsepower under full load conditions, but economical operation can be obtained by using one turbo-alternator and one " half motor " unit at about three-quarters of the maximum ship speed. Control is effected by lever-operated contactor control equipment.

Electrical Accidents

Factory Department's Report—Fewer Fatalities

THE 1944 issue of the annual report of the Factory Department (Electrical Branch) appears once more in war-time guise, but there is a change in the method of production of the last fifteen years, in that the Department has refrained from comment on the figures, leaving the reader to draw his own conclusions. This issue is mainly a collection of comments and reports on well-established and new industrial processes prepared by H.M. electrical inspectors of factories, each dealing with the industries and problems encountered in his own area.

The electrical accidents reportable under the Factories Act numbered 1 072, of which 31 were fatal. There were 45 accidents notified, 13 fatal, which were found to be non-reportable, and, in addition, 113 electrical fatalities in places other than factory premises came unofficially to the notice of the Department, the total known fatalities due to electricity being 157, against 165 in 1943, 181 in 1942, 170 in 1941, and 150 in 1940.

Difficulties had been experienced for a number of years, states the report, in the operation of arc furnace switchgear. These arose from the comparatively great frequency with which the switches were opened and closed for the purpose of tap changing, and also from rather less frequent operation on overload.

" Permit-to Work " Systems

Typical accidents that have occurred in connection with switchgear are described.

The use of " Permit to Work " cards for the control of work on high tension and other dangerous equipment was now fairly general, but, unless the system adopted was carefully thought out, misunderstandings were likely to arise.

A fatality on a 11 000 V. switchboard in a railway sub-station showed the necessity for following a standard routine with regard to making dead, testing and earthing any part of the switchboard on which work was to be done.

Another accident which occurred while an electric fitter was engaged in replacing some under-rated oil circuit breakers in a sub-station as part of an extensive programme of switch replacement, showed the necessity for strict adherence to " Permit-to-Work " systems, both on the part of the engineer in charge and on the part of the man actually doing the work.

From time to time, reference had been made to the desirability of some form of bus zone protection, at least for the more important stations, and some progress had been made in the installation of protective gear of this type. The possibility of incorrect operation had, no doubt, been one of the factors to be seriously considered by those responsible for the equipment of electrical stations.

Some of the more unusual aspects of the problem of earth connections and earth faults are dealt with.

Earth Leakage Risks

Most engineers, states the report, were well aware of the effect of leakage in portable tools, etc., and the means required for preventing accidents therefrom. The risk in such cases was shock. A second, and very important, risk was fire. It was usually difficult to assess the causation of a fire, but, in some such cases, signs of sustained earth leakage currents had been unmistakable.

In rural districts, where the efficiency of the earthing arrangements both of installations and transformer neutrals, was always problematical, the dangers of sustained earth leakage were always present, unless some form of protection other than over-current was provided.

In certain industries, where a special fire and/or explosive risk was present, some form of earth leakage indication, together with an alarm arrangement to give warning of dangerous leakage, was more or less compulsory, and the tendency to extend the requirement to new processes had been noted, as, for example, acetylene manufacture, magnesium grinding, aero engine testing, nitrate salt baths for heat treatment of aluminium, etc.

One rather interesting arrangement which had been noted in certain areas was designed to overcome the main objection raised to the adoption of earth leakage protection. An earth leakage indicator (plus recorder and/or alarm) was arranged to take care of the low values of leakage, a relay being installed set to trip the requisite switch should a dangerously high value of leakage current be sustained through failure of over-current devices to operate. Such an arrangement had been applied to several shipyards during the year in connection with their new alternating current welding layouts.

From time to time various points had been raised with regard to safety in connection with portable apparatus and, in view of the increase in use of three-phase portable and transportable equipment, it was now considered advisable to draw at-

tention to the possibility of a "two-pin and earth" plug being inadvertently pushed into a socket outlet connected to a 400/440 V three-phase supply, thus making alive the frame of the portable apparatus connected to the two-pin and earth plug. It was an unfortunate fact that both the 5 A and 15 A sizes of two-pin and earth plugs made to dimensions of a British standard specification could quite readily be inserted into certain types of 15 A and 30 A three-phase socket outlets for which there was no British standard specification.

Warning Notices Insufficient

Under these conditions there was every possibility of a serious, if not fatal, accident. The average user of portable electrical apparatus was not trained to know the difference between single and three-phase electric circuits and could hardly be blamed for putting a plug into a socket outlet which it appeared to fit. Such interchangeable plugs and sockets should, therefore, not be used on the same premises, and to do so was considered to be contributory towards a breach of the Electricity Regulations. Here it might be as well to say that notices warning users against the use of one particular type of plug in another form of socket were not considered sufficient and, where non-interchangeability was necessary, it must be secured by actual physical dimensions of the connectors concerned. It was hoped that something might be done in the near future by the introduction of a standard specification for three-pin and earth plugs and sockets which would give effect to this.

The importance of proper maintenance of portable tools and associated flexible cables and connectors, together with the need of testing and checking continuity of earth conductors, both in the flexible cable and on the fixed socket outlet, had been stressed in several previous reports. Accidents still occurred, however, due to neglect of these precautions.

In last year's report there were, *inter alia* references to the acute shortage of skilled maintenance electricians, and the lee-way that would require to be made up. The position might be difficult for a year or two, pending the return from the Services of qualified men, and the training of fresh entrants to industry. There were undoubtedly greatly varying views as to what constituted a skilled maintenance electrician, and inspection often revealed a serious lack of technical knowledge and experience in persons put in charge of factory electrical installations and plant.

During the war there had been Government training centres and, more than one trade association had started internal schemes of examination. These signs of general progress were encouraging and would tend to prevent accidents.

In the 1943 report, reference was made to the difficulties being experienced due to lack of care in providing return circuits for electric welding, with an impedance as low as practicable. In 1944 a number of cases of damage to primary earth connections of the welding transformer had been reported, together with several causes of damage to lifting tackle and to earthing conductors in 3-core cables supplying portable electric tools. There was also a fire risk if stray welding current was carried by gas pipes, or by the structural steelwork of buildings such as dockside warehouses. This matter had continued to receive considerable attention and, apart from training welders to take as much care with their return connections as with their welding leads, the following variation of the usual practice in connection with welding circuits had been evolved. The arrangement was not new as far as d.c. circuits were concerned, but, until lately, it had not been used to a large extent with a.c. circuits.

The New Arrangement

The usual practice had been to earth one pole, or the neutral point of generator or transformer windings supplying welding circuits at the generator frame or transformer tank. In the alternative arrangement, the welding circuit was insulated from earth at the generator or transformer, but earthed at the work, so that none of the return welding current could flow through the earth connection of the generator or transformer tank, through lifting tackle, or the earth connections of portable tools. In the case of multi-operator sets, however, although the first operator must connect the work to the welding supply by a return lead, the second operator might proceed to weld with only an electrode lead on another piece of work which might be only fortuitously earthed, or he might adopt an arrangement such as laying a piece of angle or tube on his work and leaning it up against some earthed metal, thus avoiding the use of a return lead. Such an arrangement would result in wandering currents between the second piece of work and the original, which might again involve lifting tackle and earth connections of portable tools. It also loaded up the return current cable of No. 1 operator, but it could not damage the generator or transformer main earth connections. With the new arrangement, therefore, it was still essential that welders should be trained to be careful to fix adequate return circuit connections, but the danger to the earth con-

nection of the transformer or generator was eliminated.

In some cases existing plant was so arranged that the welding supply winding must be earthed at the frame of the generator or the transformer tank, and, in this instance, there was no alternative, than to continue with the use of the first-mentioned arrangement.

There had already been some experience of the arrangement with the welding earth at the work in shipbuilding yards, and, in those cases where it had been tried, there had been a marked decrease in the troubles previously experienced with transformer earth connections, lifting tackle and portable electric tools.

Dangerous Accessories

Inspection of a large number of premises where electric arc welding was carried on had revealed that a number of accessories were in use which could have been of better design. The most common fault was the use of electrode holders with no insulating disc fitted to the handle to prevent inadvertent contact by the operator with the live part of the holder. A number of electrode holders were in use with live metal exposed at the handle, so that the welder's glove was the only safeguard between the operator and an electric shock. A number of electric shock accidents were due to electrode holders being left about alive and there was no doubt that some means or other of readily making dead the exposed metal conducting parts of the holder would be a means of reducing the number of such accidents.

It was obvious that more thought must be given by occupiers to equipment involving trolley wires, if safety was to be better assured. Those responsible for design, construction and installation could assist greatly by way of collaboration with the user and making themselves acquainted with particular working conditions.

While accidents involving the use of crane lifting magnets application were not numerous, they did occur, states the report. Some of the electrical features, including matters requiring consideration, with recommendations, are mentioned.

Some space was occupied in the report last year dealing with conditions in the aircraft industry where electrical apparatus is used in the presence of petrol. This year had seen The Factories (Testing of Aircraft Engines, Carburettors and Other Accessories) Order, 1944, brought into force, and this had made obligatory certain safeguards where testing is carried on of the type which the Order indicates.

There was a reference in the previous year's report to the programme of tests of specified gases being carried out by the Safety in Mines Research Board and the British Electrical and Allied Industries Research Association, so as to determine their grouping for the purpose of flameproof electrical apparatus. These tests had gone ahead during the year, and much valuable work had now been accomplished since the research was first commenced some years ago. Some work arising from the original programme still remained to be done, and might yet take a little time to complete. The data already available, however, would be used in the revision of B.S.229, now being undertaken, and it was hoped that the issue of that document would not long be delayed. This, together with the issue of a code of practice dealing with flameproof installations, which was being pursued in another place, would make available information which had not hitherto been obtainable in published form.

The necessity for keeping flameproof electrical equipment in good condition is stressed.

Certain dusts are highly inflammable and when mixed with suitable proportions of air, form an explosive mixture. During 1944 the Branch had occasion to consider an electrostatic precipitator plant for removing an inflammable dust from the air stream of a ventilating plant. In general, it would seem that the electrostatic deposit of inflammable dusts involved inherent risk which should be balanced at the planning stage against the cost of the precautions desirable.

High Frequency Burns

Considerable interest had been displayed in high frequency heating during 1944. The heating circuit was at such high frequency that, even at high voltages, the danger from electric shock was not great, but, on the other hand, contact with one of the conductors might be attended by a serious high frequency burn which was usually deep seated. The precautions normally required were enclosure of all parts of the high frequency generating equipment with interlocks so arranged that access was possible only when the high pressure supply had been cut off from the equipment and all large condensers discharged and earthed if the circuit arrangement was not such as to secure automatic discharge. All conductors at medium pressure inside the generating enclosure should be insulated or enclosed to prevent accidental contact therewith after obtaining access to the enclosure.

The high frequency heating should be done in an enclosure also provided with an interlock to prevent access while live. Such an arrangement could be devised also to form a screen to prevent emission causing radio interference and therapeutic effect on the workers.

Electronic Measuring Instruments

Increasing Range of Applications

IT has been found possible to make electronic instruments more rapid in response, more sensitive, more robust, and, in some cases, less expensive than other types. In an early example of the application of electronics to the design of this type of instrument, the galvanometer of the conventional potentiometer is replaced by a vacuum tube amplifier. The d.c fed to the amplifier is converted to a.c. by means of a carbon microphone. The amplifier output is applied through a pair of thyratrons to a reversible motor in such a way as to bring the potentiometer to balance. The instrument gives rapid response (3 seconds for full-scale traverse), is sensitive, and is robust and claimed to be trouble-free.

Another method of achieving rapid response and high sensitivity electronically in recording potentiometers is by the use of a mirror galvanometer, which actuates the potentiometer balancing motor through a photoelectric relay. This system avoids all mechanical contact with the galvanometer, and permits inverse feed-back so that its speed of response can be increased. The fastest instrument of this type can cross a 10 in. scale in 2 seconds. The price of the standard models is comparable with that of mechanically balanced recording potentiometers. High-speed models are somewhat more expensive.

Electronic Potentiometer

The electronic potentiometer is among the most recent developments in this field. In it the galvanometer is replaced by an amplifier. The d.c. input to the amplifier is converted to a.c. by means of a synchronous vibrator. The output of the four-tube amplifier is sufficient to drive the balancing motor directly. The fastest instrument of this line traverses a 10 in. scale in 4.5 seconds.

The application of electronics to recording potentiometer design has increased their speed to such an extent that they respond more quickly than the thermocouples and processes with which they are used. To take full advantage of the later types, special attention has to be paid to these factors.

One of the problems met in the operation of high-pressure refinery and chemical plant equipment is periodic inspection to determine whether corrosion, or erosion, has weakened it to a dangerous extent. The method almost universally used for this purpose is measurement of the wall thickness by mechanical calipers. Near flanges and connections, direct calipering can be carried out. By far the greatest number of measurements must be made where this is not possible. In these cases a hole must be drilled in the wall to be measured, and a micrometer similar to that used by boiler inspectors is necessary. After the measurement has been made, the hole must be closed by tapping, screwing in a plug, and welding it in place. In some locations even this technique fails. Methods involving measurement of magnetic flux have been used for this purpose, but they fail for nonmagnetic alloys.

Measurement by Rays

An instrument has been devised to meet this specific need, the principle of which may be described as follows. A source of penetrating rays, such as gamma rays, is placed next to the wall to be measured. Some of the rays pass through the wall and emerge on the opposite side, serving no useful purpose. Part of the remainder are scattered at all angles by the molecules making up the wall. Of the scattered rays, some emerge on the same side of the wall as the source. The intensity of these rays is measured by means of a Geiger-Mueller tube. It is a function of the wall thickness.

The instrument consists of two parts—the measuring head and the recorder. The measuring head contains the source of penetrating rays, a shield to prevent direct radiation from the course from reaching the Geiger-Mueller counter, the counter, and the pre-amplifier for the counter. The source of radiation is a milligram of radium. Permanent magnets are used to hold the measuring head in place on magnetic samples.

The recorder contains the scaling circuit generally used with Geiger-Mueller counters—in this case one which rejects 127 out of 128 counts, so that the counting rate is slow enough to actuate an electromechanical counter. An electric timer is provided to measure the counting period. The thickness is obtained by referring the number of counts for a 22.5-second period to a graph showing the number of counts for this period as a function of wall thickness. The latest model of the instrument weighs about 40 lbs. and will measure wall thickness up to about 0.75 in. with an accuracy of a few per cent. of the thickness involved. In practice it was found

that measurements at 150 points could be made during an 8-hour working day.

In addition to wall thickness, the instrument can measure liquid levels and liquid densities. It can, therefore, be used to answer the question "How can you measure the wall thickness of a continuous hollow steel sphere together with the level and specific gravity of the unknown amount of liquid it contains without drilling or cutting it in any way?"

An instrument named the "supersonic reflectoscope" has also been developed. This instrument sends a short train of supersonic waves into the article to be examined. Waves reflected back from the opposite side of the body can be picked up at the entering side and used to determine the thickness of the body. Flaws in the interior also give reflections which enable them to be detected. Metal articles many feet in thickness have been inspected. It is sensitive enough to detect with ease a hole 0.013 in. in diameter in a 10-in. steel block. With further development, this instrument may prove more versatile than the one just described.

The instruments cited give a small idea of the accomplishments of electronics in the field of instruments. Hundreds of similar examples could be given to cover an even wider range of applications than those mentioned. Practically any measurement problem can be solved electronically if ingenuity is exercised. However, we should remember that in many cases other methods will give equally satisfactory, or more satisfactory, solutions. As an example, we may note the fact that, while recording potentiometers now make extensive use of electronic methods, the control equipment to be used with them preferred by most plant men is of the pneumatic type. In many cases the makers can supply either electrical or pneumatic control equipment for use with their recorders. The two types seem to be equal as far as speed, sensitivity and general performance are concerned. However, the pneumatic type seems to have the edge where simplicity and freedom from maintenance is concerned.

An electronic device for automatically maintaining the temperature of laboratory ovens to within $\pm 0.5°$ C. is another new development. The device consists of two portions—the oscillator unit and the unit containing the power supply and relays. The oscillator is housed in a 2.5 in. cubical plastic case. It is designed around a 955 "acorn" triode tube and operates at a high non-critical frequency. The unit can slide over the end of a mercury thermometer so that the top of the mercury column is within the tank coil of the oscillator at the desired operating temperature. In operation, an increase in temperature causes the mercury column of the thermometer to rise in the oscillator tank coil, detunes it, and causes a rising plate current which operates relays in such a way as to turn off the oven heater power. The device is a novel application of electronics to the problem of temperature control.

Sir Lawrence Bragg's Broadcast

IN a broadcast on atomic energy on Sunday night, Sir Lawrence Bragg, Cavendish Professor of Experimental Physics at Cambridge University, said that the world is living at the beginning of one of the epochs, measured in tens of hundreds of thousands of years, when the whole structure of human society undergoes a vast change. He joined with the optimists who think that the inevitable end of our scientific and technical achievements is a world welded into one unit. He continued:

"I even dare to hope the last great achievement, atomic energy, may mark the final turning point, and that we have seen the last great war, unless some hothead in the future leads our descendants into the adventure of a campaign against Mars.

"The discovery of how to release atomic energy is one more example, the most striking yet, that something very big is happening just now.

The command over nature given by science is a discovery of the same magnitude as the first use of fire, or of domestic animals, or of agriculture, and is bringing, as they did, a general transformation of the kind of life it is possible for human beings to live. "Power to control nature is not in itself civilisation, but it is the foundation on which civilisation is built. Each time that this power has been increased in the past it has made possible a richer life. What has happened in the past will happen again."

People were apt to talk of the scientists turning their energies to inventing terrible engines of destruction, but in fact they accumulated a store of knowledge which could be used for good or evil, he said. It was war which was wrong, not science.

A Reciprocal Agreement.—The General Electric Company, Schenectady, and the Westinghouse Electric Corporation have entered into an agreement under which each company grants to the other a simple non-exclusive licence under its lamp patents and patent applications.

Trade Relations with China

Views of Chinese National Resources Commission in London

THE British electrical industry's prospects of capturing markets in China formerly dominated by Germany were discussed by a representative of THE ELECTRICIAN, on August 23, with Mr. Chen Yun, head of a delegation of the Chinese National Resources Commission, who came to this country on the "Queen Mary" about ten days ago to study technical and managerial improvements that have taken place in British industry during the war years, and to exchange information with the object of facilitating future trade relations between the two countries. Mr. Yun is managing director of the Central Electrical Manufacturing Works in China, which he described as "very much like the General Electric Co. in this country." They manufacture wireless equipment, cables, transformers, motors, lamps, telephone equipment, batteries, and so on, and have plants in many parts of free China. They are going to move forward into occupied China later, Mr. Yun stated. Another member of the delegation, which is representative of textile, chemical, mechanical and electrical engineering, metallurgic, economic and other interests, is Mr. T. Y. Liu, representing the power plant side of the Chinese electrical industry.

Since their arrival the delegation have been having talks with leaders of industry in London, and now they are visiting Manchester, Glasgow, Birmingham, Rugby, Sheffield, and other large industrial centres, where they will study the latest methods of production.

Britain's Opportunity

Mr. Yun said that in China they did not manufacture any large electrical machines or high-tension cables. All these had to be imported. Before the war, Germany was the predominant supplier of power plant. Then came Great Britain, followed by the U.S.A. and Switzerland. Electrical supplies were also imported from Japan. High-tension cables mostly came from Great Britain, and some from Germany. Now was Great Britain's opportunity to take Germany's place and provide China with much-needed plant.

Mr. Yun mentioned that the electrical members of the delegation were to study the functions of the Central Electricity Board and the operation of the grid, in which they were keenly interested, because a similar department was to be set up in China, though it would not be so centralised because of the size of the country. There would be regional managements to administer the various regions, and over all there would be a central board for the whole of China. They had already standardised a 50-cycle frequency and voltages at 220 and 330 V. The higher voltages were 6.6 kV, 13.2 kV, 33 kV, 66 kV, 132 kV, and 220 kV.

Asked if the delegation proposed to place any orders while in this country, Mr. Yun said they were merely making contacts and exchanging information, and not making actual purchases. That was the concern of the Chinese Government's Purchasing Commission, which has offices at 21, Tothill Street, Westminster. If the delegation wanted to make a purchase it would go through the Purchasing Commission. China needed a lot of electrical plant and equipment of which she was able to manufacture only a very small portion. They hoped to enter into technical collaboration contracts later on, similar to one they had with British Insulated Cables before the war, which was being renewed.

In Parliament

The following are replies to questions asked recently in the House of Commons :—

Industrial Research (Export Trade).—Replying to Sir Patrick Hannon, Mr. Herbert Morrison said the Government was fully aware of the need for promoting the application of science in industry. The attention of the export industries had already been drawn to the facilities offered by the Department of Scientific and Industrial Research. He did not propose to publish a White Paper at this stage, but the hon. Member could rest assured that Parliament would be kept informed of any developments in the Government's policy.

Battersea Power Station.—Mr. Douglas asked the Minister of Fuel and Power whether he could make a statement as to the present position of the application of the London Power Co., Ltd., to the Electricity Commissioners for consent to the further extension of the Battersea power station by the installation of 65 000 kW generating plant and associated boiler plant. In reply, Mr. Shinwell said there was no objection to the proposed further extension, subject to the observance of the same conditions in regard to gas washing as were imposed in connection with previous extensions, and he had informed the Electricity Commissioners accordingly.

Electrical Personalities

We are always glad to receive from readers news of their social and business activities for publication in this page. Paragraphs should be as brief as possible

Mr. F. L. Sharp has resigned from the board of Vactric, Ltd.

Mr. W. M. McKenzie has been appointed assistant secretary of Bruce Peebles and Co., Ltd.

Sir David Owen Evans, chairman of the Council of the Copper Development Association, left £84 762 (n.p. £68 922).

Mr. Gordon Horridge Tasker, of Sheffield, director, Tasker's Engineering Co., Ltd., left £3 803 (net £3 724).

Major C. V. Wattenbach, having been released from the Army, will be joining the board of Dictograph Telephones, Ltd., as an active director on September 1.

In consequence of the appointment of Mr. **J. A. Ogden** as deputy chief engineer of the Oldham electricity undertaking, **Mr. C. A. Cross,** assistant mains engineer, becomes senior assistant, and **Mr. H. W. Mellor** has been promoted assistant.

Mr. S. K. Reeves, who served throughout the war with the R.A.F., as a technical officer, has recently been released, and has re-joined the London sales staff of the Electric Construction Co., Ltd.

Mr. A. G. L. Anderson, general manager of the Shotley Bridge and Consett District Gas Co., Durham, has been appointed engineer and general manager of the Bognor and District Gas and Electric Co.

Mr. S. T. Pigott, a director and managing director, has resigned from the board of Chadburn's (Ship) Telegraph Co., Ltd. **Mr. D. C. Bamford** and **Mr. R. S. Vidal-Hall** have been appointed directors.

Mr. Ellis Hunter, president-elect of the British Iron and Steel Federation, will now succeed the late **Sir Allan Macdiarmid** as president of the federation. He is deputy-chairman and managing director of Dorman, Long and Co., Ltd.

Mr. A. Gordon Gledhill, a student at Halifax Technical College, has won a Whitworth Scholarship, First Class Honours B.Sc. (Eng.), London University, and First Class Final in the City and Guilds Examination for electrical engineering practice.

Mr. A. J. C. MacLeod has resigned his position of technical sales engineer with the Metropolitan-Vickers Electrical Co., Ltd., in London, in order to take up a similar appointment with the London office of the Electric Construction Co., Ltd.

Dr. G. E. Haefely has severed his connection with the Micanite and Insulators Co., Ltd., and relinquished his position as chief engineer. We understand that Dr. Haefely intends to establish himself as a consultant on plastics at 7, Glengall Road, Woodford Green, Essex.

Manchester Electricity Committee has congratulated **Mr. J. C. Carr,** distribution engineer, and **Mr. W. Kidd,** constructional engineer, on their having been awarded premiums by the Council of the I.E.E. for technical papers read before that institution.

A luncheon was given by the Association of British Chambers of Commerce and the Federation of British Industries at the Savoy Hotel, London, on August 24, in honour of the members of the Chinese National Resources Commission. Those also present included **Sir Frank Gill, Sir George Nelson** and **Lieut.-Colonel R. K. Morcom.**

Mr. Chris Blackwell, elected vice-president of the Manchester and Salford Trades Council, is the first member of the Electrical Trades' Union to be appointed to an official position on the council. Aged 35, he is chief shop steward for the E.T.U., at the works of the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, and vice-chairman of the works committee.

Mr. A. G. Stewart has been elected chairman and general managing director of Stewarts and Lloyds, Ltd., and chairman of the Stanton Ironworks Co., Ltd., to succeed the late Sir Allan Macdiarmid. Mr. Stewart has been a director of Stewarts and Lloyds since 1931. In 1941 he was appointed assistant general managing director in charge of tube and shell production and a deputy-chairman in 1943.

Sir Felix J. C. Pole entertained **Mr. Philip D. Reed** (chairman of the General Electric Co., U.S.A.) at luncheon at Claridge's Hotel, London, on August 24. Among the other guests were Sir George Bailey, Mr. I. R. Cox, Mr. C. L. Dalziel, Mr. E. P. Grimsdick, Mr. R. H. Haviland, Mr. Cyril E. Lloyd, Mr. D. MacArthur, Mr. V. J. Radbone, Mr. Owen H. Smith and Mr. H. W. H. Warren.

Following the retirement of **Mr. G. H. Oldroyd,** borough electrical engineer, Stockport, and the appointment of **Mr. W. R. Alcock** to that position, it has been decided not to appoint a deputy engineer for the time being, but as a temporary measure to create a new position, that of assistant engineer, to be filled by **Mr. E. A. Gleaves,** who has been station superintendent. **Mr. A. L. Hollinshead,** senior shift engineer, has been appointed assistant station engineer.

Sir Hubert Houldsworth, who accepted the position of controller-general at the Ministry of Fuel and Power for the period of the war, has asked to be released

from this post, and Mr. Shinwell has reluctantly agreed to his release. The administrative work at headquarters connected with the coal control will now be in charge of a controller, with the rank of deputy secretary, working under the permanent secretary of the Ministry. **Mr. John Innes,** who has held executive positions with the Ministry of Fuel and Power since 1942, has been appointed to the post. **Sir Charles Reid** has been appointed as production and technical adviser and **Mr. J. Armstrong** as labour adviser.

Among those who attended the memorial service for **Mr. John Somerville Highfield,** at St. Mary Abbots, Kensington, on Friday, were Viscount Falmouth, Sir Harry Railing and Mr. Leslie Gamage (General Electric Company), the Hon. Mrs. Gamage, Sir Montague Hughman, Sir Leonard Pearce (London Power Company), Sir Archibald Page, Sir George Nelson, Mr. A. L. Coward (partner, Highfield and Roger Smith), with officials and members of the staff, Mr. V. Watlington (director of the B.E.A.M.A.), Mr. Henry Nimmo (Electricity Commissioners), representatives of the Power Companies' Association, Central London Electricity, Metropolitan Electric Supply Company, London Power Company, Mr. J. R. Beard (Association of Consulting Engineers), Association of Supervising Electrical Engineers, Electric Construction Company, Brush Electrical Engineering Co., Ltd., Chloride Electrical Storage Co., Ltd., Institution of Electrical Engineers, Provincial Electric Supply Association, British Thomson-Houston Co., Ltd., City and Guilds (England) College, and of the Junior Institution of Engineers.

Obituary

Mr. J. A. E. Wells, a director of Edgar Allen and Co., Ltd., and a member of the Iron and Steel Institute and the Institute of British Foundrymen, aged 59 years.

Mr. Robert Ferguson, for many years secretary and later a director of Kelvin Bottomley and Baird, Ltd., aged 75 years. He commenced as a clerk and became chief accountant in 1912. He completed 50 years' service with the company in 1941.

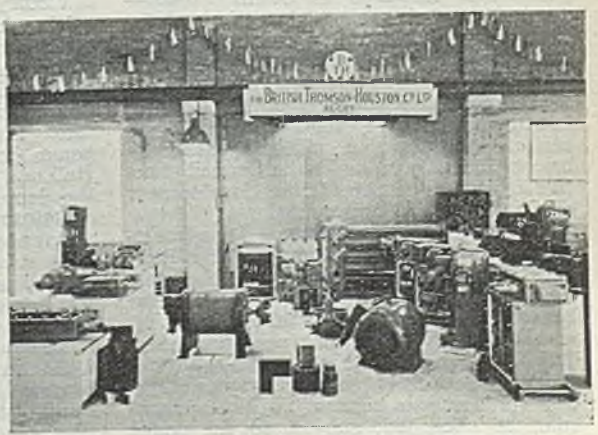
Exhibition of Mining Machinery

AN exhibition of mining machinery, arranged by the South Midland sub-branch of the Association of Mining Electrical and Mechanical Engineers, was held in the new central workshops of the Moira Colliery Co., Ltd., near Burton-on-Trent, on August 16, 17 and 18.

The stand of the British Thomson-Houston Co., Ltd., was mainly devoted to a selection of flameproof equipment for use in mechanised mining, comprising apparatus made by the company and its associated company, the Metropolitan-Vickers Electrical Co., Ltd.

As representative of mining motors, an all-steel conveyor motor, and a general purpose mining motor, were shown, but most of the available space was devoted to recent developments. There was a display of gate-end control gear consisting of an automatic gate-end box for control of coal cutters and conveyors, up to 60 H.P.; a 150 A section switch; a 2½ kVA lighting transformer unit; and a high frequency double drill supply unit. Examples of flameproof general-purpose control gear comprised 7½ and 10 H.P. direct-on-line contactor starters, a 6 H.P. self-contained haulage control unit and a 75 H.P. flameproof resistance of the tubular type.

An earth leakage protection unit developed for the ETJ switch fuse in compliance with the draft regulations on surface installations, has an interrupting capacity up to 25 MVA. The earth leakage trip is obtained by means of an explosive cartridge and toggle mechanism, and has a standard sensitivity of 12½ per cent. A typical flameproof Thrustor was shown, and there was erected outside the exhibition building, a Thrustor-operated air-lock door of novel design.



B.T.-H. stand at the Moira colliery exhibition

News in Brief

Aluminium Exhibition.—An exhibition presented by the aluminium industry, was opened at Lewis's Stores, Birmingham, on Tuesday, and will continue until September 15. The object of the exhibition is to demonstrate the wide scope for aluminium and its alloys in housing, interior decoration, furnishing and domestic appliances, and in shipping and transport.

Trolley-bus Scheme.—Representatives of the Oldham Electricity Committee are to attend a meeting of the local Passenger Transport Committee to state the case for the introduction of trolley-buses.

Blackburn Exhibition. — It is announced that the "Electricity Looks Forward" exhibition described in last week's issue of THE ELECTRICIAN, was attended by 12 000 persons.

Institution Installations.—The West Sussex Health Committee is considering a proposal by the County Architect for the installation of electric cooking equipment at Aldingbourne House institution at a cost of £333, and meanwhile the Committee has authorised the hire of a large electric cooker as a temporary expedient.

Scientific Research in South Africa.—An outline of the general intentions of the Government in setting up the South African Council of Scientific and Industrial Research has been given by Brig. B. J. Schonland, President-elect of the Council, in a memorandum to the Federated Chamber of Industries, in which he asks the help of industry to make the Council effective by means of the further development of South Africa's resources.

Watford Deposit System.—At a meeting of the Electricity Committee the Electrical Engineer reported upon the wartime practice of requiring new domestic consumers to pay deposits, and stated that in his view this was not now necessary. The Borough Treasurer agreed, and the Committee decided that the deposit system for domestic consumers, as a general rule, be abolished, subject to the power of demanding a deposit being retained in any particular case.

Lighting in Dundee.—At a recent meeting of the Police and Lighting Committee, it was agreed that Dundee's contribution to fuel economy would be to reduce the wattage of electric lamps in the city by half. This economy will result in the saving of about 7 000 tons of coal.

Oldham Domestic Appliance Sales.—It was reported at a meeting of the Electricity Committee that sales of appliances during the past month were to the value of £1 999 and included 11 cookers, 3 wash-boilers, 83 vacuum cleaners, 15 fires, 2 kettles, 7 irons, 2 tubular heaters, 1 water-heater, 51 lamps and 780 miscellaneous items.

Scottish Street Lighting.—In view of the fact that street lighting in Edinburgh and in Glasgow has not been reverted to pre-war standard, it is unlikely that there will be any further curtailment of lighting in the cities, as a result of the Government's appeal for national economy. In Glasgow the street lighting has been so cut down that £50 000 per year is being saved.

Victory Lighting.—Part of the Victory celebrations in Birkenhead has been a series of decorative electrical illuminations in Hamilton Square. The town consumption of electricity during the first week of the illuminations was lower than the week before. It is surmised that people left their homes to see the brilliance of the Town Hall and Hamilton Square, and thus saved the domestic usage of electricity.

Gainsborough R.E.M.E. — It is announced that the R.E.M.E. maintenance school at Gainsborough may be continued as a regular defence unit. During its four years' existence the school has trained 9 662 experts on radiolocation, 2 053 on guns, 2 760 on motor vehicles, 1 074 on instruments, 1 287 on electrical devices and 276 on special equipment. Many of the men trained at the school have now gone into television factories.

TWENTY-FIVE YEARS AGO

FROM THE ELECTRICIAN *of August 27th, 1920: It is announced that a working agreement has been made by the American Telephone and Telegraph, and the General Electric Companies of America, for the mutual use of all patents of scientific secrets. According to Mr. H. B. Thayer, president of the General Electric Co., the world system of the Radio Universal service and the Bell system will facilitate the use by the public of wireless linked up with the telephone. The service is to be extended to ships at sea, Europe and foreign countries. The arrangements will also make it possible for several conversations to take place on the same wire simultaneously.*

Electricity Supply

Middlesbrough.—Sanction has been received by the T.C. to borrow £2 500 for electric mains and services.

Rawtenstall.—The Electricity Committee has obtained sanction to borrow £16 659 for protective equipment, etc.

Stockton-on-Tees.—Electricity is to be supplied by the T.C. to prospective industrial sites in Dog Hill Farm Lane at £600.

Darlington. — Application has been made to the Electricity Commissioners to borrow £438 for extending electricity mains to the temporary housing site in Burnside Road.

Scarborough.—The Electricity Committee is to provide a sub-station at Valley Bridge and extend the Filey sub-station for housing on-load tap-changing transformers.

Clitheroe.—The Electrical Engineer has been authorised to give a supply of current to Gisburn Hall and Tower House at a cost of £1 954, the owner undertaking to contribute to the cost.

South Shields.—The T.C. is to instal a 1 500 kVA transformer at the sub-station in Quay Lane in place of the present 600 kVA transformer, which is insufficient to meet demands.

Billingham-on-Tees.—The North-Eastern Electric Supply Co., Ltd., is being asked by the U.C. to expedite the supply of electricity to the village of Cowpen Bewley. The company plans to lay cables from the North Tees Power Station to the Newport Bridge.

Scarborough.—The Housing Committee has agreed to reimburse the Electricity Committee in respect of any debt outstanding on the laying of electric mains to temporary houses which may become redundant in the event of the houses being removed at a later date.

Manchester.—The Electricity Committee, when considering a proposal to reblade No. 1 turbo-generator at Barton power station, received a report from the Chief Engineer and Manager embodying the following particulars: Turbo-generator first put into commission June 22, 1823, units generated up to date 2 233 957 000; hours run, 111 067.

Oldham.—The annual report of the electricity undertaking for the year to March 31 last, records a net surplus of £34 767 on the sale of 123 880 000 units (excluding designated war factories), compared with 124 022 000 units for previous year. The fall in the power sales had been practically neutralised by the combined increases of private lighting and domestic sales. Despite increases in wages, coal and materials, there had been no increase in the charges to consumers.

Scottish Hydro-electric Scheme.—It is announced that the Tummel-Garry (and Gairloch) hydro-electric scheme has been confirmed by the Secretary of State for Scotland in an order presented to Parliament. The £6 450 000 project can be started after the scheme has lain before Parliament for 40 days, provided that the confirming order is not meanwhile annulled by resolution of either House.

Aberdeen.—In the annual report, Mr. A. Gardner, city electrical engineer, states that the deficit on the year's working of £17 040, was almost entirely due to the action of the Ministry of Fuel and Power in increasing the price of coal without giving permission to make a corresponding increase in the electricity charges. The increase in total output over the war years was 17.8 per cent., while the increase for industrial power alone was only 7.59 per cent. The figures for the country as a whole up to 1943-44 showed that the total output had increased by 53 per cent., and for industrial power by 93½ per cent. The power figures clearly indicated neglect of Aberdeen as a manufacturing centre—for which there might be good security reasons in war-time—but they also showed the unfortunate position of the city, which was not scheduled as a development area under the Distribution of Industry Bill, in relation to those other areas where the war-time factories which had caused these spectacular rises would no doubt shortly be available for ordinary peace-time activities.

Eastbourne.—Schemes for a five years' electrical plan, which were submitted by the Borough Electrical Engineer and Manager last May, were considered at a recent meeting of the Electricity Committee. In 1945/46 the estimated expenditure is £48 589, of which £35 000 is for land, and the remainder divided between sub-station buildings and equipment, £1 700 and £3 468, respectively, mains and services £4 531, meters £1 500, and consumers' apparatus £2 390. In 1946-47 the proposed land expenditure is £300, sub-station buildings, £1 250, and sub-stations' equipment £1 200, mains and services, £12 132, meters, £6 000, consumers' apparatus £12 207 and transport vehicles £698, making a total of £33 787. For 1947/48 the proposed allocation for land is £750, buildings £10 000, equipment £2 000, sub-station buildings £5 200, sub-station equipment, £2 400, mains and services £16 200, meters, £6 150, consumers apparatus, £14 140, and transport vehicles, £885. The amount required for land in 1948/9 is £850, £54 000 for buildings, £2 500 for sub-station buildings,

£2 450 for sub-station equipment, £19 750 for mains and services, £6 350 for meters; consumers' apparatus, £16 464, and transport vehicles, £1 102. For 1949/50 the estimated amount required for land is £950, equipment, £3 000, sub-station buildings £2 500, sub-station equipment £3 700, mains and services £26 793, meters £6 600, consumers' apparatus, £19 781, and transport vehicles £602. The estimate was approved by the Committee.

Wood Green (London).—At a meeting of the Highways Committee the Town Clerk submitted a letter from the Northmet Power Co. intimating that during the suspension of normal street lighting it had considered it unnecessary to make any adjustments in its charges for the service as all payments other than "black-out charges" had been in abeyance. The charges for the limited amount of public lighting, bollards and signs, were increased by 12½ per cent. in 1941. Now that the resumption of unrestricted lighting was approaching, the company had been compelled to investigate the present effects of war increases in the cost of coal, labour and lamp replacements. Coal had risen from £1 per ton to approximately 50s. per ton; the wages of public lighting attendants had been increased by 33 per cent; and purchase tax had inflated the cost of certain types of lamps. The street lighting running costs were made up almost wholly of the bare costs of energy, labour and lamp renewals, so that war increases had a more marked effect on public lighting than on domestic and commercial tariffs for electricity supply, which included a proportion of fixed charges not altered by the war. As soon as prices became reasonably stabilised it was its intention to offer revised public lighting charges for a long term contract. In the meantime it asked the Council to agree to the application of adjustment clauses to the pre-war running charges, providing for an increased payment to the company to cover the higher running costs with effect from Jan. 1, 1946. The Committee recommended such variation involving an increase in the cost by 23 per cent.

Contracts Open

WE give below the latest information regarding contracts for which tenders are invited. In the case of overseas contracts, particulars are to be had from the Department of Overseas Trade, Millbank, London, S.W.1 (corner Horseferry Road), unless otherwise stated.

Brighouse T.C., August 31.—Supply and delivery of two 300 kVA transformers and two sets of e.h.t. switchgear. Specifications from the Electrical Engineer, Huddersfield Road, Brighouse.

Glasgow Lighting Department, August 31.—Supply of 500 lanterns for 300/1 500 W electric lamps. Specifications from the Lighting Department, 20, Trongate, C.1.

West Riding Standing Joint Committee, September 1.—Electrical work in connection with adaptations at the West Riding Constabulary Headquarters, Wakefield. Specifications from the West Riding Architect, County Hall, Wakefield.

West Riding C.C., September 5.—Installation of heating and domestic hot water services at new dental clinic, Bonegate House, Brighouse. Specifications from the West Riding Architect, County Hall, Wakefield.

Lochgelly B.C., September 8.—Electric lighting installations in connection with 42 houses to complete the Lumphinnans Road housing scheme. Particulars from the Burgh Surveyor, Town House, Lochgelly; deposit, £2 2s.

Birmingham Electric Supply Department, September 12.—Supply and delivery during the period ending September 30, 1946, of electric kettles, saucepans, cookers, wash-boilers, circulator water heaters, cooker control units and circulator control units. Specifications from Mr. F. W. Lawton, 14, Dale End, Birmingham 4.

Brierfield U.D.C., September 20.—Supply, delivery and placing into position, of two 250 kVA three-phase 6 600/400 V transformers. Specification from Mr. N. Ashton, "Electricity House," Colne Road, Brierfield; deposit, £1 1s.

Brierfield U.D.C., September 20.—Supply, delivery and erection of 6 600 V metal-clad switchgear. Specification from Mr. N. Ashton, "Electricity House," Colne Road, Brierfield; deposit, £1 1s.

North of Scotland Hydro-electric Board, October 15.—Supply, delivery and erection of 132 000 V transmission lines. Specification from Mr. T. Lawrie, 16, Rothsay Terrace, Edinburgh, 3; deposit, £5 5s.

Overseas

Eire Electricity Supply Board, December 14.—Civil construction work in connection with the hydro-electric development of the River Erne, Co.Donegal, including, (1) Power development at Cathaleen's Falls, for installation of about 40 000 kW; (2) power development at Cliff for installation of 10 000 kW. Particulars from Mr. P. J. Dempsey, Electricity Supply Board, 60/62, Upper Mount Street, Dublin; deposit, £21.

Industrial Information

New Industry at Bolton.—C. and D. Electrical (Appliances), Ltd., have taken over a three-storey factory covering 7 000 sq. ft., at Bolton, for the manufacture of commercial and domestic appliances, including electric irons, fires, household lighting fittings, and fluorescent lighting equipment. In the near future the firm is hoping to produce radio and television sets.

Easing the Fuel Situation.—Electricity undertakings in Scotland are now being given priority for coal supplies in order to build up adequate reserves against the advent of the winter. Gasworks were earlier given priority, and with the starting of an electrical programme along the same lines, the fuel position in these two industries in Scotland has been somewhat assisted. Electricity plants have been in very serious straits for some time past which makes the present development the more satisfactory.

Fluorescent Lighting on the G.W.R.—Reference was made in a recent issue to the fluorescent lighting which the Great Western Railway intend to instal in their new coaches. The system has been developed by the British Thomson-Houston Co., who supplied the equipment for a trial installation. Power is taken from the existing lighting set and battery, which feed a motor-alternator set, generating at a frequency of 400 cycles. The reason for the choice of this frequency depends on a number of factors, but one of the advantages is the reduction in weight and size of gear as compared with that which would be required on a normal 50 cycle supply.

Owners of Property in Germany.—The interests of United Nations owners of property in Germany are being safeguarded by a special department (Property Control far as British owners are concerned, all Branch) of the Control Commission. As communications should be addressed to the Trading with the Enemy Department, 24, Kingsway, W.C. Owners of property in Germany should already have made a return in regard to such property to this Department. As information becomes available, individual owners will be notified in regard to the condition of their property; but at present no enquiries by interested parties as to the state of specific properties in Germany can be dealt with by the Trading with the Enemy Department.

A Tribute from Brisbane.—The 25 000 kW turbo-alternator built by Parsons and Co.. Ltd., during the war for installation at the Bulimba power station of the City Electric Light Company, Ltd., Brisbane, Queensland, has now been in service for a year, and as the chairman of the company has publicly announced, has considerably improved the power station efficiency. In a despatch just received from Queensland, it is announced that the directors of the Brisbane company propose to affix to the machine a plate inscribed as follows: "This machine is a tribute to British steadfastness and courage. British workmen made it while Britain was being ruthlessly bombed; and in 1941 British seamen carried it to us through many perils. En route they brought succour to Malta."

World's Largest Cable Ship.—Electrical equipment, manufactured by the British Thomson-Houston Co., Ltd., will drive the complete cable-laying and repairing machinery on the world's largest cable ship "Monarch," recently launched on the Tyne. This equipment includes two 200 kW turbo-generators, two 100 kW generators driven by Diesel engines, switchboard, and motor and control gear for the whole of the cable laying machinery, operating on the "constant current" system. This provides "steam engine" stalling and reversing characteristics on the motors, enabling them to develop appreciably constant torque at any speed down to standstill. This torque can also be maintained should the load reverse the motor, under which condition "dynamic braking" is obtained. Special generators are not necessary, Amplidyne exciters being used, so that the same generating plant may be used either for constant current or constant voltage operation.

Company's Return to London.—The The registered and head office of W. T. Henley's Telegraph Works Co., Ltd., will be transferred back to London as from Monday, September 3, to the following address:—51-53, Hatton Garden, London, E.C.1. Telephone: Chancery 6822 (20 lines); Telegrams: Henletel, Smith, London. Henley's previous premises in Holborn Viaduct were totally destroyed by enemy action. The Hatton Garden premises are not large enough to accommodate the whole of their staff, and certain departments will, for the time being, continue to operate from Milton Court, Dorking. Correspondence may, therefore, be received from either address, and it would be helpful if replies were sent to the address given on the letter-paper. In case of doubt, communications should be sent to the head office at Hatton Garden. All enquiries and orders should be addressed to Hatton Garden, where comprehensive stocks of rubber insulated wires, cables and flexible cords, distribution accessories, etc., are available.

Company News

DAVIS AND TIMMINS LTD.—Intm. div. 10% (same).

W. CANNING AND CO. LTD.—Intm. div. 5%, payable Sept. 13. (same).

CLYDE VALLEY ELECTRICAL POWER CO.—Intm. div. on ord. 3%, less tax (same), payable Sept. 22.

CAWNPORE ELECTRIC SUPPLY CORPORATION LTD.—Pubn. of accts. still prohibited. Mtg. Orient House, New Broad St., E.C., Sept. 3.

WEST LONDON AND PROVINCIAL ELECTRIC AND GENERAL TRUST.—Intm. 2% on ord. (same), less tax, payable Oct. 1 to holders reg. Sept. 7.

KALGOORLIE ELECTRIC POWER AND LIGHTING.—Total rev. for 1944, £27 267 (£33 682) and pft. £25 500 (£31 578), fwd. £9 405 (£9 727).

LEYLAND AND BIRMINGHAM RUBBER CO., LTD.—Net pft. for 1944/45, is announced as £104 968 (£101 524). Fin. div. 7½%, and bonus 2½% (both same), less tax, mkg. 12½%.

LACRINOID PRODUCTS LTD.—Dirs. announce that, owing to the work and expense involved in the payment of intm. divs., they have decided to discontinue the practice forthwith. This change does not imply that there will be any alteration in the rate of div. for the current yr.

HEAD WRIGHTSON AND CO. LTD.—Pfts. for yr. to Apr. 30, £228 899 (£24 616 increase). Fees, interest, deprecn. and taxatn. absorb about 90%, leavg a net pft. £26 149 (£21 533). Pref. div. £5 074 and ord. £9 450 (both same). Res. receives £10 000 (£5 000), and £32 881 (£31 256) is carried fwd.

FISHER AND LUDLOW LTD.—Yr's pfts. to Mar. 31, increased by £8 488 to £726 651. Dirs.' remuneratn. takes £6 626 (£6 460), deprecn. £99 497 (£117 493), and taxatn. £508 000 (£496 000), leavg. a net pft. £112 528 (£108 210). Pref. div. takes £7 000, staff fund receives £5 000. Gen. res. £5 528 (£50 000). Fwd. £101 315 (£51 315).

COWANS SHELDON AND CO. LTD.—Tradg. pft. to June 30, £82 297 (£94 059), interest, etc., £722 (£702), mkg. £83 019 (£94 761). To dirs.' fees £600 (same), deprecn. £5 467 (£5 590), tax res. £50 500 (£66 000), pensions £1 845 (£1 362), lvg. net pft. £24 606 (£18 161). Div. 10% £15 000 (same), to genl. res. £9 000 (£3 000), fwd. £56 979 (£56 373).

RICHARDSONS WESTGARTH LTD.—Tradg. pft. to Mar. 31 (after tax and deferred repairs), £121 235 (£118 009), other income £3 364 (£4 472), mkg. £124 599 (£122 481). To dirs.' fees £2 400 (£3 267), bank int. £3 600 (£3 136), deprecn. £55 719 (£46 586), lvg. pft. £62 880 (£63 396). To div. 8% (same) £42 465 (£38 926), fwd. £79 348 (£58 933).

KIRK ELECTRICAL INDUSTRIES, LTD.—Private co. reg. Aug. 10. Cap. £2 500 in 2 500 shs. of £1 each. To carry on the business of wholesale and retail factors and sales agents in lighting heating, cooking, power and other electrical units, fittings and equipment, motor and other lamps, wireless and television goods, etc. Reg. office, 16-24, Fulford Street, S.E.16.

ELECTROLUX CORPN. (of America).—Net pft. three mos. to June 30 $233 645, after all chgs., incldg. estimated taxes and renegotiatn., equiv. to 19 cents a sh. on 1 237 500 shs. Com. (corres. 1944 period $161 122 and 13 cents). Net pft. six mos. ended June 30, after all chgs. incldg. taxes and re-negotn. $517 942, equiv. to 42 cents a sh. ($238 419 and 19 cents).

COMMONWEALTH EDISON (and subsid. cos.).—Operatg. rev. yr. to June 30 $191 002 515 ($186 185 661). To operatg. exes. and taxes $157 093 502 ($151 395 896), lvg. net operatg. income $33 909 013 ($34 789 765). Gross income $34 987 218 ($35 851 936). Net deductns. $11 904 535 ($13 210 666), lvg. cons. net income $23 082 683 ($22 641 270).

BRISTOL INDUSTRIES LTD.—Co. has changed its financial year from Oct. 31 to Mar. 31. It has now issued its results for the five mos. to Mar. 31, 1945. They show a pft. of £50 507, net div., etc., of £7 246, mkg. £57 753 (£115 937 for yr.). Deprecn. is allocated £1 359, war damage £56, taxatn. £35 000, and pref. div. (five mos.) £5 417. Fwd. £7 693 (£8 774).

AMERICAN WATER WORKS AND ELECTRIC.—Consd. gross earngs. yr. to June 30 $79 403 897 ($76 671 919). Pft. before tax adjust. $2 883 444 ($2 426 125). Tax credit $1 599 082 ($1 438 582). Net pft. $4 482 526 ($3 864 707). Earned per sh. on 2 343 105 com. (after prefd. divs.) $1.40 ($1.14). Prefd. divs. $1 199 406 ($1 200 000), balce. for com. $3 283 120 ($2 664 707).

UNITED RIVER PLATE TELEPHONE.—Gross rev. for 1944 £5 408 753 (£5 125 875), less workg. exes. £3 911 042 (£3 714 018), deb. int. £393 255 (£401 782) exch. adjustmts. £5 749 (£18 627). Cap. redemptn. £35 755 (£33 979), misc. charges £16 860 (£16 625). Add realised appraisal incremt. £170 496 (£173 089), brot. in £3 603 953 (£3 014 941), final div. 2% (3%), mkg. 7% (6%), fwd. £4 182 141.

ENGINEERING AND LIGHTING EQUIPMENT CO., LTD.—Tradg. pft. for yr. to Mar. 31, £46 254, £15 039 increase. Fees and war damage take £980 (£863), taxatn. £7 918

(£7 123) and E.P.T. res. £16 000 (£1 775), leavg. net pft. £21 357 (£21 454). Divs. absorb £13 581 (£15 928), pref. redemptn. and accrued div. £9 367 (£9 140). Final ord. div. 5% makes 8% against 6%, mkg. 10%. Blce. of £304 (£528) carried fwd.

MEXICAN LIGHT AND POWER. — Co. announces in connectn. with its 5% sec. mortg. 50-yr. deb. and 6% cum. inc. deb. stk. that, in accordance with requiremts. of the Canadian Custodian of Enemy Property, Canadian Form " G " must accompany all requests for transfer or de-registratn. of deb. stk. These forms can be obtained from the English agents and registrars, the Canadian and General Finance Co.

AEROPLANE AND MOTOR ALUMINIUM CASTINGS LTD.—Tradg. pft. for 1942-43 (after E.P.T.) was £36 073, less dirs.' fees £350, deprecn. £13 934, war damage £596, lvg. net pft. £21 193. To inc.-tax £12 500, div. 10% £5 000, fwd. £19 885 (£16 192). Tradg. pft. 1943-44 (incldg. £5 000 E.P.T. repayable) was £35 359, less dirs.' fees £350, deprecn. £13 119, war damage £562, lvg. net pft. £21 328. To inc.-tax £13 000, div. 5% £2 500, fwd. £25 713 (£19 885).

ANGLO PORTUGUESE TELEPHONE CO. LTD. —Subscribers' rentals, etc., amounted to £561 683 for 1944 (£537 235). With sales, removals, etc., £14 199 (£13 043), the yr's. rev. is £575 882, increase of £25 604. Operatg. exes., deprecn., royalties, and taxatn. absorb £488 610 (£464 192), and Bds'. remuneratn. £5 068 (£4 004), leavg. net rev. £82 204 (£82 082). Deb. service takes £31 982 (£32 041), and net pft. is £52 338 (£52 126), and carry fwd., £39 600 (£39 237).

AMERICAN TELEPHONE AND TELEGRAPH.— Operatg. rev. 3 mos to June 30 $60 341 000 (corres. period 1944 $57 380 771). Net oper. income $6 034 000 ($5 910 985). Div. income $41 525 000 ($39 759 535), net income $43 054 000 ($40 650 516), per sh. $2.18 ($2.13). Divs. $44 391 000 ($42 848 306). Operatg. rev. Bell System $475 587 091 ($438 904 519). Net oper. inc. $54 505 365 ($53 160 226). Net inc. $46 021 791 ($42 660 204), per sh. American Telephone stk. $2.25 ($2.16).

Company Meetings

A. C. COSSOR LTD.—At the annual meeting held in London on August 22, Mr. T. A. Macaulay, the chairman, said that in the field of receiving equipment for radiolocation the company was the first commercial organisation in this country, and indeed the world, to be called upon when an anxious Government was seeking the best means of preparing defences. Lest the publicity given recently to some aspects of radiolocation tend to divert attention from the more prosaic radio communications side of war, he said, their equipment, in the form of transmitters and receivers, went through the whole campaign from El Alamein to Berlin. The peacetime application of radiolocation, after the company's long experience in research, development and manufacture, opened new avenues of expansion in their industry in which the possibilities were great. The interests of their subsidiary, Sterling Cable Co., Ltd., were confined to the production of light cables and flexibles insulated with rubber, rubber substitute and synthetic materials, and their production for the Armed Forces had exceeded 50 million core yards a year since the commencement of the war. The heavier types of paper insulated cables made by their subsidiary, Lancashire Cables, Ltd., had played their part all over the world in carrying the current from generating stations under most arduous conditions. The future of their cable interests was indeed very promising.

ENGINEERING AND LIGHTING EQUIPMENT CO., LTD.—The annual meeting was held in London on August 27. In the statement circulated with the report and accounts, the chairman, Mr. S. A. Marples, said that during the war period the works had been producing over 300 assorted pattern articles for the Admiralty, in addition to a considerable number of special items which generally were required in small

(*Continued on page 230.*)

Metal Prices

		Monday, August 27. Price.	Inc.	Dec.
Copper—				
Best Selected (nom.)	per ton	£60 10 0	—	—
Electro Wirebars ...	„	£62 0 0	—	—
H.C. Wires, basis ...	per lb.	$9\frac{7}{16}$d.	—	—
Sheet	„	$11\frac{7}{16}$d.	—	—
Phosphor Bronze—				
Wire(Telephone)basis	„	1s. $0\frac{7}{16}$d.		—
Brass (60/40)—				
Rod, basis	„	—	—	—
Sheet „	„	—	—	—
Wire „	„	$11\frac{1}{2}$d.	—	—
Iron and Steel—				
Pig Iron (E. Coast Hematite No. 1)...	per ton	£7 13 6	—	—
Galvanised Steel Wire (Cable Armouring) basis 0.104 in. ...	„	£28 5 0	—	—
Mild Steel Tape (Cable Armouring) basis 0.04 in. ...	„	£20 0 0	—	—
Galvanised Steel Wire No. 8 S.W.G. ...	„	£26 0 0	—	—
Lead Pig—				
English	„	£31 10 0	—	—
Foreign or Colonial	„	£30 0 0	—	—
Tin—				
Ingot (minimum of 99.9% purity) ...	„	£303 10 0	—	—
Wire, basis... ...	per lb.	3s. 10d.	—	—
Aluminium Ingots ...	per ton	£85 0 0	—	—
Speller...	„	£31 5 0	—	—
Mercury (spot) Warehouse	per bott.	£69 15 0	—	—

Prices of galvanised steel wire and steel tape supplied by the C.M.A. Other metal prices by B.I. Callender's Cables Ltd.

quantities. They had built 55 main controlling switchboards for capital ships, cruisers and other large craft; over 23 000 electrical junction and distribution boxes; more than 215 000 switches in a range of sizes; 20 000 searchlight and other resistances; quantities of indicating and signalling gear and other apparatus, amounting in the aggregate to over 325 000 assemblies and calling for over 40 000 000 components. Continuous research, the anticipation of public requirements in illuminating and other lines, both for the domestic and the large export fields which are opening up, should keep the company busy for some time and help satisfactorily to bridge the transition stage when war controls are eased and labour is made available.

Commercial Information

Mortgages and Charges

NOTE.—*The Companies Act of* 1908 *provides that every Mortgage or Charge shall be registered within* 21 *days after its creation, and that every company shall, in its annual summary, specify the total amount of debt due from it in respect of mortgages or charges. The following mortgages and charges have been registered. The total debt prior to the present creation, as shown in the annual summary, is given—marked with an *—followed by the date of the summary, but such total may have been reduced.*

MANSFIELD RELAY RE-DIFFUSION CO. LTD. London E.C.—July 30, deb., to Barclays Bank Ltd. securing all moneys due or to become due to the Bank; general charge.

NEWCASTLE AND DISTRICT ELECTRIC LIGHTING CO. LTD.—July 18, deed of further variation, supplemental to a deb. dated January 9, 1939, and deed of variation dated January 11, 1940, extending date of repayment and reducing the rate of interest payable from 4 per cent. to 3 per cent., to Prudential Assurance Co. Ltd.; general charge. *£350 000. April 6, 1945.

P. HODGES AND CO. LTD. Nottingham, engineers.—August 3, mort. and charge, to Midland Bank Ltd., securing all moneys due or to become due to the Bank; charged on Standard Machine Works, Wells Road, Nottingham, with machinery and fixtures, also general charge. *£3 000. Feb. 14, 1945.

RICHARD C. GIBBINS AND CO. LTD. Birmingham, engineers.—July 31, deb., to Lloyds Bank Ltd., securing all moneys due or to become due to the Bank; general charge.

Satisfactions

P. HODGES AND CO. LTD., Nottingham, engineers.—Sat'ns. August 3, of mort. reg. Oct. 27, 1938, and of charge reg. May 30, 1939.

SMART AND BROWN (ENGINEERS), LTD. (formerly SMART AND BROWN (TOOLMAKERS) LTD.), Bingley.—Sat'n. Aug. 9, £10 500, reg. May 31, 1939.

Notice of Intended Dividend

TREW, Donald Archibald McDonald, 36, Binley Avenue, Binley, Coventry, lately carrying on business at 59, Primrose Hill Street, Coventry, as "Trew Electrical Service," electrical dealer. Claims to be sent by September 3, 1945, to the Trustee, Mr. Rudolf Kynoch Clark, Somerset House, 37, Temple Street, Birmingham 2, Official Receiver.

County Court Judgments

NOTE.—*The publication of extracts from the "Registry of County Court Judgments" does no. imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be actions. But the Registry makes no distinction. Judgments are not returned to the Registry if satisfied in the Court books within* 21 *days.*

GREENWOOD, V. (male), 262, Newhall Road, Attercliffe, Sheffield, electrical engineer. £69 18s. July 4.

BROWN, Fredk. L., 45, Park Road, Wallsend, electrical engineer. £21 19s. 8d. July 5.

VICKERS-JONES, S. J. (married woman), 2, Park Road, Moseley, precision engineer. £18 13s. 9d. June 25.

Company Winding Up

CHIPPING NORTON ELECTRIC SUPPLY CO. LTD. (In voluntary liquidation).—A general meeting of the members of the above named company will be held at 24-30, Gillingham Street, Westminster, London, S.W.1, on September 17, 1945, at 10.30 a.m. to receive the account of the Liquidator.

COMING EVENTS

Saturday, September 1.

I.E.E., N.E. STUDENTS' SECTION.—Visit to the shipbuilding yard of R. and W. Hawthorn Leslie and Co., Ltd. Party meet Ellison Street, Hebburn. *2.30 p.m.*

Tuesday, September 4.

COVENTRY ELECTRIC CLUB.—Open Forum on "The Future of the Electrical Industry." "Supply," F. W. Godden; "Contracting and Installation," G. S. Nott; "Retailing and Marketing," G. R. Marson; "Manufacturing," N. M. Hill.

Saturday, September 8.

A.M.E. AND M.E. (YORKSHIRE N.W. BRANCH).—Presidential Address, J. M. Langley.

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS (CREWE AND DISTRICT BRANCH).—North Stafford Hotel, Stoke-on-Trent. "Switchgear Protection," A. Lightbourne.

Printed in Great Britain by STRAKER BROTHERS LTD., 194-200, Bishopsgate, E.C.2, and published by BENN BROTHERS, LTD., at Bouverie House, 154, Fleet Street, London, E.C.4.—Friday, August 31, 1945