THE
ELECTRICIAN

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MISCELLANEOUS ADVERTISEMENTS

None of the situations advertised in these columns relates to a man between the ages of 18 and 50 inclusive, or a woman between the ages of 18 or 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945, or the vacancy is for employment excepted from the provisions of that Order.

SITUATIONS VACANT

BOROUGH OF ACCRINGTON.

ELECTRICITY DEPARTMENT—APPOINTMENT OF TECHNICAL ASSISTANT.

APPLICATIONS are invited for the appointment of Technical Assistant at the Corporation's Electricity Works, at a salary in accordance with Grade 8, Class "F," of the Schedule of Salaries of the National Joint Board for Employers and Members of Staff for the Electricity Supply Industry (commencing salary £397 per annum, rising to a maximum of £412 per annum in four years).

Candidates must be experienced in draughtsmanship, generating costs, and main and sub-station layouts, and must possess the Higher Grade National Electrical Engineering Certificate.

The appointment is designated as an established post under the Local Government Superannuation Act, 1937, and the successful candidate will be required to pass a medical examination.

Applications, stating age, qualifications and particulars of experience, and accompanied by copies of two recent testimonials, must be forwarded so as to be received by the undernamed not later than Friday, 30th November, 1945.

P. D. WADSWORTH,
Town Clerk.

Town Clerk's Office, Town Hall,
Accrington, Lancs.
10th November, 1945.

HAMMERSMITH METROPOLITAN BOROUGH COUNCIL.

APPOINTMENT OF CHIEF ELECTRICAL ENGINEER.

APPLICATIONS are invited for the appointment of CHIEF ELECTRICAL ENGINEER. Salary (which will be inclusive) in accordance with the Agreement respecting salaries of Chief Electrical Engineers made by the National Joint Council of Local Authorities and Chief Electrical Engineers for the Electricity Supply Industry, commencing at 85% of scheduled salary for first year, 92½% for second year, rising to full salary in third year. (Present full scale salary £1,780 p.a.)

Candidates must be fully qualified Electrical Engineers and have had practical experience in the administration and management of an Electricity Supply Undertaking, particularly its Commercial side.

Particulars of duties and conditions attaching to the appointment are obtainable from the undersigned upon receipt of a stamped addressed foolscap envelope.

Closing date for receipt of applications, 30th November, 1945.

W. H. WARHURST,
Town Clerk.

Town Hall, Hammersmith, W.6.
October, 1945.

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SITUATIONS VACANT

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Salary—age 25 and over—on range of £400 to £600 a year, plus Civil Service War Bonus at present £60 a year, according to qualifications and experience. Lower rates apply to successful candidates under 25 years of age. It is anticipated that a scale of pay with annual increments and a higher maximum will be introduced at a later date. Successful candidates required to take up duties as early as possible.

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THE ELECTRICIAN

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CHIEF CONTENTS OF THIS ISSUE

50 Years of X-Rays

"A SENSATIONALLY worded story has come to hand from Vienna to the effect that Prof. W. C. RÖNTGEN, of Wursburg University, while experimenting with some cloth-screened vacuum tubes in a dark room, in which some sensitised paper happened to be lying about, found that the paper became acted upon by electro-magnetic waves." Thus did the Editor of THE ELECTRICIAN of January 10, 1896, announce the discovery of what are now generally known to be X-rays. Actually, the discovery was made on November 8, 1895, but, apparently, it was not until some time during the following month that Prof. RÖNTGEN made known his observations to the Wursburg Physico Medical Society; observations, incidentally, which were published in THE ELECTRICIAN of January 24, 1896.

The "new radiation," as it was at that time called, appealed to public imagination in all sorts of ways, but according to the Editor of those days, engineers' chief hope was that the rays would permit of the detection of flaws in metal, "though whether so thick and massive a piece of metal as a screw-shaft will ever be got sufficiently transparent is a question at present unanswerable." To-day, fifty years later, there is evidence in plenty that the X-ray will not only detect flaws in forgings and the like, but has advanced medical science and assisted industry to an extent even beyond the conception of the imaginative Victorians. As a result of the discovery, which was incidentally commemorated last week at a joint meeting of all the present-day societies interested in X-rays, there has been built up in the electrical industry a whole branch devoted to the study of the "new radiation" and the manufacture of apparatus for its use in all forms of medicine and industry, without the dangers of the dermatitis which claimed so many victims in the old days.

The public who have benefited most from this discovery had little or no knowledge of the fact that this year was the fiftieth since Prof. RÖNTGEN first made his observations, and it was therefore pleasing to hear broadcast in the Home Programme on the night of November 8, a dramatised version of the circumstances leading up to the discovery and some brief details of its applications. It must not be permitted to be generally understood that the X-ray was born fully fledged in a Continental laboratory, however, for Prof. RÖNTGEN was preceded in his work by a host of others who developed the ray tube species. Those desirous of apportioning the credit where it is due would do well to refer to the 1893 Anniversary Address of the

Royal Society, and read by Lord KELVIN in November of that year. In this will be found not only references, direct or indirect, very nearly completing the history of all that had been done up to that time in the investigation of the transmission of electricity through rarified gases, but also a prediction of the then President of the Royal Society, which in the light of the Röntgen rays commemorative meeting last week makes interesting reading.

Industry's Debt to Röntgen

THE value and scope of Prof. RÖNTGEN'S work will be appreciated by the fact that no fewer than twelve learned societies participated in last week's tribute, while an exhibition of historic X-ray tubes, radiographs, a selection of early apparatus, and a contemporary cinematograph film indicated to some extent the difficulties under which the investigations were made. To their conductor the industry owes much, and in acknowledging its indebtedness it is joined by the medical profession, physicists, chemists, mineralogists and photographers, to say nothing of those many industries outside the engineering field which have benefited so much from the alertness and patience of the man to whom this note is some small tribute.

Small Firms and Export Trade

SPEAKING at a luncheon of the Institute of Export on Monday, Mr. H. A. MARQUAND, Secretary to the Department of Overseas Trade, stated that since coal could not in the future play so large a part in our export business as it had done in the past, it was hoped that its place would be taken by the trade of thousands of small firms at present without experience of overseas marketing; some as direct traders and others as sub-contractors to larger firms with wide export experience at their disposal. Mr. LESLIE GAMAGE, president of the institute, after hearing this hopeful suggestion was, however, nearer reality when he asked when the labour to make the goods to sell in the export market would be forthcoming, rounding off his observations with "If we leave the thing much longer we shall miss the 'bus." Small firms would, indeed, be willing to participate in export or any other trade, but because they are small firms the labour position is handicapping them perhaps to a greater extent than it is their bigger brothers. The withholding of one or two employees from a small business involves the proprietor in so much routine work that there is no time left for him to consider the prospects of exploiting the export market, while the good name he may have established in the home market is also endangered. The substitution of action for the hopes and promises of our Government departments is long overdue.

Proposed Sales Management Conference

BEFORE the war the E.D.A. used to devote an appreciable amount of attention to sales development, and a return to this condition is promised by a decision of the association to arrange in the Spring of next year, a two-day electricity supply sales-management conference. At the time of going to press, no details, either of date or programme, had been completed, but it is interesting to record at this stage the fact that the association has such a conference in mind. With domestic appliances in short supply for what may be some time to come, the problems of sales promotion and sales management will, in the immediate future, be vastly different in character from those met with before the war. In the circumstances the approach to their solution may be along channels not hitherto explored, and we await with special interest details of the E.D.A.'s intentions at the conference.

Prototype Domestic Appliances

AS was indicated in our last issue, the English Electric Co., Ltd., will next week exhibit for public inspection in their Kingsway, London, showrooms, examples of some of the domestic appliances which, it is hoped, will be in plentiful supply in the not too distant future. In designing the appliances the company have borne in mind the popularity of the kitchen-planning idea, and added the attraction that the appliances, though self-contained, may, as financial considerations permit, be built up into a completely designed kitchen. Many of the appliances will be found of interest for other reasons, as, for instance, a transportable fire resembling in appearance a glass fire screen. The exhibition, which is already a topic of conversation among certain sections of

the industry, promises to be a useful piece of goodwill propaganda for electricity generally, and no one can doubt that the company will be rewarded for the trouble taken in promoting it. The relationship of electrical industry and peace-time progress, the relationship of the industry's war-time efforts, and the promotion of post-war electrical development are clearly indicated at the exhibition, and well worth the attention of the public.

Training for Industrial Leaders

THE high degree of training available to scientists and technologists has not hitherto been matched on the administrative side of British industry. Great interest therefore is attached to the news that an administrative staff college is to be founded, where those holding senior positions in industry, commerce, finance, the Civil Service, trade unions, and social work will be able to attend courses. The syllabus will normally be of three months' duration, and will provide opportunity for study, reflection, and "comparing notes." During a period in which industry and Government are forming new relationships, partly as the outcome of the war and partly as a result of political trends, the new college will serve a useful purpose if it helps to dispel suspicion and foster mutual understanding. Most Government officials are still ignorant of the factors that determine commercial practice, while business men are not much better informed of the inner workings of the Civil Service. The inclusion of trade unionists and voluntary social workers within the scope of the scheme is another valuable aspect.

An American Suggestion

DOUBTLESS some business men will regard the new college with misgiving; any form of training is still apt to be suspect by those who learnt their trade by rule of thumb. We are therefore interested to read that the need of better administration in industry is now recognised even in America, still the home *par excellence* of individual enterprise. Addressing students at Princeton University, the Assistant Secretary of U.S. Navy, recently suggested that senior executives in business and Government departments should actually exchange places for short periods of duty. This, he believed, would provide an insight into mutual points of view with resultant advantages to all concerned. British business men who are still struggling with Government controls would hardly welcome such a spell of "office"—they might prefer to abolish Whitehall—but it would undoubtedly help if some of our civil servants could see at first hand the burden imposed by their rules and regulations on the day-to-day workings of business.

Central Board's New Tariff

IN view of the criticism that had been levelled at the first tariff which was fixed for a period of ten years, the Central Electricity Board, before deciding upon the new tariff, which has now been approved and will come into operation on January 1, consulted the associations representing the supply industry in accordance with an undertaking given some years ago. Two conferences were held and various aspects of the kilowatt charge were fully discussed. Different sections held widely divergent views, and though the task of the Board was thus made more difficult, the result of their deliberations has been a new form of tariff, which, as the chairman, Mr. HAROLD HOBSON, told a representative of THE ELECTRICIAN on Monday, "goes a long way to meet the more legitimate and, to some extent, the somewhat less legitimate criticisms of the original tariff."

Reconstruction Considerations

ONE of the most important changes in the tariff is that a national charge, based on an average of two readings, one taken in the first quarter of the year and the other in the last quarter, will be substituted for a set of regional tariffs based on a maximum demand. Taking the country as a whole, the outcome is a reduction of 2½ per cent., which, while very satisfactory, is unlikely to benefit the domestic or industrial consumer to any great extent. Because of the uncertainties of the reconstruction period, the tariff has been fixed for five years instead of ten. It is as yet too early to judge the reactions of those whose accounts will be subject to the new tariff, but as it has, seemingly, been approved by the various supply associations, little criticism may be forthcoming.

Temporary Installations

By F. GEOFFREY MARSHALL

WHAT exactly do we mean by "Temporary Installations"? And for how long can equipment installed on a temporary basis be allowed to function before being entirely removed or being made permanent?

Now that the war in Europe has been brought to a satisfactory conclusion, there must be hundreds of temporary installations, both large and small, which will have to be considered from this angle.

War-time Necessity

Let us take two examples. Consider the case of a heavy ring distribution main, costing perhaps hundreds of pounds and giving an important alternative means of supply to a busy production point. This might have been installed on a purely temporary basis back in 1940, but it is now necessary either to alter it so as to comply with our recognised standards for permanent installations, or to entirely remove it. Again, to take the other extreme, we can consider the case of a single lamp, installed as a temporary measure soon after the black-out regulations came into force, to illuminate a dark corner near a factory exit. This lamp has now been in service for so long that its removal might be followed by immediate protests from those who benefit from it.

It would appear that temporary installations can conveniently be classed under two headings:—First, those that are put in to help over an immediate crisis, and are truly temporary in that they will only be in use for a matter of a few days and will then definitely be removed. Secondly, there are those installed as a war emergency, but which, nevertheless, were put in to last an indeterminate time, in all probability until the end of hostilities, and during a period of reconstruction thereafter.

In many cases there is a possibility of an installation, classed as a "temporary" when originally put in, being at a later date regarded as permanent, and here lies a danger. Many firms and contractors of unassailable repute as regards the quality of their workmanship, and who would not think of putting in a shoddy installation normally, have often had to forego to a certain extent their former high standards of efficiency during these last few years, in order to satisfy an immediate demand. It is all too easy for work of this nature to have been lost sight of, either due to pressure of other commitments, or to changes in staff, and then to have been ultimately forgotten.

As an example we can quote the case of the management of a certain factory, who had decided that if production was not to be curtailed, a power supply must be made available for a new machine at a stated spot in a very short time, and that in connection with this, a dozen different lighting points must be installed at various locations nearby. It is possible that, if the power feed required in these circumstances is of any size, its temporary state will not be lost sight of, and it will be made permanent in due course, but it is quite conceivable that the lighting points, probably installed in open wiring instead of in normal screwed conduit, may be forgotten.

With regard to the general subject of wiring, there is another factor to be considered over and above that of the actual method of installation, and that is the question of the current-carrying capacity of the cable. As a result of war pressure, many distribution systems have become overloaded—some due to the unavoidable addition of extra points and feeds to tide over some critical situation, many of which may be quickly lost sight of—and some deliberately when the current loading has been increased beyond the figures set out in the standard rules and regulations. This latter case was, of course, considered quite legitimate during the war, and was, in fact, encouraged at times, but the fact remains that, whether the overloading of cables and their ancillary equipment has been brought about deliberately or inadvertently, the time is now approaching when we must return to our former standards.

Standards and Finance

The financial angle has also an important bearing on the question. Many installations of a temporary nature might never have been put in were is not for the fact that the relaxation of our standards might have allowed the work to be carried out at a reduced outlay. Another factor is that the financial authorisation to convert the temporary installation to one of permanency, which in many cases may necessitate a complete re-wiring, is not always willingly forthcoming, except in those comparatively few cases when this ultimate state of affairs has been envisaged by the management at the time of the original installation, and a financial allowance for this conversion made accordingly.

However, we have now come to the time when all installations should be examined in detail, and any conversion to peace-time standards found necessary should be carried out at an early date, rather than being left to show themselves in later years by a sudden and unwelcome developing of faults and failures.

New Grid Tariff

Full Statement by Chairman of Central Electricity Board

LAST week-end the Central Electricity Board published a new grid tariff which will come into force on January 1 next in all districts except the North-east England area, where the existing tariff will operate until the end of 1947. There are legal difficulties which prevent a change there until January 1, 1948. On this occasion the Board has budgeted for a five-year period instead of ten years, because the chairman, Mr. Harold Hobson, explained, the next five years would probably be as uncertain as the last five years as to what might happen.

Two Important Changes

In a statement on Monday, the Chairman said that with regard to the kilowatt charge the Board had made two important changes. In the first place, instead of basing the charge on a maximum single half-hour in any of the four winter months as they had done hitherto, they had now based the charge on the average of two readings, the first being the highest in the first quarter of the year, and the second the highest in the last quarter of the year. At the end of last year and early this, before the calculations of the tariff were put in hand, the Board had two conferences with representatives of the associations in the industry and the various aspects of the kilowatt charge in particular were very fully discussed. The views expressed, as sometimes happened in that industry, were far from unanimous, and the Board were faced with a difficult task in trying to find the greatest common measure among those divergent views. They, at the same time, applied their own minds to the problem, and the result had been that new form which he thought went a long way to meet the more legitimate and even to some extent, some of the less legitimate criticisms of the original tariff. In the event of a cold snap falling in December, undertakers would, under the new form of charge only be called upon to pay for half the accretion of load in the year of account. There was one other feature of the new method. In the past there were eight months of the year in which undertakers could make additional demands without incurring liability for any kilowatt charge. Under the new tariff that period had been reduced to six months because the maximum demand in March or in September would now rank whereas before it did not. A good deal of thought was given to that aspect because it had been felt by some that the original tariff gave a rather unfair advantage to those who owned non-selected stations and were able to use them for peak loading in the winter after getting eight months in which to maintain plant and put it into perfect running order for the winter, and the result was that in most winters they were able to run that plant right to the hilt without maintaining any standby plant of their own. That gave them some advantage compared with undertakers who bought the whole of their supply at the tariff, but against that, the Board felt that during the next few years they were to be very short of plant and the existing stringency in the supply of coal was likely to persist and both those would be helped first by allowing adequate time for maintaining non-selected station plant during the summer and, secondly, by closing down those stations to save on running and coal and concentrating during the summer on the more efficient stations.

Demand for Uniformity

The second big change in the kilowatt charge was that the Board had done away with the basic demand feature which was based upon the demands of undertakers in 1932. He thought it would be difficult to hold that it was right that the payment by undertakers for their supplies in 1946-1950 should depend on the quite fortuitous circumstance of what they happened to be doing in 1932. Moreover, one had always had the feeling that the original tariff was hardly a tariff at all, because it resulted in a different tariff for every undertaker except those who were so small that their basic demands were 2 000 kW. Those who in 1932 made demands of more than 2 000 kW were all in fact on different tariffs. There was, he thought, a crying demand throughout the country for more uniformity of prices, and the Board felt that it was consistent with that view that they should do away with that differential form of tariff. They had substituted a straight block kilowatt charge so that every undertaker would be paying exactly the same tariff. The rating clause was in the same form as originally, but instead of applying by area as hitherto, it was based upon the average rate paid throughout the country as a whole.

The continued application of the coal clause to region by region was, he thought, very essential, because to-day there were differences of up to 10/- between the price per ton in one area and the price per ton in another, and if one attempted to apply

the coal clause nationally it would, in fact, mean that certain districts would subsidise others to the tune of 5s. a ton and would completely upset the economic balance between public supply and private plant in respective areas.

From the figures it would appear that the kilowatt charge had gone up substantially, ranging from £4 per kilowatt up to 2 000 kW down to £3 8s. from 8 001 kW inclusive, but it must be stressed that those were average kilowatts, whereas the kilowatts in the original tariffs were maximum kilowatts, based on a reasonable estimate of the future demands and the rise in future demands. For that purpose the Board had taken a rise of about 6 per cent. per annum, which, he thought, was not unreasonable for the period. The difference in the estimate and measurement of the maximum demand meant that it was necessary for the charge to go up by roughly 6 per cent. in order that the revenue from the same supply might be the same. The new scale of charges applied to the estimates which had been furnished to the Board by the undertakers for 1946 would represent an average revenue per kilowatt on the chargeable demand—and he must emphasise chargeable demand—of £3 12s. 9d.

Cost of New Plant

For comparison with that, if the existing tariffs had remained unchanged, the average gain per kilowatt on the chargeable demand would have been £3 2s. 3d., but of that apparent difference of 10s. 6d., 4s. 1d. was directly attributable to the changed method of measuring the demand—the substitution of the average for the maximum—so there remained the real increase in the kilowatt charge of about 6s. 5d. That, of course, was to be expected, because the Board were spending on bringing into operation in the course of this tariff period of five years over 4½ million kW of new plant, and the average price of which was probably 75 or 80 per cent. above the pre-war level. That was bound to be reflected in the increased kilowatt charge. He felt some satisfaction in that the increase was not more than it was. It was to some extent offset by the cheaper money rates.

Judged by pre-war levels, the running charge of .44d. per unit looked a very startling figure. It was based on coal at 38s. a ton, having a calorific value of 11 000 B.Th.u. The 38s. was, in fact, the average price paid about 1944. It had gone up since then, and he would not like to prophesy what was going to happen to it in the future. The coal clause adjustment, which was universally applicable, was 0.0007d., which was substantially lower than in the original tariffs, which operated upon .308d. and .201d. in the various districts.

On the face of it, the new tariff looked higher than the existing tariffs. In fact, it was not higher, but on the average of the country as a whole it was lower by about 2½ per cent. That reduction was inevitable when they substituted a national for a set of regional tariffs. The reduction was not equally spread as between one area and another; some areas got a bigger reduction than others, and one area—S.E. England—did not share in the reduction but actually suffered a very small increase of about one-fifth of one per cent. to bring it into step with the other areas.

Comparison of Running Charges

The following table shows a comparison of the running charges for the various areas under the existing and new tariffs:—

Area.	Today's Price of Coal. s. d.	Standard Calorific Value. B.T.U.	Running Charge under Existing Tariff. d.	Running Charge under New Tariff. d.
Scotland	42 9	11 000	.5510	.4799
Mid-East England	39 11	11 500	.5090	.4414
S.E. and E. England	51 0	11 500	.5460	.5303
N.W. England and N. Wales	46 0	11 600	.5348	.4869
Central England	38 6	10 000	.5140	.4764
S.W. England	44 9	12 700	.5154	.4463

Under the new tariff the fixed kilowatt charge in respect of each point of supply will be as follows: For each kilowatt of maximum demand on the Board in the year up to 2 000 kW inclusive, £4; from 2 001 kW to 5 000 kW inclusive, £3 16s.; from 5 001 to 8 000 kW inclusive, £3 12s.; from 8 001 kW inclusive, £3 8s. "Maximum demand on the Board" means in respect of each year the sum of the largest number of kilowatt-hrs. supplied and taken at this tariff during any half-hour in the first three months of that year, and the largest number of kilowatt-hrs. so supplied and taken during any half-hour in the last three months of that year. Where electricity is made available for the purpose of supplementing a supply generated wholly or in part at a station or stations not operated under the control of the Board, the maximum demand on the Board will be ascertained by the same method, or it may be two-thirds of the number of kilowatts for which notice has been given, whichever is the greater.

The Chairman mentioned that it would be very unsafe to assume that there would be a further decrease in tariff in the next period of five years. The Board felt that they ought to do everything they could to avoid any increase in price in the reconstruction period of the coming five years.

Röntgen Commemoration

Fiftieth Anniversary of the Discovery of X-rays

THE inaugural meetings in the Conference Hall of the Royal Society on November 8 of the commemoration of the 50th anniversary of the discovery of X-rays by Wilhelm Conrad Röntgen, on November 8, 1895, were attended by scientists from France, Holland and Sweden, as well as Great Britain.

In the morning Sir Henry Dale (Pres., R.S.), occupying the chair, gave some reminiscences of the impact made by the announcement of Röntgen's discovery upon his mind as a young man at Cambridge early in 1896. He also referred to investigations by British scientists which preceded the discovery of X-rays. To physical scientists, he said, he supposed Röntgen's discovery was like the ringing of a bell, the pulling of a trigger, or the opening of a window upon a new vista of discovery which had revolutionised fundamental conceptions of physics and chemistry, and had culminated in nuclear fission on a large scale.

Sir Lawrence Bragg, F.R.S., quoted passages from two reprints, one dated December, 1895, and the other March, 1896, of a paper in which Röntgen described how he discovered X-rays and the exhaustive experiments he made, measuring the relative transparencies to X-rays of different materials and proving that the rays showed no refraction, no reflection and no polarisation, and that they were not affected by any property of the bodies they passed through except their density.

Prof. Karl Siegbahn, of Stockholm, said the importance of Röntgen's discovery was recognised at an early stage and its spectacular medical application esepecially contributed to make it known outside the scientific sphere. Not the least among its later developments was its technical application in industry.

Mlle. Y. Gouchois, of Paris, projected some slides of historic interest, from the Duc de Broglie, showing the results of X-ray investigations in spectroscopy.

Astonishment Among Cavendish Workers

Sir William Dampier recalled the general psychological atmosphere of physics in the years before 1895 and the great change that was ushered in by Röntgen's discovery. He remembered well, he said, the interest and astonishment with which they who worked in the Cavendish laboratory at that time heard the news of Röntgen's discovery of the X-ray, and how they rather regretted that the lucky accident which revealed it had not happened within their own walls, for J. J. Thompson's electrical experiments on gases must have been radiating X-rays for some time.

Other speakers included Sir Owen Richardson, Sir Richard Gregory, Prof. Born (Edinburgh) and Prof. Whiddington.

Historical Exhibition

AN exhibition of apparatus and radiographs of historical interest was held in the Reid Knox Hall of the British Institute of Radiology, 32, Welbeck Street, London, on November 8, 9 and 10.

Among the exhibits were a pear-shaped tube, the glass wall of which served as the source of the rays, as used by Röntgen; a copy of an early Crookes tube, of which the glass wall served as the source of the rays, made by Cuthbert Andrews; a small tube with a platinum foil anode; a small tube formerly the property of Sir William Crookes; an Oliver Lodge tube made by A. C. Cossor and Co.; an early tube with a platinum-faced target; a tube with extension pieces and small window; a copy of a tube used by Campbell Swinton in which a penny with an insert of platinum was used as the anode; a Bunsen filter pump used by G. H. Gabb in February, 1896, in the first stage of the exhaustion of X-ray tubes, the final stage being completed by a Sprangel pump; a photograph of an induction coil used by Gabb in February, 1896, in his early X-ray experiments; a triple-valve tube made by Cuthbert Andrews; a copy of Campbell Swinton's tube with sliding cathode; an early light anode tube with regulator; a heavy tube (Leviathan); a water-cooled tube of the type freely used from 1909 to 1923; a heavy anode tube used between 1909 and 1918; a tube with a ring electrode—it was with this instrument that the first radiograph which resulted in an operation was taken; a small X-ray tube of about 1900, used in Middlesex Hospital; the tube which produced the first radiograph taken in Birmingham; Lenard's tube; early Röntgen-ray photograph by A. A. Campbell Swinton and J. C. M. Stanton, stated to be first taken in this country, in January, 1895; X-ray photograph taken by G. H. Gabb of his own hand and foot. A group of lantern slides from X-ray negatives taken in 1895-1896, included one which was stated to be the work of Campbell Swinton about November 18, 1895, and believed to be the first X-ray photograph taken in this country. There were other lantern slides and radiographs of considerable interest.

X-Rays and Pure Science

Sir Lawrence Bragg on Influence of Rontgen's Discovery

AT the only plenary session in connection with the jubilee celebrations of Röntgen's discovery of X-rays, an audience which filled every section of the Phoenix Theatre, London, on November 9, assembled to hear Sir Lawrence Bragg speak on the influence of that discovery on pure science.

Science and War

The researches of Sir Lawrence Bragg and his father (the late Sir William Bragg) have been responsible for much of the development in atomic physics during this century, and in commenting on the fact that it was 50 years almost to the day since Röntgen had made his discovery, Sir Lawrence said that during the war we had been applying knowledge which had been painfully accumulated in the past. The fruits of research might not ripen for many years; often 40 or 50 years might elapse before the results of research into pure science came to have a wide application. Röntgen's discovery, made in 1895, was followed by an outburst of enthusiasm greater than was accorded any other experimental discovery before or since. One of the first consequences of the discovery, said Sir Lawrence, was to give an immense impulse to the brilliant school of researchers working under J. J. Thomson at Cambridge—Rutherford, C. T. R. Wilson, Townsend and others—who had used X-rays as a means of ionising gases. Other agencies, sulch as electric discharge ionised gases, were known but X-rays provided for the first time a steady way of making a gas conducting and, therefore, of muking quantitative measurements and measurements which could be repeated. With their X-ray tube, J. J. Thomson and Rutherford had worked out the theory of the ionisation of gases. "J.J." had used it in the determination of the unit of electrical charge and the tube was used by C. T. R. Wilson in his cloud chamber experiments. It was an integral part of that brilliant series of researches which led to the discovery of the electron, the unit of electrical charge, the idea of the electron as a part of atoms of all kinds. That really was the beginning of the new physics. It was an era. It opened the door which had led to the discovery of the structure of the atoms, and all the things that had resulted from those discoveries.

The next turning point was 33 years ago. At that time the nature of X-rays was still in doubt. Then Loewe, in Germany, discovered that when X-rays passed through a crystal he obtained regularly diffracted beams whose geometrical arrangement showed that the regular arrangement of the atoms in the body was scattering the X-rays in the same way that any regular pattern scattered ordinary light.

Later Sir William Bragg had experimented on the ionisation which the rays produced, and by indirect reasoning he concluded that the X-rays themselves did not ionise the gases, but started electrons in the gases, and the electrons, charging along in a gas, produced ionisation along their path. That was brilliantly verified later by Wilson's cloud chamber; the pictures which Sir William had produced were extremely like those which Wilson had produced in the cloud chamber.

After commenting on the part played by X-rays in the work of the atomic physicist in discovering how the atoms themselves were built up, Sir Lawrence discussed the field in which his father and himself were interested, a field in which they had examined the structures of many different materials, starting from the very simplest structures. That field, he said, had grown enormously and was explored in every part of the world. The work of discovering the arrangement of the atom had had repercussions in many other fields; and he did not think it unfair to say that many of the fundamental conceptions in chemistry, mineralogy and metallurgy had been simplified and revised in the light of the new knowledge. Indeed, one result of the use of X-rays was to reduce the minerals to order.

Sir Lawrence illustrated a number of molecular structures, to show the complexity of structure analysis and the help which was derived from X-rays. The next field of study by X-rays was that of the vastly more complex molecules which formed the structure of living matter.

A Discovery Difficult of Comparison

Thus, he concluded, Röntgen's discovery had started a vast amount of work in many different fields. The work on the electron structure of the atom, the laws of chemical combination, the results obtained in mineralogy, metallurgy and organic chemistry, the attempt now being made to study the structure of living matter, which would start a new science, were all cases in which Röntgen rays had supplied a new means of measurement, a new kind of vision to the scientist. It was difficult to find a parallel single discovery which had led to such vast results.

I.E.E. Tributes to Röntgen

Some Indication of Present and Future Applications of X-Rays

THE final meetings in connection with the celebrations of the discovery of Röntgen rays were held at the Institution of Electrical Engineers in the afternoon and evening of November 10, when Dr. P. Dunsheath, president, was in the chair, and four addresses on various aspects of X-rays from the historical point of view with, at the same time, some indication of present and future development were given.

Evolution of Equipment

The first speaker, Dr. C. C. Paterson, F.R.S. (director of research, G.E.C.), dealing with the evolution of electrical high tension equipment for X-ray tubes, said that many of the older workers in the X-ray field would agree that a most striking feature of the early work was the excellence of the standard attained with temperamental and difficult-to-control apparatus, and in skilled hands the best of the induction coil-gas tube combinations gave results which compared favourably with those obtained by modern equipment.

In 1895, the two available sources of h.t. current were the electrostatic generator and the induction coil. The early electrical equipment was used to energise an X-ray tube of variable behaviour and the induction coil was able to compensate for these variations, to some extent, better than could the transformer sets developed later. In the years preceding the 1914/18 war, a number of X-ray workers began experimenting with the use of a hot-cathode, to enable the positive ion bombardment and tube resistance to be more closely controlled. The basis of modern tube design was the hot-cathode vacuum tube invented by Coolidge in 1913 and the introduction of the Coolidge tube brought new demands on the high tension equipment, which led to the early development of the transformer for h.t. supply. Mechanical rectifiers were made use of, but whilst robust and reliable, they had the disadvantage of being rather noisy. However, they remained in popular use for several years and were only gradually displaced by valve rectification. It was probably not recognised outside the circle of X-ray workers that the Coolidge X-ray tube was one of the first thermionic devices in widespread use, and the principle underlying the self-rectifying property of the Coolidge tube was applied by Dushman to the kenetron described by him in 1915. The developments in the last 20 years until the present day were as much aimed at improving control gear and providing shock-free equipment as they were towards new applications. The Philips "Metalix" tube was one of the earliest self-protected tubes but the first completely shockproof tubes followed a few years later with the advent of the rubber insulated h.t. cable. In the 1930's the double focus tube was introduced, to be followed by the rotating anode tube. With these the risk of accidental damage was so high at first that special safeguards had to be incorporated in the control gear. Indeed, with each successive development in tube design the emphasis was increasingly on a good control table and less on the high tension generator itself.

The United States had been prominent in the production of super-voltage equipment but one of the earliest units was installed in this country at St. Bartholomew's Hospital by the Metropolitan Vickers Electrical Co., Ltd. This installation was formally opened for deep therapy treatment in December, 1936. The X-ray tube was initially designed for voltages of about 600 kV but it was now run at 1 000 000 V. In the United States there were comparable early developments but during recent years a new technique had grown up round the use of a new insulator, Freon gas, which was a derivative of methane. Dr. Charlton and his collaborators of the American General Electric Co. had designed two units using high pressure Freon insulation. A 1 000 000 V unit was described in 1940 and more recently, in 1944, a two-million volt unit had been described. Both units employed a sealed-off multi-section X-ray tube which was mounted co-axially within a resonance transformer.

The electrostatic machine, continued Dr. Paterson, was being used once more; this time as a generator producing upwards of a 1 000 000 V at about 0.5 mA.

Needs of the Future

For the future, the prospect was bright. In the medical diagnostic field, the improvements wanted were refinements such as finer focus, giving better definition, and even simpler and more flexible X-ray sets. There were similar requirements for industrial radiography, where also routine visual testing with high output tests of comparatively low kilo-voltage was within sight. For special cases, such as the radiography of heavy metal castings, and in deep therapy, flexible and reliable 1 000 000 V units were now available, and still higher voltages could be attained if their need was proven.

Crystal Analysis

Application of X-Rays to Diffraction Studies

THE second speaker at the I.E.E. meeting on November 10, dealt with the application of X-rays to crystal analysis, an abstract of the address being as follows:

Representing the Crystal Analysis Group of the Institute of Physics, and associated with the G.E.C., Mr. H. P. Rooksby said the use of X-ray diffraction methods fell naturally into two broad divisions. In one, X-rays were utilised to obtain information that would enable the atomic sites in the space lattice of a crystal to be located, and the other was of interest from the practical point of view. In the latter, X-ray reflections and patterns from crystals were utilised for directly practical ends without necessarily involving very detailed structure determination.

X-ray Ionisation Spectrometer

He described in some detail the X-ray ionisation spectrometer, introduced by Sir William and Sir Lawrence Bragg, and with which the fundamental basis of crystal structure determination was mapped out. In Britain most of the X-ray sets for multiple diffraction work were made for research use in university laboratories. The G.E.C. was one of the first industrial research organisations in this country to set up X-ray apparatus for general research problems. The first apparatus built in the early 1920's was a very crude arrangement and more time was spent on getting the apparatus to function than on examining the photographs. But considerable progress had been made since then.

To obtain a still greater output from the X-ray tube so that photographic exposures may be brought down to times comparable with those employed in radiography, resort must be made to moving targets. The work of Muller and Clay at the Royal Institution, London, and of Astbury and McArthur at the Leeds University was a noteworthy contribution in this connection.

Mr. Rooksby then considered some aspects of the interpretation of X-ray diffraction patterns and referred to the use of the X-ray powdered crystal photograph for identification purposes. The method had become of invaluable assistance in several different fields, and its adoption could be envisaged in many other directions in which up to the present its value had not been fully recognised. But the extensive use of X-ray technique for identification problems must rest in some degree upon the readiness and rapidity with which the pattern of an unknown could be compared and matched against standard photographs. The library of standard reference photographs must be large if a wide variety of problems was to be dealt with. In 1936 the Americans, Hanawalt and Rinn, described a method of classification of X-ray powder photographs which was based upon planar spacing values.

Co-operation with America

In a year or two this scheme was taken up by the American Institute of Physics and the American Society for Testing Materials, and the Hanawalt file was published in the form of a card index, now known as A.S.T.M. card index of X-ray diffraction data. Soon after this index was published, the X-ray Analysis Group of the British Institute of Physics decided it was desirable to co-operate with the responsible American bodies and to proceed with the collection of more data. This was done and the whole collection was finally sent to America for inclusion in the supplement on which work was proceeding there. This supplement had recently been issued and it was worthy of note that the British contribution constituted a very considerable part of this valuable reference.

Mr. Rooksby concluded with some speculations about the future applications of industrial X-ray analysis. In the first place, he said there was bound to be a more widespread adoption of X-ray technique for routine control purposes, but in his view there was going to be an even greater extension of the use of X-ray methods in what he described as the investigational sphere, and a time was rapidly approaching when no self-respecting metallurgist, chemist or mineralogist would consider his facilities complete unless he had access to X-ray analytical information.

Photographic Materials

Dr. H. Baines (Royal Photographic Society) told the story of the development of X-ray photographic materials. Looking into the future, he said that faster films were still required. A fundamental difficulty was that the photographic effect was dependent on the absorption of X-rays by the emulsion, and at present only a fraction of 1 per cent. of the incident radiation was so absorbed. If that absorption could be increased, the consequent advances in radiography would be tremendous.

Industrial Radiology

Development of High Voltage Tubes—War-Time Experiences

THE growth of industrial radiology was dealt with at the I.E.E. meeting on November 10, by Mr. W. J. Wiltshire (Woolwich Research Department, and representing the Industrial Radiology Group of the Institute of Physics) who said that a great deal of experimental work had been done in this country, particularly in regard to X-ray tubes for higher voltages but when new types became available commercially from America and the Continent, this part of the work was abandoned.

This, in his view, was an unfortunate policy for the beginning of the recent war found us entirely dependent on imports from America to meet the increasing demands for high voltage tubes for industrial work. By 1919 radiographs through about 2 in. of steel had been made but the practical limit was little more than an inch as there were no tubes working above about 100 kV. 200 kV tubes came into use about 1922. The ten years after 1919 were years of steady progress and a noteworthy milestone was reached when the Chief Inspector of Armaments decided that the radiographic inspection of certain types of fuses should be tried on a routine scale; Woolwich completed the first routine fuse inspection apparatus in 1927.

Appreciation by Service Departments

By 1932 industrial radiology was fully established within the Service Departments but there was still no regular use of it outside. It was not until 1933 that the first industrial apparatus was installed in this country by Messrs. Babcock and Wilcox, Ltd., following a decision by Lloyds Register of Shipping to accept radiographically tested welded pressure vessels.

One of the most important developments in Britain took place round about 1932. The Air Ministry had decided that all highly stressed castings used in aircraft construction must pass an X-ray test. The method having been established and proved, a scheme was put into operation which had been worked ever since.

Since 1932 radiography, usually by means of gamma rays, had been employed for some purpose or other in many ships of the Royal Navy. For some years the Admiralty had accepted welded high pressure boilers, but only from approved firms and only after every inch of the welding had been radiographed in accordance with a specified technique.

The war had produced tremendous developments in the radiological field and expansion had been enormous. In Britain, outside Government establishments, there were only ten or a dozen regular commercial users of X-rays in 1939, but there were now probably not far short of 200. In the United States, counting only the steel foundries, there were 42 who had used radiography in 1941 and to-day there were more than 100.

What might well be the dawn of a new era in radiology had occurred during the war years—the introduction of super-high voltage X-rays. First came an industrial X-ray apparatus working at 1 000 000 V, permitting radiography through thicknesses up to 8 in. of steel. More recently, a 2 000 000 V set had appeared allowing thicknesses as great as 10 or even 12 in. of steel to be radiographed.

New Developments

But the tale of war-time progress, said Mr. Wiltshire, was not yet complete. By 1941, D. W. Kerst had developed the first Betatron, Instead of electrons being projected by the use of extremely high potentials, they were accelerated on a circular path by magnetic induction. After many revolutions, on each of which they had gained energy, they were deflected on to a target, and radiation was emitted. In the first type the electron energy acquired was equivalent to that of an electron subjected to a potential of 4.5 million V; one of these machines was at Woolwich. Very soon 20 million electron-volt betatrons were produced, and one or two were now being used for radiographic work in America. The radiation output was equivalent in intensity to that from several kilogrammes of radium, and was more penetrating. Up to 15 in. of steel could be radiographed in reasonable time. Thus, in a few short years the maximum voltage had increased from 400 000 to 20 000 000, and the limit of penetration from 5 to 15 in. of steel.

An interesting development had recently been reported from America. A very small source of gamma rays was employed for measuring thickness, but the source was an artificially radioactive element prepared in a cyclotron. The reason for the use of this unusual source was that the gamma ray spectra of radioactive isotopes were all different. Some included gamma rays of considerably longer wavelengths than those from radium, and their consequent greater absorption made for increased accuracy of measurement. This development of radiology seemed to open out still new possibilties. It was true that radioactivated elements were not plentiful at present, but it might well be that in the near future they would be far more readily available in research laboratories.

High-Voltage Overhead Lines

Recent Progress in Design on the Grid System

IN a paper read before the I.E.E. Transmission Section on Wednesday, Mr. W. J. Nicholls, of the Central Electricity Board, reviewed the progress that has taken place in the last fifteen years in the design of the steel-tower high-voltage transmission lines of the grid system.

Conductor Metals

The conductor originally chosen for the 132 kV lines (0.175 in.² copper equivalent s.c.a., consisting of 30 aluminium and 7 steel strands) he said, had proved generally satisfactory and was still used, although when aluminium was required for more urgent purposes two alternatives of the same copper equivalent sectional area were used. These were 19/.118 cadmium-copper and steel-cored copper, consisting of 30/.087 copper strands on a steel core of 7/.075 strands wrapped with tape and bitumen. Both these conductors were carried by towers designed for s.c.a. conductor. As experience with both these conductors had extended for only two or three years, judgment on them in comparison with s.c.a. must be postponed.

Vibration occurred on the s.c.a. conductor originally erected to a maximum working tension of 8 000 lb. at 22° F. with ice and wind equivalent to a tension of 3 450 lb. at 40° F. in still air, and as soon as broken strands were discovered vibration dampers were fitted to all lines. The type chosen for general use was the Stockbridge damper, and these were fitted one to each normal span, with two per span where the length exceeded 1 000 ft. or wherever vibration was found to be excessive. In order to ensure that on new lines vibration would not cause strand breakages, the conductors were erected to a tension of 2 560 lb. at 40° F. in still air, and the use of Stockbridge dampers was continued as an additional safeguard. The effect of this reduced tension was to increase the sag under maximum specified temperature conditions from 22 ft. to 27.25 ft. and the tower heights were increased accordingly, the basic span remaining at 900 ft. Vibration dampers had not been fitted on the cadmium-copper or the steel-cored copper conductors, but it was too early yet to say whether they would prove to be necessary.

On all the 132-kV lines prior to 1938 the s.c.a. conductors were jointed in mid-span by cone-type joints gripping the steel and aluminium strands separately by means of steel and aluminium cones respectively. In 1938, the compression joint was introduced on new lines and for the maintenance of existing lines. The reason for this change was the increasing number of failures of cone-type joints due to increased resistance. On the cadmium-copper conductor two types of joints in mid-span had been used. One was a cone joint similar to that used on s.c.a., but simpler because with homogeneous conductor only one set of cones was necessary. The other was the drawn-sleeve joint which had been used extensively in America. This joint gave good results on test, although it was early to pronounce on its final performance. On the steel-cored copper conductor, cone-type joints similar to those used on s.c.a. had been adopted, with results that had, so far, been satisfactory.

Originally all cone joints and clamps were filled after assembly with a bituminous compound to seal them against the entry of water. After several years in service it was found that this compound hardened and cracked. High-melting-point grease had been used for this purpose in recent years, and had been free from the above defect.

Various types of clamps had been used to terminate the s.c.a. conductors on the angle and terminal towers. More recently the snail-type clamp had been adopted for general use. This had the merit of simplicity and, like the bolted clamp, had the advantage of keeping the conductor continuous from the line to the jumper loop. Compression clamps had also recently been used to a considerable extent on s.c.a. conductors. Experience with the non-tension cone joints on s.c.a. conductors had not been good. On the cadmium copper and steel-cored copper conductors parallel-groove clamps had so far been used successfully.

Originally all 132-kV lines were transposed en route, generally three times so that the phasing was the same at each end following a complete transposition in the run of the line.

Snow Loading Difficulties

It was found that clashing could occur between the top conductor and the earth wire during the release of snow loading on those spans, and, prior to the war, with the approval of the Post Office, single-circuit transpositions were removed and special arrangements were made to eliminate the cross-overs at junctions of single- and double-circuit lines except where the vertical clearance between the crossing conductors was 17 ft. or over. On new lines transposition en route were

omitted with the approval of the Post Office, so that the question now seldom arose. Sufficiently good electrostatic balance for the grid as a whole was provided by transposing complete lines at sub-stations.

A single earth wire only was used on the original lines, but since 1938 double earth wires had been erected for one mile at each end of each line to provide better protection for the sub-station apparatus against direct lightning strokes.

The chief changes in insulators had been the general adoption of single strings of heavy-duty tension insulators in place of duplicate strings of normal units, and the use of anti-fog type suspension units in place of the normal shedding. Toughened-glass insulators, both for tension and suspension position, had been used to a limited extent, the suspension units being of the anti-fog type similar in shape to the porcelain units. Glass units had been in successful use for about five years, but it would be premature to compare them with porcelain units.

Changes in tower designs had followed the requirements of extra sag for the conductors and the use of double earth wires. The vertical clearance between the earth wire and the top conductors had been increased to a minimum of 7 ft. throughout by increasing from 4 to 7 ft. the height of the peak of all towers carrying tension insulators.

There were three sizes of 60 kV and 33 kV conductors in general use of equivalent copper sections of 0.15 in.^{2}, 0.1 in.^{2} and 0.075 in.^{2}. The same procedure was adopted on the lower-voltage lines as on the 132-kV lines, namely the fitting of Stockbridge vibration dampers to existing lines and reducing the tension, in addition, on all new lines. Experience with the lightest conductor, 0.075 in.^{2}, had not been as good as with the others and its use on long-span construction was discontinued.

An important concession was obtained from the Electricity Commissioners in 1942. Now a road crossing was treated as a railway crossing, single insulators being used with a 10 per cent. higher flashover value than that of the normal insulator on the line. This relaxation had enabled lines designed for 33-kV operation to be increased in insulation to operate at 66 kV without encroaching on the clearances to tower steelwork.

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. Peter Renwick, an electrician, has been elected a Labour member of Newcastle-on-Tyne City Council.

Ald. H. E. Rhodes, the veteran chairman of Preston Electricity Committee, was installed as Mayor of Preston, on November 9.

Mr. G. Machin has been appointed chief clerk in South Shields electricity department, in succession to **Mr. J. Woodhouse,** who has retired.

Formerly general manager of the Southern Railway, **Mr. Gilbert S. Szlumper,** Director-General of Supply Services, Ministry of Supply, has resigned from his appointment.

Dr. W. B. Lewis, lecturer in physics at the Cavendish Laboratory, Cambridge, has been appointed chief superintendent of the radar research headquarters at Malvern in succession to Mr. A. P. Rowe.

Miss Elsie Noblett, an inspecter at the English Electric Company's works at Preston, was married at Emmanuel Church, Preston, recently, to Mr. Tom Finney, the well-known North End football player.

Hull Electricity Committee has accepted the resignation of **Mr. I. D. Campbell,** generation engineer, who has been appointed deputy general manager of the Sheffield electricity department, and promoted **Mr. T. K. A. Douglas,** power station superintendent, to fill the vacancy.

Mr. F. E. Goens, of the Automatic Telephone and Electric Co., Ltd., has been elected vice-chairman of the North-West branch of the Incorporated Advertising Managers' Association.

The Association of Supervising Electrical Engineers and the Institution of Engineers-in-Charge are holding their twentieth combined annual meeting at the Connaught Rooms on November 17, and the General Electric Co., Ltd., has invited the combined meeting to luncheon. Afterwards **Mr. R. O. Ackerley,** manager of the company's I.E. department, will give a lecture on illuminating engineering.

At a meeting of the Coventry Electric Club, on November 6, with **Mr. F. W. Godden,** city electrical engineer, in the chair, **Mr. P. W. Cave** delivered a lecture on "Cables for Special Conditions," covering indoor (vertical) installations, submarine installations, installation in corrosive soil, tropical conditions, 33 kV and higher operating voltages outside the scope of present British standard specifications, and abnormally high ambient temperatures. The meeting was well attended and a lively discussion followed.

Dr. H. E. M. Barlow, Reader in Electrical Engineering at University College, London, since 1938, has now become Professor of

Electrical Engineering in the college. He has been on the staff of University College since 1924, as assistant reader, lecturer and then senior lecturer in electrical technology, electro-communications and so on, before the title of Reader was conferred upon him in 1938. Dr. Barlow was educated at the City and Guilds College and University College. He obtained his B.Sc.(Eng.) degree in 1921 and later his Ph.D. degree, and had practical training in electrical engineering with Barlow and Young, Ltd., in 1923-24. In the 1914-18 war he served in the R.N.V.R. Wireless Section.

Mr. J. C. Turnbull, who represented the Midland Electric Mnfg. Co., Ltd., in the Yorkshire area until called for service with the R.N.V.R., has recently been promoted to the rank of Commander. Mr. Turnbull's experience has been put to good use during his service with the Navy, he having served on the electrical engineering staff both afloat and ashore, latterly with the Combined Operations' staff.

Comdr. J. C. Turnbull

The Royal Society has awarded the Hughes Medal to **Prof. B. F. J. Schonland** for distinguished work on atmospheric electricity and other physical researches. Head of the new industrial research body for the Union of South Africa since 1944, he is Director of the Bernard Price Institute of Geophysics and Carnegie-Price Professor of Geophysics at the University of the Witwatersrand, Johannesburg.

Norwich Electricity Committee have been honoured by the election by the City Council of their chairman, **Alderman Bailey,** as the Lord Mayor, and the vice-chairman, **Alderman Deacon,** as Sheriff of Norwich for the ensuing year.

Mr. Charles A. Britton, borough electrical engineer at Maidenhead, has married Mrs. Nora Gray, formerly assistant billeting officer at Maidenhead.

The new borough electrical engineer for Maidenhead in succession to Mr. C. A. Britton, who resigned to take up an appointment with the Sudan Light and Power Co., is to be **Mr. John Downes Markland,** of Bradford - on - Avon. At present he is an electrical commander, R.N.V.R., in the technical section at the Admiralty, but he is expecting demobilisation shortly. Mr. Markland was formerly assistant sales engineer at Westminster, and on the merging of the central London supply companies to form the Central London Electricity Corporation, he was appointed deputy manager to the Kensington, Brompton and Knightsbridge district.

Messrs. F. C. Barford and **G. W. Johnson** have rejoined the staff of the British Thomson-Houston Co., Ltd., and are now attached to the Manchester district office. Mr. Barford was on the staff of the company's Glasgow district office before the war, during which he served in the R.E.M.E. attaining the rank of Lieut.-Colonel. Mr. Johnson was one of the company's switchgear sales engineers on the outbreak of the war. After varied war service he attained the rank of Major in the R.E.M.E. Both Mr. Barford and Mr. Johnson were B.T-H. apprentices and both were members of the Territorial Army.

Dr. R. R. Nimmo, of Birmingham University, who has recently returned to this country after working on the development of the atomic bomb at Oakridge, Tennessee, said at Manchester last week, that he believed Britain was on the same level as America so far as atomic knowledge was concerned. He thought the real possibility of obtaining heat energy from atomic energy seemed to come from the construction of huge piles of graphite into which uranium had been inserted. At the present time the heat energy from such piles was in a form unsuited to the development of electrical power, but presumably this disadvantage could be overcome.

Mr. A. J. Haselfoot has recently been released by the Central Electricity Board to take up a position with Asea Electric Ltd., and their associated company, the Fuller Electrical and Manufacturing Co., Ltd., as manager of their power department. Mr. Haselfoot obtained a First Class Honours Degree in Engineering Science at Oxford University and received his practical training with the B.T-H. Co., at Rugby. After 15 months' experience with Messrs. Merz and McLellan on work in connection with the construction of the grid, he joined the staff of the Central Electricity Board, S.E. England district, in 1932 as an assistant in the technical department, later becoming senior assistant technical engineer and ultimately senior assistant operation engineer. In his new position Mr. Haselfoot will be responsible for the sales and engineering side of all switchgear and power schemes, excluding transformers, and will handle both the home and export business of the two companies in this line.

Although starting their new industry only four months ago, Commercial and Domestic (Electrical) Appliances Ltd., 8, Folds Road, Bolton, are, we are informed, already building up an extensive export trade. Orders have so far been received from Holland, Iceland, Bombay, Sweden, Copen-

hagen, Persia, Brazil, Belgium, and Ceylon. Manufacture of electric irons and fires is under way, whilst during the next few months boiling rings, table standards, hall lanterns and other lighting equipment will be on the market. **Mr. Jack Hinton,** managing director, has explained that the firm is being inundated with orders, but owing to difficulties with regard to labour and materials, only part orders can be delivered at present. We are informed that the latest inquiry is from Messrs. Watson's, of London, E.C.2, for 60 000 fires for export, while for the home market, orders are already in hand for Falk Stadelmann and Co., Ltd., the Sloan Electric Co., Ltd., the Wholesale Fittings Co., Ltd., and others. The distribution of articles manufactured by the company is exclusive to factors to whom retailers should apply as supplies become available.

The General Electric Co., Ltd., announce that **Messrs. W. Horsfall, F. Lonsdale, R. E. Robinson** and **W. H. Williams,** have been appointed to the board of the company. Mr. W. Horsfall, was assistant manager of the Cardiff branch until 1923, when he was appointed manager of the company's Newcastle branch. Subsequently, he was posted as manager of the North Eastern area which embraces the Newcastle, Hull and Middlesbrough branches. Mr. F. Lonsdale joined Fraser and Chalmers, Ltd., in 1909, and when that firm was absorbed by the G.E.C., in 1918, became sales manager. He was appointed joint general manager of the Erith works in 1938. Mr. R. E. Robinson joined the company in 1908 as chief engineer of their telephone works, at Coventry. He relinquished that post in October of this year when he was appointed general manager of the company's telephone and radio works at Coventry. Mr. W. H. Williams has been with the company since 1916, and soon after joining was appointed assistant manager of the Osram lamp department. He held that office until 1930 when he was given the position of manager of the department at the head office. He is now manager of the whole of the Osram lamp sales organisation. He was recently chairman of E.L.M.A.

Obituary

Sir Glynn West, a director of McMichael Radio, Ltd., on November 6, aged 68 years.

Mr. Alfred H. Wright, manager for Oil Palms of Malaya, Ltd., Layang Layang, Johore, from January, 1932, at Palembang Camp, Sumatra, on February 9 last. He was an associate of the I.E.E., and had been chief assistant mechanical and electrical engineer at the Telmanstone Colliery, near Dover.

Mr. E. R. Hudson, of Ilkeston, the Midlands representative for Crompton Parkinson, Ltd. (Derby Cables), since the foundation of Derby Cables Ltd., aged 60 years. Amongst his many other interests in the Midlands, Mr. Hudson was for over thirty years the secretary of the Midland branch of the Association of Mining Electrical and Mechanical Engineers. He was National President of the association for the year 1944-45.

Street Lighting

Discussion by Installations Section of Some Post-War Problems

AT a meeting of the Installations Section of the I.E.E., on November 8, Mr. E. C. Lennox delivered a paper on "Street Lighting," an abstract of which was given in our last issue. This, in brief, pointed out that after nearly six years of black-out conditions, street lighting in this country was to be recommissioned on pre-war standards. This would initiate a period of development of new or improved lighting in which the electrical industry would play a leading part. A brief introduction and a reference to the need for adequate street lighting were followed by a consideration of the illumination requirements. Agreement throughout the industry was desirable on the theoretical considerations governing good visibility; the provision of adequate "background brightness" should be a basic aim. Street-lighting appliances, lanterns, sources and control gear were discussed.

The legal position of lighting authorities in relation to street lighting was reviewed; annual running costs were analysed and were applied to an example of lighting, a through-traffic route to show the difficulties which would have to be surmounted before adequate street lighting could be extended over the whole country.

Dr. C. C. Paterson, F.R.S. (G.E.C.), referring to the work of the Departmental Committee of the M. of T. said that when this began in 1935 the principles of street lighting were new and the contribution of the Committee to the subject was a pioneer piece of work which had been admired in other countries. The principles laid down by the Committee were being copied, and were likely to be further copied, all over the world. By the time war broke out these principles were well understood but he was not sure that the idea had percolated to lighting authorities. Therefore, this

paper would help considerably to revive the position as it was just before the war, and give a reminder of the things that really mattered with regard to street lighting. The main point behind the work was that the amount of light provided in the streets was really quite secondary to the composition and distribution of that light. This was illustrated particularly in the unidirectional type of lighting by the use of which the wattage could be cut down by 60 per cent. and yet give better lighting from the visibility point of view. This had a particular significance owing to the need for keeping down running costs, and both from the point of view of vehicles and pedestrians, the results obtained with this method of lighting for such places as double roadways, for example, were amazingly good. With regard to the specification now in course of preparation, he was Chairman of the B.S.I. Committee dealing with that and the specification was practically completed. It had been recognised that it was difficult to lay down a rigid specification which would cover street lighting generally and therefore the specification to be issued would be more in the nature of a Code of Practice telling how to apply light to the sort of roads we had in this country. Certain matters must be left to be decided according to the particular circumstances, and especially in regard to double roads, bends and roundabouts. The only light which mattered from the point of view of the motorist was that emitted between 80 and 90° and if drivers would make use of their visors, as they had to do when driving against the sun, the discomfort from glare would entirely disappear.

Dr. J. W. T. Walsh (N.P.L.) disagreed with Dr. Paterson on the latter point and also pointed out that the author had said practical results showed that drivers suffered no real disability from glare with the non-cut-off type of distribution. We were apt to be misled by tests carried out on installations on isolated occasions, so far as glare was concerned, and the fact that the driver could detect objects and not suffer any actual disability from glare was by no means the whole story. His own view was that any form of glare was a disadvantage and led to a lowering of the performance of the driver of a car. Therefore, glare in any form should be avoided. The metal filament lamp still had an important part to play in street lighting where we were not willing or able to put up with the colour distortion of the mercury vapour or sodium lamp, as the author had suggested, but his comment on that was that he refused to be defeated as regards the use of fluorescent lamps for street lighting, and he looked forward to such lamps of very much higher brightness than was the case to-day. Lamp makers should be asked to provide a form of lighting which did not make people using the streets look like animated corpses. Commenting on the lack of uniformity of administration of street lighting throughout the country, he said that one of the primary difficulties of the Standards Committee was that the specification had to be drawn up with due regard to this unsatisfactory state of affairs.

Mr. W. N. C. Clinch (Northmet Co.) commented that the paper amply testified to what private enterprise could do in the matter of street lighting when the area to be covered was of the proportions in question, notwithstanding the difficulties introduced by having to deal with so many different authorities. At the same time, he expressed the hope that lamp manufacturers and designers would help in overcoming the present lack of uniformity in lighting by developments in lamps, although that would not overcome the problem introduced by having the parish councils and other councils as lighting authorities. With regard to d.c. injection as a method of control of street lighting, care must be taken against interfering with other devices and he did not share the author's view that there should be a relay in every post. With such systems it was better to have one relay controlling a group of lamps. He favoured mercury discharge lamps in all main thoroughfares and the use of sodium and other smaller wattage lamps in Class B roads, for in this way the side roads would immediately be indicated by the change of colour.

Mr. Chamberlain (Commissioner of Police Office) thought it was a pity that despite the enormous improvement that had been made in street lighting before the war, the result was now seen to be a gloriously coloured patchwork. Moreover, there were the difficulties of having so many lighting authorities. Within five miles of Charing Cross there were as many as five different authorities, and though they all had good lighting systems, the variation among them was to be deplored because there was bound to be some mental reaction among drivers of vehicles. The cumulative effect of having to pass through so many varying systems of lighting produced irritability, and this might lead to danger. On the general grounds of the prevention of crime, he deprecated the reduction in street lighting and said the Commissioner of Police had asked for street lighting to be kept on longer than midnight in certain parts for this reason.

Mr. Arthur Cunington (Southern Railway) thought that insufficient attention had been given to the cut-off type of lighting and said that in regard to railway yards, the lighting of which was a not dissimilar problem to that of street lighting—a larger number of small powered

lamps gave better results than a few larger units. That principle should be more widely adopted in street lighting, although perhaps it was impracticable from the point of view of cost.

Mr. H. Horwood commenting on a statement in the paper that synchronous motor-driven time switches had a life of 15 to 20 years, said his experience had been that these devices had nothing like that life. It had been claimed that the ripple control relay could run for 20 years without maintenance, but in that case the relays were practically stationary for most of the time and could be said to be in operation for an aggregate of only four or five days in 20 years. Apparently the author's experience with audio-frequency control systems had not been very happy, but it was claimed that the trouble mentioned in the paper was inherent to a parallel system, for which the relays had to be very sensitive and delicate.

Mr. J. M. Waldram (G.E.C.) referring to the criticisms of the cut-off and non-cut-off types of distribution said it must be remembered that street lighting was in course of development. The non-cut-off system had made street lighting possible in the past at a cost which could be borne, but the time would come, when, more skilled in the art of lighting and with more money available, more attention would be paid to the cut-off system.

Mr. W. J. Jones (E.L.M.A.) after agreeing on the need for greater uniformity in street lighting, said that immediately before the war we had no fewer than 1 000 miles of first class electric discharge lamp street lighting, which was rather more than the quantity of the same type of lighting in the rest of the world. Therefore, he hoped that one of the results of the paper would be that our Commercial Attachés would tell people in other parts of the world that this country was leading in this particular development. It was very necessary at this time that information of this sort should be made available, because only last week he had had an inquiry from abroad with regard to street lighting material, and great surprise had been expressed at the developments that had taken place here. We were leading the world in street lighting. The author had not made his story complete in making the comparisons between various light outputs and the cost of the installations referred to in the Tables. For instance, in the case of electric discharge lamp installations, it was possible either to save 20 per cent. in the cost or, alternatively, have 100 per cent. more light for the same cost. That point should be emphasised more. As regards the fluorescent type of lamp, he looked forward to the time when this would be used for central areas, and this would come when the restrictions on economy and the amount of energy that might be used were generally raised. The author seemed to have been a little pessimistic with regard to the charge for electricity for street lighting; for all-night street lighting a charge of 1d. per unit was unwarranted, having regard to the fact that current for heating and cooking could be obtained at 1d. per unit. The charge for all-night street lighting should seldom exceed ¾d. per unit.

Mr. F. C. Fuke discussed the paper from a motorist's point of view and reminded Dr. Paterson that on small cars there was no place to fit a visor. He objected to the non-cut-off type of lantern because of the glare which was continually approaching the motorist and then disappearing, and suggested the use of uni-directional lanterns shining across the roadway so that a motorist could judge his position in fog by the direction of the beam.

Mr. Hochmeyer, as a buyer of street lighting, said that from the point of view of preventing glare, the light sources should be of low intensity and development of the cut-off type of distribution with low intensity light sources would enable us to see better, although the cost might be higher.

Mr. Lennox, in the course of his reply to the discussion, said the prevention of glare was entirely one of economics. The difference in cost of spacing at 90 ft. and 120 ft. was an increase of something like 30 per cent., and that was an important item and in many cases, if not all, the ratepayers would not be able to afford it. No doubt everybody at heart objected to the colour of discharge lighting but it was realised that it provided good street lighting which prevented accidents at a minimum cost. Improvement and uniformity in colour were necessary and he was convinced that sooner or later mercury discharge lamps would have a better colour. As to costs of maintenance, there was a great difference between industrial and residential areas and his figures were based on averages. He did not think street lighting should be looked upon solely from the motorists' point of view. That was not the main object; the aim must be to secure the maximum visibility during the maximum time the lamps were alight which involved, of course, illuminating the roadway adequately. Many of the problems of safety on the road called for the use of commonsense, and if a user of a road at night did not exercise commonsense, he should not be allowed on it at all. As to having light across the road instead of down the road, wet weather conditions produced definite light and dark spots with the former, but it was all a question of cost.

Electrical Developments in India

From Our Own Correspondent

PLANS of the Government of Madras for the development of electric power were, on November 3, explained by Mr. Bahadur G. Sundarum, Chief Engineer for Electricity in Madras.

Machkand Hydro-Electric Scheme

A big hydro-electric scheme, he said, has been planned on the Machkand river in the Vizagapatam district, costing Rs. 5 crores in the initial stage, with an installed generating capacity of 52 000 kW. The scheme is to be carried out in co-operation with Orissa and when completed will supply the power requirements of the Vizagapatam, Godavari, Kistna and Guntur districts. A power scheme is projected to meet the demands in the Ceded Districts and the construction requirements of the Tungabhadra dam; later it will operate in conjunction with the hydro-electric station to be established at the dam. A thermal station for the Nellore area is also being planned.

The Madras power undertaking owned by the Madras Electric Supply Corporation will be acquired by the Government in 1947, and additional generating plant is shortly to be ordered to meet the large demand for power expected in the city and its environs. The thermal station at Basin Bridge is to be linked up with the Mettur hydro-station by a 110 000-V line, to be completed by 1947.

A new power undertaking, called the Moyar Scheme, utilising the tail waters of the Pykara station on the Nilgiris is to be built shortly with an installed capacity of 28 000 kW. A 90-mile 110 000-V line will carry power to Eroda and enable the increasing demands of the Coimbatore, Trichy and Tanjore districts to be met. A 66 000-V line is under construction to carry Pykara power to Calicut and Cannanore in Malabar, and will be in service early next year. The Papanasam hydro station will be taken to its final stage by the addition of a fourth generator.

The programme of work along with extensions to the distribution network, Mr. Sundarum said, will cost Rs. 12 crores and will take five years to complete. It will result in doubling the capacity of the power plant in Madras Province. When industrial and agricultural expansion calls for more power, it is proposed to develop the Periyer water-power site and also to build a large thermal station in the South Arcot area, where lignite deposits have been located.

Railway electrification has a big future, especially in South India, which has no coal, said Mr. Sundarum. A programme for Madras suburban line electrification up to Arkonam and Chingleput, and for main line electrification of the more important sections of the M.S.M. and S.I. Railways can be justified on grounds of economy, as well as national fuel conservation and is long overdue, he said. The programme of power and transmission development sketched so far is only for the immediate future, said Mr. Sundarum.

When the public get better acquainted with electricity and realise the enormous contribution which it makes to their well-being and social progress, they will demand more and more of it, and it should not be long before all the available power sites are put to use and connected to the grid. Already it has been agreed to link the Madras network with that of Travancore, and it is hoped that linkage with Mysore will soon be established. The day is not far distant when several Provincial and State networks will all be connected to form a super-Indian grid pooling power from the Himalayan glaciers, from the collieries of Bengal and Bihar, and from the mountain slopes of the Deccan, and spreading to all the villages and towns in India.

At the same time, Mr. J. F. C. Reynolds, general manager of the South Indian Railway, at a Press conference in Madras, pointed out that there may be a considerable development in the near future in the electrification of the South Indian Railway. Mr. Reynolds expressed the view that with the electrification they had at present in the Madras suburban area, and with the prospect of ample high tension current becoming available in the near future from the Pykara grid, the whole of the Madras-Villupuram section and the Arkonam branch line of the railway would be an ideal section to electrify.

New Manufacturing Organisation

An electrical company has been registered in Bengal with an authorised capital of Rs. 5 000 000 and an issued capital of Rs. 3 300 000, to carry on all kinds of business such as that of manufacturers, importers, exporters, assembling, distributors and dealers in radios, radiograms, gramophones, coolers and freezers of all kinds, humidifiers, bare and rubber insulating wires, cables, flexible cords, fuse wires, copper weld and aluminium wires, electric switches and switch-gear, lamps, motors, fans and electric appliances, and plastic and like material products.

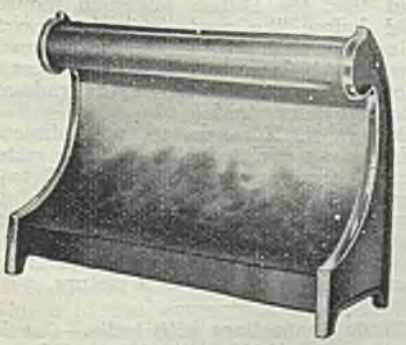
Equipment and Appliances

An Electronic Relay—New Rotary Switch

THE Sunvic electronic relay, type E.A.2, produced by **Sunvic Controls, Ltd.**, of Stanhope House, Kean Street, Aldwych, London, W.C.2, was developed

The Sunvic electronic relay

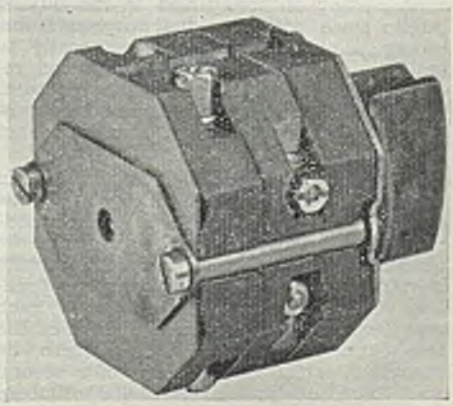
primarily for use with control instruments having light contacts, such as toluene regulators, but it can be adapted to operate with a photo-electric cell, and thus has a wide range of usefulness. Needing only a few micro-watts to operate it, it will, it is claimed, control a load of 2 kW at 200/250 V a.c. The instrument has a cast-aluminium case and incorporates a gas-filled relay, a Sunvic hotwire vacuum switch and thermal delay switch, a mains transformer, a fuse protecting the primary of the transformer, and a pilot lamp to indicate the condition of the load circuit. The control device is connected in such a way that the opening of the



Rosyglow convection radiator

control contacts changes the phase of the grid in relation to the anode, so as to cause the gas-filled relay to fire. The anode current flows through the heater winding of a hotwire vacuum switch which closes the load circuit. When the control contacts close, the gas-filled relay ceases to fire and the hotwire vacuum switch opens the load circuit.

The Rosyglow convection radiator, produced by **A.E.W. Ltd.**, of Imperial Works, High Street, Edgware, is designed so that the air is heated at low temperature and is in constant circulation. The heating elements are enclosed in an air duct of suitable shape to direct hot air all over a room. The front of the radiator is flood-illuminated to give a pleasing effect. Some of the advantages claimed for this apparatus are that it gives safety from burning of persons or clothing, because there are no open elements; the air circulation requires only half the amount of electricity to maintain an even temperature; it is easy to



Diacam rotary switch

clean; the elements will not ordinarily burn out; it is shock-proof; and the running costs are low, the consumption of current being 1 kWh. The radiator can be obtained with either 1 kW or 2 kW loading, the latter giving the alternative of two heats.

The new Diacam 30A double pole, double break, 500 V a.c., rotary switch introduced by **Craig and Derricott, Ltd.**, of Sutton Coldfield, is the outcome of an effort to produce a simple switch, capable of maintenance, embodying the rotary principle and a gang assembly. It has both domestic and industrial applications. It is claimed that the switch assembly makes it possible to achieve a large variety of combinations of circuits. An advantage is

that it is possible to advance one of the poles to operate in the no-volt, or operating coil circuit of starting equipments; this ensures that the starter may be closed or opened before the main contacts of the switch are engaged. The cams mounted on the main actuating shaft are made of high-grade Bakelite. Each is milled with one or several contours and engages the main contacts through the medium of an additional roller moving freely in the section chamber. This additional roller reduces the operating friction and provides single point suspension of the moving contact. By these means true alignment of the contacts is ensured. The cam contours also ensure the latest technical requirements, namely, a quick micro-break with wide isolation and double break on each pole. The switch, which has a body size of 2 in. sq. by 1⅝ in. deep, is produced in high-grade Bakelite. All metal parts are plated and working parts are enclosed in dust-tight housings.

A New Television System

Linking Sound With Vision on Single Carrier Wave

A NEW system of television which enables both sound and vision to be broadcast from the same transmitting unit and to be received in one set in the home is announced by Pye Ltd. The adoption of the new system, it is claimed, would reduce the cost of television both to the broadcasting authority and to the buying public since with the dual-purpose transmitter, a station would be less costly to equip and the combined sound/vision receiver would be cheaper to manufacture. There being no separate sound transmission, the present type of sound receiver would disappear.

When a television transmitter is in operation there are short intervals of time during which no signals are being broadcast. These intervals occur during the time that the spot which traces the picture is returning to its starting point preparatory to making another line, and each represents rather more than 1/10th of the total transmission time. Each of these idle periods lasts for 10 millionths of a second and there are just over 10 000 of them during each second. It is now possible to use the television transmitter during idle periods to transmit the sound programme. This is done by taking a " sound snapshot " of the aural part of the programme whenever the transmitter is not transmitting the vision part of the programme. Using television of the present definition, 10 125 of these " sound snapshots " can be transmitted per second. The " sound snapshot " is really a pulse similar to a radar pulse, which is sent out by the vision transmitter and the width of which is made to vary according to the sound that has to be transmitted. With the new Pye system in operation this modification to the transmitted wave form would enable both the vision and the sound to be transmitted on a single carrier by a single transmitter with a single aerial system. This pulse would be separated from the vision programme in the television receiver and the variation in its width would be made to operate the loudspeaker.

It is claimed that the possibility of interference in the television receiver between the sound and the vision would be eliminated. It would be possible to incorporate automatic gain control, ensuring that the picture would be held steady even during severe fading of the signals. At a later date it should be possible, by using the Pye system, to transmit sterophonic sound. Further developments should lead to colour television being more easily achieved, while in the immediate future this system would enable one station to transmit many sound programmes without any interference, and with the highest fidelity.

Speaking at a demonstration of the system at the company's laboratory at Cambridge on October 31, Mr. C. O. Stanley, the managing director, said that the development would continue the world lead that the British television industry held before the war, and as it would bring receiving sets within the means of considerably larger numbers of buyers, it should stimulate first the export trade and later the home trade.

Mr. B. J. Edwards, technical director, said the material reduction the new system would permit in costs was from 15 to 20 per cent. Mr. D. I. Lawson, head of the research department, said the new development was comparable to that of motion pictures, whereby the sound track is carried on the same film as a picture.

Trade Connections with India.—Cavalay Brothers, of 66, Visveswarapuram, Bangalore City, are anxious to represent in India, manufacturers of electrical goods, more especially motors, dynamos, automatic telephone systems, and meters.

Notes on Plastics

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

POLYSTYRENE is, chemically speaking, a vinyl derivative but, as a plastic, its properties are so different that it is not usually classed with the polyvinyl materials. Chemically, styrene is vinyl benzene, its formula being $C_6H_5.CH:CH_2$ and to the chemist it has been known for well over a hundred years.

It is produced from benzene and ethylene, passing through the intermediate stage of ethyl benzene which is converted into styrene by " cracking " at a high temperature. Styrene is a colourless odourless liquid which has a boiling point of about 150°C. If styrene is heated in the presence of a catalyst it polymerises to form polystyrene; alternatively, heat alone will cause polymerisation. Another method is to dissolve the styrene in an inert solvent and heat it with or without a catalyst. According to the temperature to which the styrene is subjected and the duration of the heating, the polymerisation progresses in stages, the higher the molecular weight of the polymer the higher is the softening point. Polystyrenes with molecular weights up to 350 000 have been produced, but commercially, products with a molecular weight of 80 000 to 100 000 are preferred for injection moulding materials. When the product is to be used in coating or adhesive compounds, much lower polymers of molecular weight of 12 000 to 70 000 are generally used.

Polystyrene is a glass-like thermoplastic material, with a specific gravity of 1.05, i e., lower than most plastics; it posseses extraordinarily good resistance to water and has excellent electrical properties. Commercially it is available as a moulding material in sheet and rod form and in film.

Comparison of Materials

So that a general comparison may be made with the other plastic materials already discussed in this series of articles, the usual table of mechanical and electrical properties is given :—Specific gravity, 1.05; tensile strength, 5 000-9 000 lb. per sq. in.; impact strength, .35 to .50 ft. lb. per sq. in.; volume resistivity, 10^{16} ohms.cms.; dielectric strength, 500-700 V. per mil.; water absorption, .00 per cent. after 24 hrs. immersion, .05 per cent. after 318 hrs. immersion.

Polystyrene can be plasticised by the addition of plasticisers, but the moulding powders usually made contain very little or no plasticiser. It can be moulded by injection just like cellulose acetate, and it can also be extruded. If the moulds are cored for steam-heating and water-cooling, it can be moulded by compression but, except in very exceptional cases, this method of moulding is not used. The natural colour of the moulding materials is that of glass, and in most cases this is the material commonly used. However, if desired, coloured moulding materials can be obtained by the introduction of suitable colouring matters.

Its exceptionally good resistance to water is shown by the water absorption figures quoted above. In addition, polystyrene exhibits excellent resistance to many chemical reagents. It is unaffected by both weak acids and strong alkalis, and it is insoluble in acetone, the lower aliphatic alcohols, in glycol derivatives and in animal and vegetable oils. It is not even affected by hydrofluoric acid or bromine. However, being a hydrocarbon, it is soluble in certain other hydrocarbons such as benzene, toluene and zylene. It is also soluble in certain esters such as ethyl and amyl acetates and in chlorinated hydrocarbons such as nethyllene chloride, trichlorethylene and carbon tetrachloride

Electrical Properties of Polystyrene

However, it is on account of its exceptionally good electrical properties that polystyrene is of importance. Its dielectric constant and its power factor are both low even at high frequencies. According to figures quoted by the suppliers of British-made polystyrene, the dielectric constant at frequencies ranging between 60 and 10^6 cycles is 2.6 to 2.7. Similarly, the power factor (tan 8) up to 60 megacycles ranges between 0.0002 and 0.0004. The volume resistivity is quoted at 10^{17} to 10^{19} ohms.cms., and the surface resistivity as 10^{16} ohms.

Another advantage of polystyrene is that its mechanical properties do not vary much with changes of temperature, say from 40°C. up to 70°C., in fact higher values are obtained for its impact, flexural and tensile strengths and for its modulus of elasticity at low temperatures than at normal temperatures. This has made it a valuable material for electrical components of aircraft, where it is necessary to maintain properties at the low temperatures existing at great heights. Its low specific gravity has also made it valuable for aircraft work.

Much use has been made of polystyrene for the manufacture of various components for radio, television and radar equipment such as coaxial cables, coaxial beads, spreaders, low-loss dielectric plates, insulation, etc. Its resistance to acid solutions has resulted in its being used for parts of accumulators.

The quantity produced in this country has not been very large, with the result that its use has been restricted, during the war, to essential purposes where no more abundantly available material was capable of being used. In America its output is much greater, with the result that it has been more commonly used. Apart from the electrical uses mentioned above, the Americans have taken advantage of its low temperature properties and have used it in refrigerators for doors, frames and other fairly large parts. Availability and our more intense war effort have prevented such uses in this country.

Optical Uses of Polystyrene

Polystyrene also has interesting optical properties. Its refractive index is high, viz., 1.59, and a plate 0.1 in. thick will transmit 92 per cent. of light. The result has been that it has found application in special lenses for light condensers, signal-lights, etc. These may be manufactured either by moulding or casting, and can, of course, be produced in various colours.

The manufacture of polystyrene for optical purposes has, however, been faced with certain difficulties. During cooling, when moulding or casting, strains are set up within the material and tend to spoil it from the optical point of view. Heat is evolved during polymerisation, and unless steps are taken to allow this to escape, and unless the temperature is carefully controlled during polymerisation, the material produced is not suitable for optical purposes. However, the manufacturers have carried out considerable research on these problems and optical material in sheets from $\frac{1}{16}$ in. up to 2 in. thick with an area of 12 in. by 24 in. are now available in America.

Ordinary polystyrene begins to soften at a temperature of about 80°C. (Moortens test), but, in America, a chlorinated compound, polydichlorstyrene, has been developed which is stated to withstand temperatures up to 112°C. before distortion occurs. This material is even more water resistant than polystyrene and it possesses excellent electrical properties at very high frequencies.

Within very recent times polystyrene has been produced in the form of a very thin foil. Output is only on an experimental basis in this country, but the material possesses interesting properties and many applications can readily be visualised.

Another recent development in connection with polystyrene is its production in emulsion form. The emulsions consist of completely polymerised polystyrene together with varying plasticisers, and their use has been suggested in America as a substitute for rubber latex and also as a waterproof adhesive.

Mention should also be made of the fact that styrene can be made to co-polymerise with other polymerisable products, for example butadiene. In fact, the Buna S type of synthetic rubber, commonly known as GR-S, is a co-polymer of styrene with butadiene. GR-S has been used to replace natural rubber in a number of electrical and other applications, such as cable sheathing, battery cases, etc.

Another rubber substitute material, which is a co-polymer of butadiene and styrene, is manufactured in America under the trade name of Hycar OS-10. The product was developed originally on account of its specially good electrical properties, which made it eminently suitable for wire and cable covering and for insulating blankets and pads.

Still another styrene butadiene co-polymer, known as Nubun, has been produced in America for which high dielectric strength and insulation resistance are claimed, as well as low specific conductive capacity.

I.E.E. London Students

About 150 members of the I.E.E. London Students' Section attended a "Brain's Trust" meeting on November 6, when six members of the institution gave entertaining and instructive replies to the several questions put to them by the Question Master, Mr. Shorland, the Section chairman. On the suitability of engineers to manage engineering concerns, it was suggested that whilst engineers with a flair for business might often be successful, the ability of the personnel in other professions, such as accountancy, should be acknowledged. The future of street tramways was next discussed, the view that they had little owing to the flexibility of competing buses being offset by a reminder of their proved safety, reliability and immense load capacity. The economic possibility of high voltage d.c. transmission was another subject, and this caused reference to transverters, rectifiers and inverters, emphasis being made that very high voltages were required for the system to become economic.

A request for information on the best training for a potential electrical engineer brought forth a reminder that a good engineer had a mechanical sense as well as technical knowledge, and that the former was best acquired through practical experience.

The proposal of a vote of thanks to the Trust, Mr. W. N. C. Clinch, Sir Arthur P. M. Fleming, Mr. A. J. Gill, Mr. S. E. Goodall, Mr. J. Hacking and Mr. B. N. Maclarty, brought an interesting evening to a close.

News in Brief

Washing Machines for West Lothian.—The West Lothian C.C. Housing Committee has received a request from householders to instal electric washing machines in new council houses, instead of the normal type wash-boilers. The Council has appointed a sub-committee to deal with the request.

New Housing Equipment.—The Chesterfield Housing Committee has decided that electric immersion water-heaters be installed in all new permanent houses and that in future permanent houses gas and electric points for a refrigerator be installed, but that no refrigerator be supplied in the first place.

Post Office News.—More telephone operators are being trained at Post Office schools in London at present than at any time in G.P.O. history. Over 1 200 recruits are under tuition. About 15 000 telephone engineers are still in the Forces, and the Post Office has a telephone waiting list of over a quarter of a million applications.

Electrical Engineering Society. — The annual general meeting of the society was held at the S.E. London Technical Institute, on October 22, and was the first since the outbreak of war, when the society's activities were postponed. A return to its former strong position has been accelerated by a keen membership, and by the efforts of the officers and committee who were unanimously re-elected.

Magnus Maclean Memorial.—Glasgow University and electrical circles are raising funds for the establishment of a memorial to Dr. Magnus Maclean, of the Chair of Electrical Engineering at the Royal Technical College, Glasgow, for 25 years. He was as a young man, one of Lord Kelvin's most capable students and later assisted the great scientist in his researches over a period of fifteen years.

London Heating Plan.—At a meeting of the City Common Council at the Guildhall, on the motion of Sir George Elliston, the Improvements and Town Planning Committee was instructed to report on the practicability of including in the rebuilding plans a scheme for district heating. This would involve the erection of generating stations to meet central heating and domestic hot-water requirements. Major S. E. Sandle said that it would be more economical to obtain hot water by electric immersion thermostatically controlled.

Institute of Welding Victory Dinner.—A victory dinner is being organised by the West of Scotland branch of the Institute of Welding to take place on December 7, in the Royal Arch Halls, Edinburgh. Among the guests who will attend are Mr. W. Wallace, president, Edinburgh Chamber of Commerce, Principal Smail, Heriot Watt College, Mr. J. Thomson, Mr. A. Dyson, vice-president Institute of Weldings, and Mr. G. Parsloe, secretary, Institute of Welding.

I.E.S. Lunch.—To mark its foundation, the Liverpool Centre of the Illuminating Engineering Society held an inauguration lunch at the Adelphi Hotel, Liverpool recently, under the chairmanship of Mr. A. E. Darlington, when its members were congratulated by the president of the society, Mr. H. C. Weston, on the speed with which, following their formation in 1944, they had been promoted to the status of a centre. The principal speaker was Mr. J. Eccles, the city electrical engineer.

Newcastle Technical Exhibition.—The National Trades' Technical Societies are organising a technical exhibition for the fortnight beginning February 10, 1946, in the Northumberland Road Drill Hall, Newcastle. Member firms of the Scientific Instrument Manufacturers' Association and the Gauge and Toolmakers' Association will take part, and some new exhibits of unique scientific interest will be on view. As an added attraction, technical films will be shown in the side hall adjoining.

E.I.B.A. Ball

THE Victory Ball of the Electrical Industries Benevolent Association, which was held at Grosvenor House on November 9, was generally voted to be a brilliant success, 660 people being present. The president, Mr. J. N. Stephens, in a speech of welcome to the guests, said that during the whole war period the association had maintained its proud boast that no deserving case had gone without assistance, and by this he meant not mere monetary help.

He was very pleased that there were present Mr. E. E. Hoadley and Mr. P. V. Hunter, who between them had so splendidly occupied the Presidential Chair in the first five war years and had all the president's work and none of its peace-time compensations.

The cabaret artists were Margaret Eaves, Michael Howard and Jack Train, and the dancing was to Jack Payne's orchestra, Jack Payne himself being unable to be present owing to illness.

The function had to be held in the ballroom, which will not accommodate so many as the Great Hall, used in previous years. In consequence, many applicants for tickets were too late. It is hoped, however, that by next year the larger room, which is now occupied by the American Embassy, will be available.

Book Reviews

Alternating Current Motors and Control Gear. By C. H. CLAUDE COOK. (London: Crosby Lockwood). Pp. VIII + 88. 5s. net.

This little book is intended for apprentices and wiremen who have little or no theoretical knowledge of the subject and it is therefore almost entirely descriptive. The early chapters describe the construction of a.c. motors, types of foundation, methods of transmitting the drive, and give brief details of the characteristics of the 1-phase and 3-phase motors (including fractional-horse-power motors) which are in common use. A chapter on starters and overcurrent and low-voltage protective gear follows, and is succeeded by a useful section on installation work. The elementary nature of the book makes an explanation of power factor difficult, but the author tackles this directly rather than by the use of the somewhat ludicrous analogies which are often found in books of this nature. The final chapter discusses maintenance, and stresses the need for routine inspections and the keeping of careful records. We can recommend the book to those for whom it is intended, particularly perhaps to those who have picked up a smattering of electrical knowledge in the Forces and who now find themselves concerned with the care and maintenance of electrical plant in civil life. E.O.T.

Report on the Market for Household Appliances.—By P.E.P. (Political and Economical Planning). (London: Oxford University Press) 18s. net.

At the request of the Board of Trade, P.E.P. undertook in 1943 to investigate the post-war demand for household appliances and this book is based on the material collected. In addition to providing statistics relating to the number of appliances in use before the war and the annual sales, the book deals with the design of the appliances, the principal manufacturers and retail selling prices. It goes on to consider the types and design of appliances likely to be required after the war and also to estimate demand, in relation to the selling price at which the appliances are likely to be available.

The book deals with cooking, space and water heating appliances, home laundry equipment, vacuum cleaners, storage equipment, including refrigerators, together with subsidiary chapters on lighting fittings, hair driers, motor car heaters, electric dry shavers, and so on. This book is a practical contribution in a field which is commanding a great deal of attention at the present time, though not in all cases does the reviewer agree with the conclusions reached. One of the objects of the survey was to provide material for assessing the prospects of employing after the war the additional light engineering capacity brought into being by war needs, and already a proportion of the Government factories released has been allocated to the production of household appliances.

"Distribution and Utilisation of Electricity."—By E. O. Taylor. (London, Blackie and Son). Pp. 162. 6s. net.

This book has nine chapters, and is divided into two parts. Part I—Distribution, covers Layout and Construction; Circuit Calculations; Voltage Regulation and Control; Faults: Prevention, Clearance and Location; Tariffs and Metering. The author has attempted to deal in a broad sense with the layout of distribution systems—both overhead and underground—but the information given could be usefully expanded. Sub-station design and construction is introduced, and the various types of equipment outlined. Chapter 2, dealing with circuit calculations should prove of special interest to students. Chapter 5—Tariffs and Metering, is useful as an introduction to the subject, but here again the inclusion of further information would enhance the value of the book. Part II—Utilisation, covers Industrial Electric Drive, Electric Heating, Illumination, and Factory Power Supply. The various types of motors and enclosures are dealt with, together with methods of speed control. The chapter on Electric Heating includes Resistance Ovens, Induction Furnaces, Arc Furnaces, Dielectric Heating, Electric Welding and Building, and Domestic Heating. Lamps and Lighting Calculations are briefly touched on in Chapter 8, whilst the book concludes with a short chapter outlining the fundamentals of Factory Power Supply.

From the students' viewpoint, the questions which are appended to each chapter should prove of value in preparing for examinations leading to the City and Guilds and Ordinary National Certificates. A set of answers to these questions is also included.

The author in his preface quite rightly states that the distribution and utilisation of electricity is a wide subject and only the basic principles can be touched upon in the present volume. Keeping this in mind, the volume should serve as a useful introduction to this branch of the supply industry, and prove of value to students and juniors engaged on mains and substation work. T. H. C.

Electricity Supply

Hull.—The Electricity Committee is seeking sanction to borrow £50 000 for mains and services.

Burton-on-Trent.—The Health Committee is to renew wiring and fittings at the swimming baths at a cost of £110.

Sheffield.—The Electricity Committee has obtained sanction to borrow £19 202 for mains for temporary houses.

Stockton-on-Tees.—The Corporation has received sanction to spend £770 on switchgear for the Thompson Street sub-station.

Newcastle-on-Tyne.—The Tyne Improvement Commission is to spend £1 200 renewing the electric lighting arrangements at the Bergen transit shed.

Barnard Castle.—The Cleatham P.C. has asked the North-Eastern Electric Supply Co., Ltd., to supply electricity to the district for domestic and street lighting.

York.—Supply is to be provided to Cettal Village, South Marton Farm, Stillington, and Carlton Farm, Nun Monkton by the Corporation at a cost of £2 263.

Torquay.—The Electricity Committee has obtained sanction to borrow £6 763 for an overhead line from Newton Abbott to Torquay, and is seeking sanction to borrow £32 200 for power station extensions.

Lichfield.—Sanction to borrow £1 475 for mains and £1 115 for sub-station equipment, has been obtained by the Electricity Committee. Mains are to be extended to the Ponesfield housing estate at a cost of £1 050.

Chesterfield.—The Electricity Committee has decided that the assisted wiring scheme for lighting be made available to consumers at a charge of 5s. per quarter and also, on the same conditions, as an assisted wiring scheme for heating points at a charge of 1s. per quarter per point.

Mansfield.—In connection with the coal adjustment clauses the Electricity Committee has decided that the additional charge of .015d. per unit per shilling per ton increase in the cost of coal shall be amended to .013d. to all consumers supplied under special tariffs embodying a coal clause.

Cardiff.—At a meeting of the Parliamentary Committee, the Town Clerk reported as to an interview with the Electricity Commissioners regarding the obtaining of powers to acquire the Penarth electricity undertaking, and the Committee decided to promote a Bill to enable the corporation to purchase the undertaking.

Torquay.—Councillor Langdon, at a meeting of the Electricity Committee, raised a question as to the inability of consumers to obtain cookers for hire, and the Electrical Engineer reported that the Electricity Commissioners made it a condition that any cookers purchased by the undertaking must be sold to consumers, and not hired under present conditions.

Power Station Extensions.—Proposals are under discussion for extending the North Tees power station belonging to the North-Eastern Electric Supply Co., Ltd., by the installation of two 60 000 kW turbo-alternators. Two 50 000 kW turbo-alternators are to be provided at Dunston power station. These two extensions are expected to meet the electricity needs of the north-eastern area for several years.

Sheffield.—At a meeting of the Electricity Committee it was reported that a direction had been received to extend the Neepsend generating station under the programme of 1949 by the installation of one 50 000 kW turbo-alternator with ancillary plant, three boiler units, and the necessary buildings, and one cooling tower. The cost will be borne by the Central Electricity Board until such time as the load justifies the extra plant.

Bangor (N. Wales).—The gross profit of the electricity undertaking for the past year was £12 765, but after allowing for loan charges, income tax, etc., there was a deficit of £535. As the result of negotiations with the North Wales Power Co., regarding the charges for bulk supply, it is expected to obtain a net refund of approximately £1 600 in respect of the years 1939-1944. In the year 1944-45, the Corporation purchased 2 000 000 units less than in the previous year, but had to pay £1 000 more for it.

Barrow-in-Furness.—At a meeting of the Electricity Committee the Town Clerk submitted correspondence with the Electricity Commission with regard to the proposed introduction of a new tariff for supply to cinemas, shops and business premises, and stated that the introduction of an alternative tariff did not call for any approval, but that the compulsory application of such tariff to cinema consumers would require approval by the Ministry of Fuel and Power. The Committee decided accordingly to seek such approval.

Oxford. — The city electrical engineer and manager, Col. H. G. Fraser, in his annual report stated that the quantity of energy sold during the year within the Corporation's area of supply amounted to 54 698 069 units, against 51 731 606 last year. This was a record for the undertaking, being 192 125 units more than the previous highest figure, which was obtained during 1942. That brought the average number of units sold per annum during the last five years of war to over

fifty millions. The accounts for the year showed a loss of £8 141, and Ald. F. G. Blackler, the chairman of the Electricity Committee, has warned consumers that in the near future it will be necessary for the Committee to revise the charges.

Leeds Inquiry.—The Electricity Commissioners recently opened an inquiry at Leeds to consider an application by Ilkley U.D.C., supported by 20 other authorities, for a determination under Section 12 of the Electricity Act, 1926, and a direction under Section 3 (2) of the 1935 Act, as to the payment which should be made. The case for the applicants was that the charges payable to the Yorkshire Electric Power Co. for bulk supplies were too high, and that, although agreements were subject to information being supplied that would enable the local authorities concerned to assess the costs, the information had not been given. The Councils concerned contend that it would be in the general interest if the electric transmission lines, cables, voltages, and sub-stations were pooled for the purpose of ascertaining charges and allowances in respect of the transmission component under the Electricity (Supply) Act, 1926. Mr. Cope Morgan appeared for the applicants and Mr. Sydney Turner, K.C., for the Yorkshire Electric Power Co. At the end of the hearing the Chairman said that, while reserving their decision on disputed points, the Commissioners were satisfied that it would be in the general interest to give a direction subject to any limitations they might find necessary. There were some complicated matters to consider, and he urged all concerned to furnish any further information available without delay in order that the inquiry might be expedited.

Farm Electrification Campaign.—Mr. J. C. Leslie, agricultural adviser to Edmundsons Electricity Corporation, recently attended a meeting of the Wiltshire N.F.U. Executive at Devizes for the purpose of inviting the executive's co-operation in a county-wide instructional campaign. He said Edmundsons, on their side, were prepared to help to the full, and pending the appointment of public instructors they would provide qualified technical staff to assist in any way desired. He emphasised the necessity of a full understanding of how electricity could be applied to various farm practices, with a consequent saving in cost and labour, together with a working knowledge of the type and maintenance of equipment best suited to their purpose. Confidence must be established between the industry and farmers, and this would result if the latter knew something of the fundamentals of the distribution system, of the capital costs involved, and how annual revenue must be related to capital and standing charges. The suppliers, on their side, must see and understand the farmers' problems. A Liaison Committee, consisting of representatives of N.F.U. Headquarters and the Power Companies' Association, had been established with the express object of bringing about mutual understanding and co-operation. Difficult cases would be referred to this committee. The association, whose companies distributed electricity throughout nearly 75 per cent. of England and Wales—mostly rural territory—was sincerely anxious to develop farm electrification. The power companies had promised to extend distribution to remote rural areas and isolated farms as soon as labour and materials were available; and to minimise, and wherever possible avoid, capital contributions.

Fuel Exhibition

TO emphasise the continued necessity for the public to save fuel, and the need for coal to help in the reconstruction of British industry and trade, an exhibition under the title of "Other Peoples' Jobs," is being held by the Ministry of Fuel and Power at the Army and Navy Stores, London, S.W. It was opened by Mr. Emmanuel Shinwell, Minister of Fuel and Power, on Tuesday, and it will continue until November 24. Then the exhibition will visit various centres in Southern England and Wales, the South Midlands, and Eastern area, commencing at Bournemouth. A similar exhibition will be opened at Glasgow on December 5, and will go to Edinburgh, the North of England and the North Midlands.

The exhibition includes a working model of trucks of coal passing from a mine to a power station, complete with cooling tower and switchgear. An electricity display unit shows domestic, industrial and public services, increasing by stages the load on the power station, until a red light on a dial indicates the danger point and automatically switches off the current.

There is also an electric milker shown in the dairy of a model farm, and an electrical-planned kitchen is incorporated in a housing display.

WILLOW HOLME EXTENSIONS

In the description, in our last issue, of the Willow Holme power station extensions, it was stated that the work was designed and supervised by Mr. A. C. Thirtle, city electrical engineer and manager. This is, of course, incorrect, for Mr. C. W. Salt held the post of city electrical engineer for Carlisle from 1919 to 1944, and he, not Mr. Thirtle, was responsible for the whole of the design, work and supervision until its near completion, in collaboration with the consulting engineers, Messrs. Kennedy and Donkin.

On-Load Tap-Changers

Some Notes Which If Acted Upon May Save Trouble

FOR the purposes of maintenance a tap-change transformer should be treated as two independent units. Being a static unit, the transformer proper only requires the minimum of maintenance to operate continuously without trouble. In the case

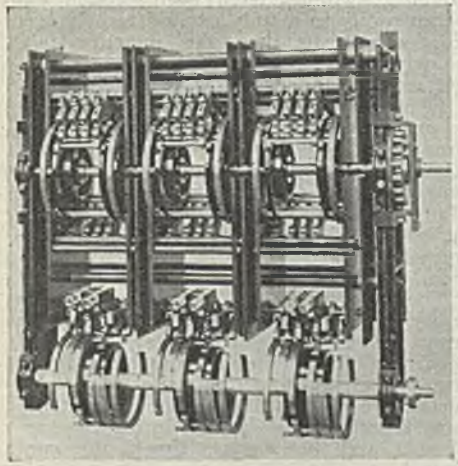


Fig. 1.—Dual-drum on-load tapping switch equipped with mercury switches

of the tap-changing unit, however, this is a mechanical device which may, like all other mechanical devices, give trouble for the want of a little occasional attention. It also has to make and break current and should therefore be regarded as an oil switch.

A certain amount of carbon is always present in the oil under which contacts are required to deal with current—no matter how small. Part of the carbon settles on the mechanism, and insulators—particularly the horizontal surfaces—and at the bottom of the tank, while the remainder goes into suspension; this suspended carbon has little influence on the electric strength—unless a certain amount of moisture is also present. Carbonisation may not then be detectable by an electric strength test of the oil, but the deposited material may provide a creepage on insulators which may lead to tracking and, eventually, breakdown. It is therefore essential to open up the tap-changer occasionally to remove the deposited carbon; and to treat the oil before replacement by some purifying method.

Contacts should be inspected at least once a year or every 5 000 operations. Any fingers and/or segments badly roughened by arcing should be smoothed off with a file. If badly burnt the finger tips and/or segments should be renewed. The essential requirement is that the original profiles of the finger tips and the segments should be maintained so as to ensure correct relative motions and adequate line contacts at suitable pressures. The gear should be operated by hand step-by-step and contacts checked in each position.

To avoid the frequent maintenance of contacts and oil, The British Electric Transformer Co., Ltd., have in recent years, re-designed their drum type tap-changers to incorporate a mercury switch as the sparking contact. These switches have been used for a long time but they have certain disadvantages when used as the sole means of carrying the load current. This is due to the fact that if the current exceeds a certain value—as might occur under short-circuit conditions on particular systems—the mercury is subject to "pinch" effect, the mercury parting and opening the circuit. Directly the circuit is broken, the "pinch" effect disappears and the mercury recloses, thus setting up a make-and-break cycle at comparatively low frequency, the latter

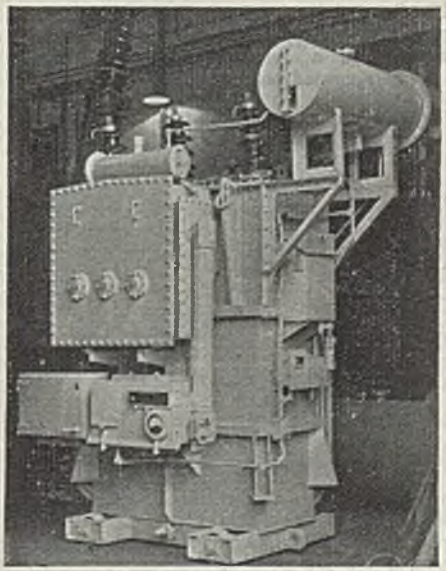


Fig. 2.—ON transformer, 500 kVA, three-phase, 50 cycles, 33 000/11 000 V, star/star delta tertiary, fitted with fully automatic on-load tap-changer, type MOA

depending mainly on the volume of mercury in the switch. In the company's tap-changers the mercury switch is arranged as a sparking contact only. It makes the circuit in advance of the main contacts and breaks it after they have opened. Thus there is no burning of the

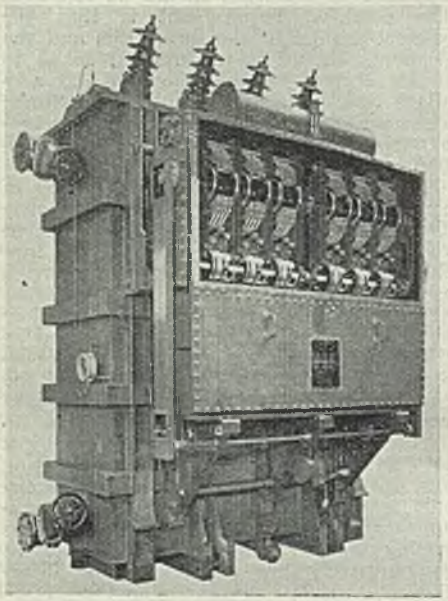


Fig. 3.—ON transformer, 10 000 kVA, three-phase, 50 cycles, 6 300/30 500 V, delta-star, fitted with a double type, MOA, hand-operated on-load tapping unit

contacts or oil, the spark being taken wholly on the mercury. But at the same time, the mercury switch is short-circuited in all operating positions so that in the event of a heavy through short-circuit current, this is not carried by the mercury switch but by ordinary metal to metal contacts.

Although the mercury carries part of the load-curent for a fraction of a second only, there is a remote possibility of a system short-circuit occurring at the moment when the mercury switch is not short-circuited by the copper contacts. In such a case, any opening of the circuit due to the " pinch " effect is only anticipating the normal operation of the switch, and since one end of the auto-transformer is connected to the winding through copper contacts, there is little possibility of interrupting the whole of the circuit. A typical tap-changer of this make is shown in Fig. 1. The upper drum is the tap selector unit and is driven from an operating shaft by reduction gear. The lower drum transfers the load from one tapping to the other and is fitted with the mercury switches. The mercury switches have been selected and rated for the duty which they have to perform, and the replacements that have been necessary during several years of operation have been quite negligible. It should be noted that in the event of a breakage, the tap-changer becomes in effect the earlier type where the sparking takes place in the oil and at the metal contacts. Thus no interruption to operation of the gear results. Mercury switches have been broken experimentally in a fully excited tap-changer to demonstrate that the mercury falls quickly to the bottom of the casing without causing any flashover or other failure.

Experience with these two equipments is put forward by the company as confirming a claim that deterioration of the oil and the necessity for periodic maintenance has been practically eliminated. Many tap-changers examined after tens of thousands of operations have, we are informed, proved to be in excellent condition.

The mechanism is mounted on the transformer as shown in Fig. 2. In the front cover three portholes are provided to give a view through a toughened glass window, of the mercury switches of each phase. Inspection of the mercury switches can therefore be made during a tap-change, and their correct functioning confirmed.

With the British Electric Transformer tap-changers employing mercury sparking contacts, if the first examination after 15 000 operations, or one year, shows wear to have occurred, and that the mercury switches are in good order—effectively preventing sparking at the metal to metal contacts—the interval before the next inspection may be increased considerably.

Clearly, maintenance will be minimised by avoiding unnecessary operations. For this reason attention should be given to time-delay setting of voltage relays associated with automatically-controlled tap-changers. These may operate more frequently than is really necessary to maintain satisfactory voltage regulation, due to a response to voltage variations which persist for only a few seconds longer than the existing time delay. The time delay required should be determined in relation to the particular conditions.

Army Engineering Course.—A course for members of the Dominions and Allied Forces arranged by the British Council at Shrewsbury, from November 26 to December 1, includes visits to the Technical College, the Shelton Waterworks, the West Midland Joint Electricity Authority's establishments, and the works of the Sentinel Co. and the Chatwood Safe Co.

Industrial Information

Anglepoise Lamps.—As from November 5 last, it was no longer necessary for intending purchasers to obtain the approval of the Board of Trade before placing orders for Anglepoise lamps manufactured by Herbert Terry and Sons, Ltd., Redditch.

Change of Address.—The Electric Construction Co., Ltd., have had to vacate their premises at 416/9, Cecil Chambers, London, W.C.2, and the London and district sales office address is now 61, Catherine Place, Westminster, S.W.1.

A Brighton Sub-Branch.—The London Electric Wire Co. and Smiths, Ltd., announce that they are opening a sub-branch office and stores at 16, Market Street, Brighton (Telephone: Brighton 4850), in the near future, the provisional date being November 19.

Production and Engineering.—In this month's bulletin issued by the Ministry of Labour and National Service are given further glimpses of life at the Ministry's rehabilitation centre at Egham. Other articles deal with safety floors for factories, overhead conveyors for internal works transport, safeguarding drop hammers, and developments in "lofting."

Clydeside Development Scheme.—The Clyde Navigation Trust has announced a big scheme involving the development of the south side of the river from King George V Dock to Renfrew, in which area sites have been allocated for new industries. Among some 29 concerns to whom sites have been allotted are Scottish Cables, Ltd., and the Central Electricity Board.

Factory Allocations.—Sixteen more Government factories have been allocated by the Board of Trade for civilian production. They include one at St. Albans allocated to Marconi Instruments, Ltd., for the production of measuring and testing apparatus, and medical supplies; two at Oldham to the General Electric Co., Ltd., for the manufacture of fluorescent tubes; one at Castlereagh to the British Vacuum Cleaner Engineering Co., Ltd., for the production of vacuum cleaners; and one at Castlereagh to P. R. Mallory and Co., Ltd., for the production of Drycel batteries.

Grouped Motor Control Gear.—In a paragraph on page 452, in our issue of October 26, referring to a new publication issued by the British Thomson-Houston Co., Ltd., describing their grouped motor control equipment, the displacement of the word "not" altered the sense of the second sentence. This should have read: "With the cubicle form of construction it is not always necessary to separate one control equipment from another; but it is often desirable to be able to attend, with safety, to any individual sub-unit without having to shut down the complete installation."

Pooling of Technical Resources.—To enable them to compete more keenly in the world's markets for Diesel-electric rail traction, a number of British firms have agreed to pool their research and technical resources. The companies are: Associated Locomotive Equipment; Petters Ltd.; Mirrlees, Bickerton and Day, Ltd.; J. and H. McLaren, Ltd.; Oil Engines (Coventry); Brush Electrical Engineering Co., Ltd., and other members of the Associated British Engineering group of companies. Among important orders already received by this group of companies is one for over £250 000. It includes a high-speed train capable of 100 m.p.h. and incorporating the latest safety and comfort devices.

Forging Aluminium Alloys.—A booklet dealing with the manufacture and production of aluminium-alloy forgings and stampings, prepared by the Technical Committee of the Wrought Light Alloy Association has been published by the Aluminium Development Association. To those approaching the problems of forging aluminium alloys for the first time it will prove invaluable, since it presents concisely and in detail all the facts relevant to the manufacture of good quality light alloy forgings. It will also be useful to those who have had experience of the working of the metal. The brochure is lavishly illustrated with photographs, line drawings and graphs, and much information is presented in tabular form.

Goods Imported From Italy.—In relation to goods imported from Italy, post-liberation sterling accounts have been opened by the Banca d'Italia with the Westminster, National Provincial, Lloyds, Barclays and Midland banks and with the Bank of England; the Banca d'Italia are understood to be applying a rate of 400 Italian lire to the £. Payment by the United Kingdom importer in accordance with the contract terms can be made to these accounts through normal banking channels. Importers are reminded of the necessity of complying with the United Kingdom exchange control requirements, full details of which can be obtained from any bank. Import licences will not, in general, be granted for goods not, for the time being, licensed from other countries.

Plant and Equipment for India.—The Government of India have established in the United Kingdom, under the High Commissioner for India, a new organisation to

assist in the sponsoring and supply to India of plant, machinery, equipment and other goods. Mr. P. C. Chaudhuri has been appointed in charge of the organisation, and offices have been opened at 45-47, Mount Street, London, W.1. The work of the new organisation will cover the registration, co-ordination and processing of all import licences; sponsorship under consumer goods scheme, or under sponsorship arrangement; programming and progressing of requirements of machinery, plant, equipment and other goods as, for instance, heavy electrical plant scheduled through the Central Technical Power Board; all other power plant, including boilers, etc.; refrigeration machinery; wireless and tele-communications equipment.

Aluminium Domestic Equipment.—The Rolls-Royce aluminium foundries at Hillingdon, Glasgow, are to produce domestic equipment of every type.

Fuel Efficiency News.—In this month's issue of the Ministry of Fuel and Power's leaflet opportunities afforded by reconstruction, expansion or modernisation planning for ensuring that fuel and power are used to the best advantage in works and factories are stressed. It is pointed out that factory insulation not only saves fuel, but permits better standards of heating, and keeps the building cooler in summer.

E.T.U. Problems.—Two world wars had called for modification in the structure of the Electrical Trades Union, declared Mr. T. L. Haxell, presiding at a specially convened rules revision conference of the union in Cardiff on Monday and Tuesday. Mr. E. W. Bussey, general secretary, in introducing the proposals of the Executive Council, said he felt they would enable the union to deal with the problems of ensuring that 25 000 members who were in the Forces got back their pre-war jobs; secondly, while protecting the interests of the members, to be fair to those who had rendered service within the industry during the war, and endeavour to fit them in if they desired to stay in the industry; thirdly, to give an opportunity to people in the Forces who had a high degree of electrical training for exercising their skill in industry, and also to include those who were being trained under the Government's rehabilitation schemes. Over ninety delegates and officials attending the conference were given a civic welcome by the Lord Mayor (Ald. Walter R. Wills) and entertained to tea after the Monday's session.

Control of House Fittings.—Under the powers vested in the new Department of Housing Supplies of the Ministry of Supply, and the Ministry of Labour, all engineering components for houses, as distinct from bricks, cement, lime, timber and tiles, are to be ordered in bulk, distributed and standardised and have their quality and prices controlled by the Government during a period of emergency which may last five years. They will be supplied to temporary Government housing schemes and permanent prefabricated houses and to local authorities for housing schemes. Among the materials and components that come under the scheme are: Electric ceiling blocks, ceiling roses, cookers, fires, immersion heaters, lamp-holders, motors, plugs, sockets, socket boxes, switches, switch boxes and fuses, thermostats, wash-boilers and water heaters, auxiliary, and refrigerators.

Prototype Appliances

THE prototype electric cooker and washing machine on show at the English Electric Co.'s War Activities Exhibition, at Queen's House, Kingsway, London, which is to be opened to the public on November 19, and was briefly described in our last issue, are of the universal 36 in. height and are designed to fit into a planned kitchen. The aim of the company in its production of kitchen equipment is to enable the many consumers whose means do not permit of their acquiring a complete planned kitchen set in the first instance to buy individual appliances to fit into such an arrangement as they can afford them. The upright cooker is of the family size with two boiling plates and a griller, and reasonable oven capacity. The loading of the boiling plates with which the new cookers will be fitted will be such, it is claimed, that they will equal in speed anything that the gas industry can produce and the heat will be variable from high to simmering.

In the new model washing machine particular attention has been paid to the motor gearing for the wringer and agitator. It is in a compact form and easy to service.

Electric fires of novel design are also displayed. A two-bar transportable model is so designed that the heat is radiated at the sides as well as in front. Another has the appearance of an ornamental glass fire screen. It can be placed anywhere in a room. The electrically heated panel consists of two sheets of Armourplate glass. On one side of each is sprayed a metallic ribbon having a definite known resistance. The glasses are then placed back to back with a small air space in between them to form a complete heating unit having a total surface area of about 5.8 sq. ft. The loading of these panels, connected in series, is 1 000 W.

In addition, the company's range of manufactures will include electric storage heaters, circulators, ordinary fires, plate warmers, irons and so on. They are also doing a big business in heavy duty hotel cooking equipment.

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.

Bury T.C., November 19.—Supply and delivery of two 750 kVA, 6 500/400/23 V, 3-phase transformers. Specification from Mr. J. G. Potts, Electricity Department, Market Street, Bury.

Bradford City Council, November 23.—Supply, delivery and erection of one 30-ton electrically-operated overhead travelling crane. (Contract " C.37.") Specification from Mr. T. H. Carr, Electricity Department, 27, Bolton Road, Bradford.

North-West Midlands J.E.A., November 26.—Supply of outdoor type static transformers (No. A.278), electricity supply meters (No. A.279), spraying of cooling towers (No. A.281). Specifications from Mr. F. Favell, York Chambers, Kingsway, Stoke-on-Trent; deposit, £2.

Manchester City Council, November 26.—Supply, delivery and erection at Stuart Street generating station of six capstans and bollards (Spec. No. 840), and surge and make-up water cast-iron tanks, etc. (Spec. No. 841). Specifications from Mr. R. A. S. Thwaites, Electricity Department, Town Hall, Manchester; deposit, £1 1s.

Kettering Electricity Department, November 28.—Supply of e.h.t. and l.t., p.i. lead-covered armoured cables for the period of 15 months ending March 31, 1947. Specification from Mr. C. Burns, Rockingham Road, Kettering; deposit, £1 1s.

Bedwellty U.D.C., December 1.—(1) Supplying and laying approximately 1 000 yards of 3 in. cast-iron main; (2) supplying and erecting 11 000 V switchgear, underground cables, and overhead lines. Particulars from the Electrical Engineer, Electricity Showrooms, High Street, Blackwood.

Southend D.C., December 3.—Supply and delivery of l.t. cable for 12 months commencing January 1, 1946. Specifications from Mr. A. C. Johnson, Electricity Works, London Road, Southend-on-Sea.

North of Scotland Hydro-Electric Board (Distribution Scheme No. 1), December 10.—Supply, delivery and erection of h.t. and l.t. distribution lines. Specification from Mr. T. Lawrie, 16, Rothesay Terrace, Edinburgh, 3; deposit, £2 2s.

Sheffield Electricity Department, December 31.—Supply and delivery of two 600 kVA, 11/440 kV, 3-phase double wound self-cooled transformers. Specification from Mr. John R. Struthers, Commercial Street, Sheffield, 1; deposit, £2 2s.

Overseas

State Electricity Commission of Queensland, December 10.—Supply, delivery, erection, and setting to work of 7 500 kW and 750 kW steam turbo-alternators, accessories, and evaporating plant at Wide Bay Regional Electricity Board, Maryborough; Capricornia Regional Electricity Board, Rockhampton; and Townsville Regional Electricity Board. Tender forms from the Agent-General for Queensland, Queensland Government Offices, 409-410, Strand, London, W.C.2.

Eire Electricity Supply Board, January 28.—Supply, delivery and erection of the hydro-electric generating plant at Cathaleen's Fall and Cliff stations on the River Erne. Particulars from the Chief Design Engineer, Electricity Supply Board, 26, Lower Fitzwilliam Street, Dublin, C.18, deposit, £5 5s.

In Parliament

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

Wireless Sets (Adaptor Units).—Sir S. Cripps informed Colonel Erroll that arrangements have been made with the manufacturers under which the war-time civilian receivers can be modified to receive the long wave programme. Those who wish to have their sets adapted should get in touch with their retail suppliers. A separate adaptor unit for the sets is also on the market at a price of 43s. including Purchase Tax.

Future of Television.—In a written reply to Mr. Freeman, Mr. E. J. Williams said he was now taking steps to set up an Advisory Committee on Television on the lines recommended in the Hankey Report. Until this Committee was constituted and had taken stock of the position, it would be premature for him to make any statement on future television arrangements. Meantime, the B.B.C. was getting together the necessary staff for the service.

Gas and Electric Cookers.—Replying to Major Lloyd, who asked what was the present annual output capacity in gas and electric cookers in this country, Mr. Wilmot stated that the approximate present annual rate of output of gas and electric cookers is respectively 100 000 and 60 000. Potential capacity is considerably higher, but production is at present restricted by the shortage of labour, particularly in the iron foundries. All possible steps are being taken to improve the position.

Company News

GLENFIELD AND KENNEDY, LTD.—Intm. div. 5% (same).

REVO ELECTRIC CO., LTD.—Intm. div. 5% (same), payable, less tax, Jan. 1.

WARD AND GOLDSTONE LTD.—Intm. on ord. 15% (10%) for yr. ended Mar. 31.

ANGLO-PORTUGUESE TELEPHONE CO. LTD.—Intm. on ord. 3%, less tax (same).

R. AND J. DICK, LTD.—Ord. div. 15% less tax (10%). Net pft. £18 125 (£14 702).

BURCO LTD.—Fst. and fin. 20%, less tax (15%). Net pft. to Sept. 30, £21 968 (£16 477).

GUEST KEEN AND NETTLEFOLDS LTD.—Intm. div. 4%, less tax (same), for yr. ending Mar. 31.

FERRANTI LTD.—Fst. and fin. div. on ord. 6% tax free (same) for yr. ended June 30. Net pft. £95 678 (£96 237).

DRAKE AND GORHAM LTD.—Fst. and fin. div. on ord. 5% (same), less tax. Net pft. for yr. ended June 30 £12 104 (£10 173).

T. W. WARD, LTD.—Fin. div. on ord. 6¼% (same), mkg. 10%, less tax (same) for yr. ended June. Net pft. £134 696 (£120 447.)

GREAT NORTHERN TELEGRAPH HOLDINGS.—For yr. ended June 30, dirs. anticipate being able to pay a div. of 17% or Kr.9.18 per sh. of Kr.54 (£3). Paymt. is subject to receipt of a div. of 20% for 1944 from the operatg. co.

SYDNEY S. BIRD AND SONS, LTD.—Intm. 20%, less tax, for 15 mos. to Dec. 31, next (fst. and fin. 30% to Sept., 1944), payable Nov. 28.

EVER READY CO. (GT. BRITAIN), LTD.—Intm. on ord. 15% (same), and on 7% cum. partg. pref. 5% (same), both payable Dec. 1 to holders reg. Nov. 3.

CRABTREE ELECTRICAL INDUSTRIES.—Fin. div. 5% (same), and bonus 7½% (same), makg. 17½% (same) for yr. to Oct. 31, 1945. Pft. £77 982 (£72 439).

OLIVER PELL CONTROL, LTD.—After inc.-tax and E.P.T. £33 500 (£33 000), deprcn. £4 652 (£5 006), etc., net pft. to Mar. 31. £5 801 (£4 750), plus £3 016 (£516) brot. in.

ATLAS STEEL FOUNDRY AND ENGINEERING CO., LTD.—Fin. div. 17½%, and bonus 10%, makg. 42½% (same). Pft. to Sept. 30 £24 918, after credtg. E.P.T. refund £15 000.

WHESSOE FOUNDRY CO. LTD.—Co. proposes to increase its cap. to £450 000 by creatn. of 250 000 £1 4% redeem. cum. pref. of which 150 000 are to be issued immediately.

JOHN RIGBY AND SONS LTD.—Trdg. pft. to Aug. 31, £1 878 (£19 541), invstmnt. inc. £1 278 (£3 886). To deprecn. £10 313 (£9 419), tax £11 419 (£25 800), leavg. loss £19 124 (pft. £16 494), incldg. E.P.T. refund £27 726. Div. nil (10%).

BRITANNIA ELECTRIC LAMP WORKS, LTD.—Net pft. for 11 mos. after deprcn. and taxn. £8 101 (£8 433 12 mos.). Brot. in £13 214 (£13 405). Less writtn. off goodwill and trade marks £2 500 (same), div. 7% (same), fwd. £12 690.

PETO SCOTT ELECTRICAL INSTRUMENTS.—Tradg. pft. to Mar. 31, £62 400 (£59 608). To tax £52 500 (£53 249), defd. repairs £4 735 (nil), lvg. net pft. £5 505 (£6 359), incldg. £340 (nil) excess deb. int. res. Fst. and fin. 25% £3 720 (same), fwd £9 084 (£7 299).

HENRY BERRY AND CO.—Trdg. pft. to Aug. 31, £16 051 (£17 548). Deduct. deprecn. £4 025 (£4 115), dirs.' fees £633 (£450), inc. tax, £5 510 (£5 116), war dmge. £11 (£436), employees' gratuities £320 (£256). Div. 12½% (same), fwd. £11 120 (£10 106).

ASSOCIATED INSULATION PRODUCTS LTD.—Rev. for 1944 £49 426 (£49 196). Taxn. £18 295 (£18 293), exes. £12 195 (£11 549), dirs.' fees £1 960 (£2 000), net pft. £16 976 (£17 354). Divs.: pref. £9 258 (£11 650), ord. 5% (same), less tax, £7 010 (£6 947), fwd. £20 257 (£19 549).

A. AND J. MAIN CO. LTD.—After Imperial taxn. tradg. pft. 1944 £51 470 (£50 603), plus transf. fees £3 (£2). Deduct deprecn. £9 500 (£8 000), int. £5 320 (£4 651), etc., net pft. £33 117 (£31 277), plus £9 066 (£8 735) brot. in. To pref. div. £4 463 (same), ord. div. 10% £6 842 (same), gen. res. £20 000 (same), fwd. £11 238.

ELECTRIC FURNACE CO. LTD.—Loss for yr. to Mar. 31, 1945, £1 771 (pft. £79 262), div. from subsid. £4 000 (same). E.P.T. credit (less inc.-tax 1945-46) £25 000 (to tax provn. £59 000), to prefd. div. 8% £6 840 (same), sec. intm. (made fin.) on ord. 4½% mkg. 8, £6 260 (same), gen. res. £10 000 (same), fwd. £10 312 (£9 733 gross, £6 183 net).

THOMPSON BROTHERS (BILSTON), LTD.—Pft. for yr. to July 31, £57 095 (£56 258). Add interest £1 467 (£1 634), mkg. £58 562 (£57 892). Deduct dirs.' fees £183 (£200), deprecn. £7 750 (£7 325), A.R.P. £6 468 (£5 462) war risks, etc., insurance £567 (£1 463), contings. res. nil (£2 000), inc.-tax £21 607 (£20 186), leavg. £21 979 (£21 132). To gen. res. £10 000 (same). Pref. div. £624 (same), fin. ord. div. £10 080 (same), div. 7½% and bonus 7½% on £29 868 ord., £2 240 (nil), fwd. £16 357 (£15 110).

PARSONS MARINE STEAM TURBINE.—Pfts. on mfg. and royalties acct. to June 30, after deprecn. £44 629 (£84 931), plus int.

and divs. £22 220 (£22 728) and transf. fees £9 (£7), mkg. £66 857 (£107 666). To taxn. £11 000 (£52 250), experimental pioneer and devpt. work £3 013 (£2 493), dirs.' fees £1 400 (same), leavg. net pft. £51 445 (£51 523). Transf. to plant replacement res. £25 000 (same), fin. div. 11% (8%), mkg. 15% (12%), fwd. £24 522 (£21 847).

ERINOID CO., LTD.—Trdg. pft. to July 31 £59 755 (£87 640), int. etc., £1 660 (£2 865), tax res. not required £15 000 (nil), mkg. £76 415 (£90 505). To dirs.' fees £3 421 (£1 897), deprecn. £10 531 (£10 260), tax res. £30 277 (£61 546), defd. repairs £14 575 (nil), lvg. £17 611 (£16 802). To cap. increase exes. £2 142 (nil), pref. div. £1 650 (same), ord. div. 10% £13 750 (same), fwd. £10 419 (£10 350).

NEEPSEND STEEL AND TOOL CORPN. LTD.—Net interest, divs., etc., to Mar. 31, £110 500 (£109 952). To tax on bank int. £89 (nil), int. on welfare fund £300 (£250), lvg. net rev. £110 111 (£109 702). To genl. res. £20 000 (same), conting. res. £5 000 (same), welfare fund £3 000 (£2 000), 6% pref. div. £934, 4% partg. pref. div. £623, ord. div. and bonus 50% £76 452 (all same), fwd. £22 517 (£18 425).

SMITH'S STAMPING WORKS (COVENTRY) LTD.—Pft. on tradg. to Aug. 4 £18 171 (£23 538), E.P.T. credit £3 400 (nil), trs. fees £35 (£17), div. from subsid. £7 500 (same), and int. on tax certs. £625 (£1 050), mkg. £29 731 (£32 105). To dirs.' fees £400 (£450), lvg. £29 331 (£31 655). To div. 10% £12 500 (same), to bonus of 5% £6 250 (same), again mkg. 15%, less tax, to res. nil (£50 000), fwd. £53 870 (£43 289).

HUGHES - JOHNSON STAMPINGS LTD. — Tradg. pft., incl. E.P.T. recoverable, to Aug. 3, £51 035 (£51 684), plus divs. and int. £4 474 (£6 155). To deprecn. £12 288 (£16 993), dirs.' fees £1 500 (same) and tax thereon £1 500 (nil), subject to approval at gen. mtg., W.D.C. £125 (£750), leavg. pft. £40 096 (£37 096). Brot. in £68 198, mkg. avail. blce. £108 295. To pension res. £2 000 (same), defd. repairs £5 000 (same), div. equalisatn. res. £50 000 (nil), intm. div. 10% £6 500, fin. 5% £3 250, plus bonus 10%, mkg. 25% (all same), fwd. £35 045 (£69 698).

PHILCO RADIO AND TELEVISION CORPN. OF GREAT BRITAIN.—Net tradg. pft. for yr. to Mar. 31, 1945, £115 701 (£108 862). Deduct bank interest £25 626 (£12 612), note interest £2 580 (£2 560), deprecn. £9 309 (£13 346), defd. repairs £4 957 (same), dirs.' fees £3 200 (£1 802), leavg. £70 029 (£73 585). To taxatn., after deductg. £15 000 res. made for future tax £31 741 (£2 074), future tax nil (£15 000), premium on notes £516 (same), cert. int. £1 736 (£1 749), skg. fund for cert. redemptn. £3 180 (£3 023), pref. cap. redemptn. fund £4 710 (£3 732), addtnl. deprecn. nil (£5 577). Pref. div. £12 337 (£10 500), ord. div. 10% (25%), fwd. £12 930 (£3 371).

Company Meeting

ERINOID LTD.—The annual meeting was held in London on November 1, Mr. W. G. Waldron, the chairman, presiding. In the statement circulated with the report and accounts, the chairman said the trading profit for the year was £59 755, £27 900 less than in the previous year; the company's activities, however, were by no means diminished, sales actually being in excess of those for 1944. It was anticipated that the company would only suffer the minimum reverse in the transitional period from war to peace production. The raw material position was unfortunately not assured. However, the major departments should have supplies of raw material to carry them over for some months, when it was hoped the position would be less temperamental. The demand had been intensified for the company's products, and this demand had been considerably greater than the available supply. The research and development programme had been intensified and the quality of the company's products had been maintained with every prospect of research enhancing them even further.

Metal Prices

		Monday, Price.	Nov. 12. Inc.	Dec.
Copper—				
Best Selected (nom.)	per ton	£60 10 0	—	—
Electro Wirebars ...	„	£62 0 0	—	—
H.C. Wires, basis ...	per lb.	9 7/8d.	—	—
Sheet	„	11 1/8d.	—	—
Phosphor Bronze—				
Wire(Telephone)basis	„	1s. 0 7/8d.		—
Brass (60/40)—				
Rod, basis	„	—	—	—
Sheet „	„	—	—	—
Wire „	„	11d.	—	—
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	—	—
Spelter...	„	£31 5 0	—	—
Mercury (spot) Warehouse ...	per bott.	£31 5 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

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.*

COOPER-STEWART ENGINEERING CO., LTD., London, W.—Oct. 6, undertaking securing to Carlton Security Co., Ltd., £30 000 and further advances not ex. therewith £50 000; charged on factory and land agreed to be purchased by the co. in Works Rd., Letchworth, also general charge. * Nil. Dec. 27, 1944.

WESTOOL, LTD., London, S.W., tool mfrs.—Oct. 11, £550 mort. to Bishop Auckland Rock Bldg. Soc.; charged on 77, High Seymour St., Bishop Auckland. *£6 000. Jan. 2, 1945.

WILLIAM HEAP AND CO. LTD. Manchester, tool makers.—Oct. 22, £750 submort., to Lloyds Bank Ltd.; charged on land at Delph, Saddleworth. *£7 400. Jan. 6, 1942.

County Court Judgments

NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not 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.

JACOB, Hans F., 113, Manor Rd., Stechford, electrical salesman. £65 15s. 3d. Sept. 4.

MARROW, R. J. (male), Radio Service, Hartford Park, Northwich, radio dealer, £13 13s. 8d. Sept. 13.

HILLIER, Maurice, 486, Kingsland Road, London, E.8 (Trading as Moreburn's Radio), wireless dealer. £16 7s. 4d. Sept. 21.

Notice to Creditors

LEOMINSTER ELECTRIC SUPPLY CO. LTD. (Voluntary Winding-up).—Creditors of the above company are required on or before November 20, 1945, to send in their names and addresses with particulars of their debts or claims to Mr. Arthur M. Scott, of 24-30, Gillingham Street, London, S.W.1, liquidator.

Coming Events

Friday, November 16 (To-day).

INCORPORATED RADIO SOCIETY OF GREAT BRITAIN.—I.E.E., London, W.C.2. "Aerial Systems for the Radio Amateur," F. Charman. *6.30 p.m.*

BRITISH INSTITUTION OF RADIO ENGINEERS.—University College, Southampton. "Engineering Methods in the Design of the Cathode Ray Tube," Dr. H. Moss. *6.15 p.m.*

Saturday, November 17.

I.E.E., N. MID. STUDENTS' SECTION.—Leeds. "Electrical Machinery for Ship Propulsion," W. J. Belsey. *2.30 p.m.*

Monday, November 19.

I.E.E., MERSEY AND N. WALES CENTRE.—Annual dinner.

BRITISH INSTITUTION OF RADIO ENGINEERS.—Birmingham Chamber of Commerce, New Street. Discussion, "Post-war European Broadcasting," A. H. Cooper. *6.15 p.m.*

BIRMINGHAM ELECTRIC CLUB.—Grand Hotel. "Latest Face Practice in Coal Mining," T. C. Paul. *6 p.m.*

Tuesday, November 20.

ROYAL INSTITUTION OF GREAT BRITAIN.—London, W.1. Lecture I (Course of two lectures on "Recent Research Work in the Davy Faraday Laboratory"); I. "Atomic Movements in Crystals," Mrs. K. Lonsdale, F.R.S. *5.15 p.m.*

Wednesday, November 21.

I.E.E., RADIO SECTION.—London, W.C.2. "A Method of Increasing the Range of V.H.F. Communication Systems by Multi-Carrier Amplitude Modulation," J. R. Brinkley. *5.30 p.m.*

INSTITUTE OF FUEL.—Institution of Mechanical Engineers, London, S.W.1. "Heat Transmission," Drs. M. Fishenden and C. Saunders. *6 p.m.*

INSTITUTE OF WELDING (WOLVERHAMPTON BRANCH).—Victoria Hotel. "Electrical Technique in Resistance Welding," T. E. Calverley. *7 p.m.*

Thursday, November 22.

INSTITUTE OF WELDING, S. WALES BRANCH.—Neath. "The Welding of Aluminium," Dr. E. G. West.

Thursday, November 22-23.

INSTITUTE OF METALS.—12, Great George Street, London, S.W.1. Autumn general meeting. *10.30 a.m.* and *2.30 p.m.* "Dolomite Linings for Basic Electric Arc Furnaces," R. C. Brampton, H. Parnham and J. White (Nov. 22, *2.30 p.m.*).

Friday, November 23.

I.E.E., MEASUREMENTS SECTION.—London, W.C.2. "The Influence of Irradiation on the Measurement of Impulse Voltages with Sphere-Gaps," J. M. Meek. *5.30 p.m.*

ASSOCIATION OF SCIENTIFIC WORKERS.—Onward Hall, 207, Deansgate, Manchester. Lecture, "Science To-day in the U.S.S.R.," Dr. W. A. Wooster. *7 p.m.*

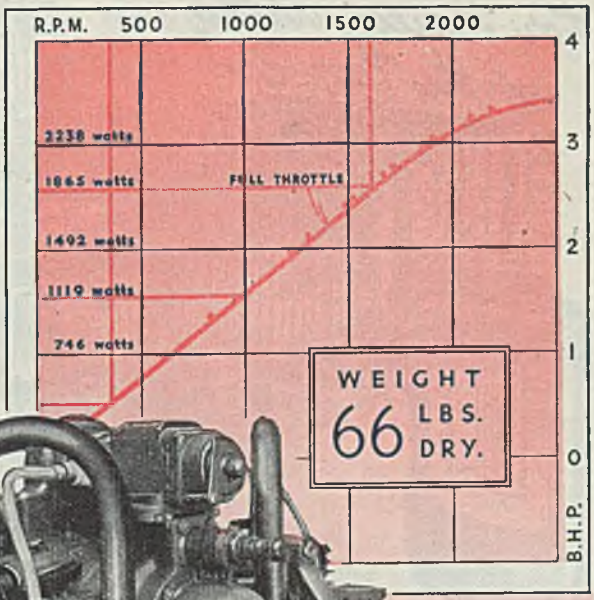
JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria Street, S.W.1. Annual general meeting. *6.30 p.m.*

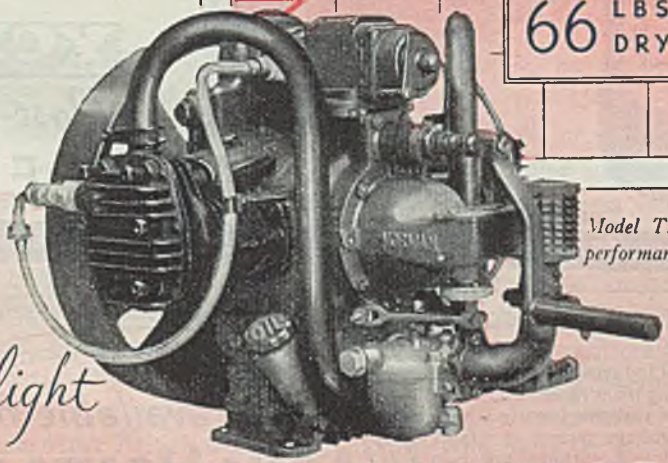
Saturday, November 24.

I.E.E., N.W. STUDENTS' SECTION.—College of Technology, Sackville Street, Manchester. Dance. *6.45* to *10.30 p.m.*

We shall be happy to discuss the future requirements of manufacturers who will be buying Lightweight Aircooled Engines.

THE NORMAN ENGINEERING CO. LTD., WARWICK, ENGLAND.





Model T.300 and its performance graph.

An ultra light

POWER SOURCE

Aircooled - Compact - Silent - Smooth - Reliable

The design of Norman Aircooled Engines has been perfected during 25 years of manufacturing for a wide range of applications, and world-wide operating experience. Lightest engine in its own class, it is also one of the best engineered of any class. Many thousands are on war service and their extreme mobility takes them right into the "front line." For battery charging sets, lighting sets, transmitters, refrigeration and air conditioning, marine, aircraft, and all portable equipment requiring up to 3 h.p. this engine is unrivalled.

Warwick NORMAN England

LIGHTWEIGHT AIRCOOLED PETROL ENGINES

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, November 16, 1945.