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THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

INTERNATIONAL CONFERENCE OF GOVERNMENT TELEGRAPH AND TELEPHONE ENGINEERS.
BUDA-PEST. SEPT. 1908.

D. Cimponeriu (Hungary) · E. Berdenich (Hungary) · L. Lázár (Hungary) · S. Hattenberger (Buda-Pest) · E. Rédl (Hungary) · J. Hollés (Buda Pest) · E. Fritz (Hungary) · Bela Gáti (Buda-Pest) · B. Paskay (Hungary) · K. Hansel (Austria) · T. M. Barthel (Dresden) · C. Holzmann (Buda Pest) · Dr. Mirabelli (Rome)

H. C. Diell (Vienna) · F. Patlevicz (Austria) · H. K. Steidle (Munich) · F. Schaden (Buda Pest) · E. Ratkovszky (Buda Pest) · M. Müller (Germany) · B. Julcher (Hungary) · T. F. Purves (London) · L. Komarnicki (Buda Pest) · U. Tanasescu (Roumania) · Prof. di Pirro (Rome) · W. Herz (Germany) · J. Fodor (Buda Pest) · M. Ivcevic (Austria)

W. Gadomski (Austria) · A. Sándor (Austria) · F. Gutzmann (Berlin) · E. Wittichen (Frankfort) · J. Vater (Buda-Pest) · A. Hultmann (Stockholm) · E. Günther (Halle) · A. Major (Hungary)

F. Stecher (Austria) · P. Balla (Buda Pest) · J. G. Hill (London) · C. Vidic (Roumania) · A. Marini (Roumania) · K. Havelik (Austria) · A. Kraatz (Berlin) · R. Knabe (Austria) · A. Stegu (Austria) · F. C. Proper (Holland) · M. O. Filepek (Austria) · M. Gebhard (Germany)

Hassan Ferid (Constantinople) · S. Montinari (Rome) · N. Rousseff (Bulgaria) · F. Stegmann (Munich) · G. M. Radacovitch (Bucharest) · K. Barth von Wehrenalp (Vienna) · Major O'Meara (London) · A. Kolossváry (Buda Pest) · Dr. Strecker (Berlin) · A. E. R. Collette (Amsterdam) · B. Evangoulow (St. Petersburg) · A. Rydin (Stockholm) · C. E. Krarup (Copenhagen) · M. Emin (Constantinople)

SPECIAL CONFERENCE NUMBER.

THE

Post Office Electrical Engineers' Journal.

THE FIRST INTERNATIONAL CONFERENCE OF TELEGRAPH AND TELEPHONE TECHNICIANS.

HELD AT BUDA-PEST, SEPTEMBER, 1908.

Special Reports and Summaries by T. F. PURVES *and* J. G. HILL.

THE institution of an International Technical Conference of Government Telegraph and Telephone Engineers is the fruit of suggestions made by the Hungarian and French representatives at the General International Telegraph Conference of London in 1904. In January of this year those proposals were revived and developed by the Hungarian administration. It is thus appropriate that the first Conference should have been held at Buda-Pest, and the officials there are to be warmly congratulated upon the indisputable success which has attended their efforts.

The names of the delegates who attended the Conference appeared in the official list as follows:

AUSTRIA.—M. Karl Barth von Wehrenalp, Conseiller aulique, Chef de la Section technique; M. H. G. Dietl, Conseiller supérieur technique; M. Franz Patlewicz, Conseiller supérieur technique; M. M. O. Filepek, Conseiller technique; M. Wladislaw Gadomski, Conseiller technique; M. Karl Hansel, Conseiller technique; M. A. Šandor, Conseiller technique; M. Anton Stegu, Conseiller technique; M. Karl Havelik, Commissaire supérieur technique; M. Rudolf Knabe, Commissaire technique; M. Franz Stecher von Sebenitz, Commissaire supérieur technique; M. Mate Ivčevič, Ingénieur, Élève de construction.

BULGARIA.—M. M. Rousseff, Chef de la Section technique.

DENMARK.—M. C. E. Krarup, Chef du Département des Télégraphes.

FRANCE.—M. Estaunié, Directeur du Matériel et de la Construction; M. A. Dennery, Ingénieur-en-chef des Postes et Télégraphes, Directeur du Cabinet du Sous-Secrétaire d'État; M. Bazille, Ingénieur-en-chef, chef de Bureau.

GERMANY.—M. le Professeur Dr. Strecker, Conseiller intime supérieur des Postes; M. A. Kraatz, Ingénieur des Télégraphes; M. F. Gutzmann, Ingénieur des Télégraphes; M. Th. M. Barthel, Secrétaire des Télégraphes; M. Gebhard, Conseiller impérial, Directeur des Télégraphes; M. E. Günther, Élève de Construction supérieur; M. W. Herz, Inspecteur des Télégraphes; M. Müller, Inspecteur supérieur des Postes; M. Ritter (Württemberg), Conseiller technique; M. F. Stegmann (Bavière), Conseiller des Postes; M. H. K. Steidle (Bavière), Adjoint supérieur des Postes; M. E. Wittichen, Ingénieur des Télégraphes.

GREAT BRITAIN.—Major W. A. J. O'Meara, C.M.G., R.E. Engineer-in-Chief; Mr. T. F. Purves, Staff Engineer; Mr. J. G. Hill, Engineer.

HOLLAND.—M. A. E. R. Collette, Ingénieur-en-chef des Télégraphes et Téléphones d'État, Directeur du service technique; M. F. C. Proper, Chef des Matériaux des Télégraphes et Téléphones d'État.

HUNGARY.—M. André Kolossváry, Premier Directeur technique, Chef du service technique; M. Joseph Váter, Directeur technique; M. Paul Balla, Conseiller technique; M. Frédéric Schaden, Conseiller technique; M. Joseph Hollós, Conseiller technique; M. Étienne Bayler, Conseiller technique; M. Edmond Ratkovszky, Conseiller technique; M. Charles Holzmann, Conseiller technique; M. Jules Burzogany, Ingénieur supérieur; M. Leopold Lazar, Ingénieur supérieur; M. Julien Fodor, Ingénieur supérieur; M. Bernard Paskay, Ingénieur supérieur; M. Béla Gati, Ingénieur supérieur; M. Samuel Haltenberger, Ingénieur supérieur; M. Eugéne Rédl, Ingénieur; M. Béla Julcher, Ingénieur; M. Ernest Berdenich, Ingénieur; M. Charles Kisfalndy, Ingénieur; M. Denis Cimponeriu, Second Ingénieur; M. Dezső Véghely, Second Ingénieur; M. Ernest Zerneck, Second Ingénieur; M. Josef Kuchejda, Second Ingénieur; M. Ladislas de Komarnicki, Second Ingénieur; M. Augustin Maior, Second Ingénieur; M. Eugéne Fritz, Second Ingénieur.

ITALY.—M. le Professeur Giovanni di Pirro, Chef de Section dans l'Institut supérieur postal-télégraphique; M. Salvatore Montinari, Secrétaire chez la Direction Générale des Télégraphes; M. le Docteur Enrico Mirabelli, Inspecteur central technique.

ROUMANIA.—M. Georges M. Radacovitch, Ingénieur, Chef de la Division technique; M. Carol J. Vidic, Ingénieur des Télégraphes; M. A. Marini, Ingénieur des Télégraphes.

RUSSIA.—M. Balthazar Evangoulow, Ingénieur Électricien, Chef de la Division technique.

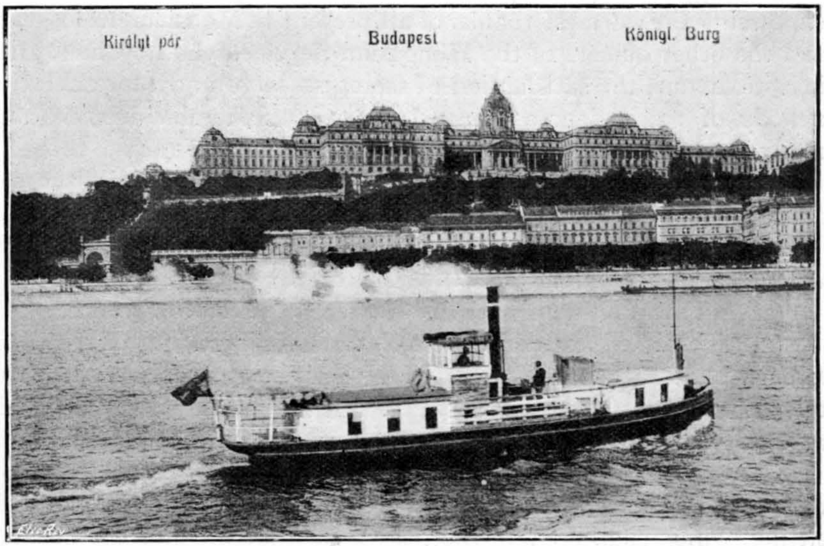
SERVIA.—M. Jacques Petrovitch, Chef de Section; M. Milan

Georgevitch, Chef de Section; M. Kosta Dantchevitch, Chef de Section.

SWEDEN.—M. Axel Rydin, Chef de la Division technique à la Direction des Télégraphes; M. Axel Hultman, Directeur des Téléphones d'État.

TURKEY.—M. Hassan Férid, Directeur de la Fabrique; M. Mehmed Emin, Sous-Chef du Bureau des Ingénieurs.

The proceedings of the Conference were opened on the afternoon of Monday, September 21st, at a reception of the delegates by the Hungarian Committee in the rooms generously placed at their



I.—THE ROYAL PALACE OF BUDA.

disposal by the Hungarian Society of Engineers and Architects. The same evening the Society of Engineers and Architects held a reception of the delegates in the Conference Chambers.

The inaugural sitting took place on the following morning in the large hall of the Society. Monsieur Kolossváry, the President, briefly welcomed the delegates. He thanked the various administrations for the facilities they had granted for the attendance of their representatives, and for the moral and material support which they had accorded to the Conference. He dwelt upon the far-reaching results that might be expected to attend the labours of such an assembly, and on the advantages of friendship and co-operation on the part of those who are working towards common ends. Reviewing the objects and scope of the Conference, he indicated the lines on which its discussions could most usefully proceed, and expressed his hope that the new form of activity that day inaugurated might achieve results of importance to the progress of humanity. It was his sad duty to allude to a disaster which had unfortunately deprived the Conference of the attendance of the three French delegates, namely, the total destruction by fire of the great Central Telephone Exchange in the Rue Gutenburg, Paris. At that moment the French delegates were on their way back to Paris at the urgent call of their administration. He was sure that the whole Conference would concur in the proposal that a telegram, expressive of their deep sympathy, should be despatched to the French authorities. (Applause.) He now declared the Conference open. (Applause.)

Dr. Strecker (Berlin) responded to the presidential address, expressing the warmest thanks of all present to Monsieur Kolossváry and the other officers of the Hungarian Service, who now had, after infinite labour, the satisfaction of seeing so large and representative a body of technicians assembled under so favourable auspices and ready to undertake the labours which lay in front of them.

The standing regulations of the Conference were then discussed and adopted. The following points were included:

(1) The President of the Conference shall be the senior technical officer of the administration convoking the Conference.

(2) A Vice-President shall be elected by each Conference.

(3) The only questions admitted to the deliberations of the Conference shall be those associated with the technical aspect of the telegraph and telephone services. Resolutions modifying this regulation are not in order.

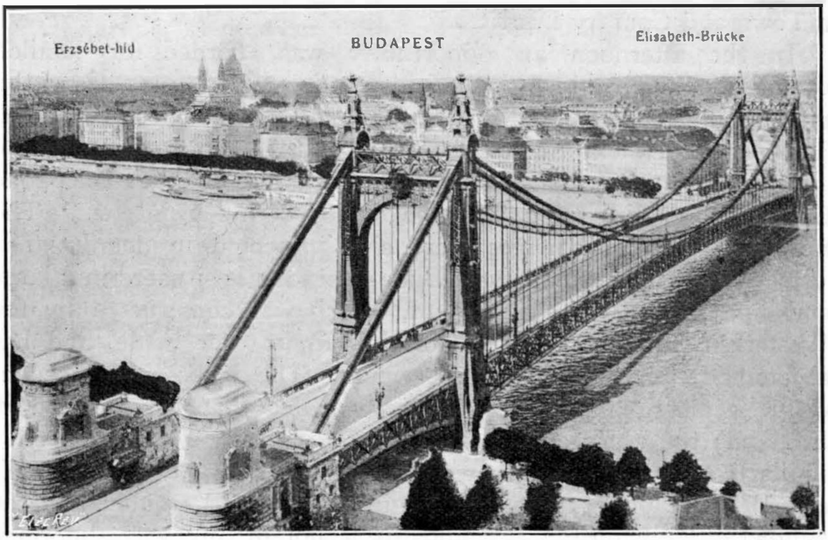
(4) A Bureau shall be elected at the first sitting, and shall be responsible for the preparation and issue of a *procès-verbal* of each sitting, which shall contain the title of each lecture and the debates thereon. The full text of the lectures shall appear as an appendix to the *procès-verbal*.

Thereafter Major O'Meara was unanimously elected to the position of Vice-President, and the Bureau was elected and constituted as follows:

Chief.—M. Hollós.

Editors.—M. Gutzmann, M. Sandor, M. Hill, M. Mirabelli, M. Vidic, M. Fodor, M. de Komarnicki.

It was resolved that the sittings should commence at 9.30 a.m., and should be continued as late as the programme of visits and inspections for each afternoon would allow. The grouping of lectures and discussions for each day was settled. In the afternoon a visit was paid to the Central Telegraph Office, a stately building with abundant light and air in all its parts. Among the noteworthy features of this installation mention may be made of the method by which the current required for working the telegraph system is supplied. There are no primary or secondary batteries, but a motor-driven generator discharges continuously across a bank of lamps with "earth" in the centre. Positive and negative voltages up to 250 volts by steps of 25 volts are supplied to the instrument room by means of taps taken from suitable points in the discharge circuit. A further feature of special interest to the British delegates was a large intercommunication switch, the construction of which has been, to a great extent, modelled on that recently installed in the London Central Telegraph Office. In the evening the delegates were entertained to dinner by the Hungarian Administration of Posts and Telegraphs. Monsieur de Kossuth, Minister of Commerce,



2.—ELIZABETH BRIDGE AND LEFT BANK OF DANUBE.

presided, and proposed the health of the delegates and the success of the Conference. Major O'Meara responded and gave the toast of Hungary.

Wednesday, September 23rd.—Major O'Meara presided, and read telegrams of good wishes received from various administrations.

The following lectures were delivered and discussed :

M. Krarup (Denmark).—"The Use of Subterranean and Submarine Cables for Telephonic Purposes."

Dr. Mirabelli (Italy).—" Methods of Overcoming Disturbances of Telegraph Working Caused by Electrical Traction Systems."

Major O'Meara (Great Britain).—" The Main Telegraph Cable System of the British Isles."

M. Bazille (France).—" Types of Subterranean Cables employed in France " (given by M. Hollós in M. Bazille's absence).

In the afternoon a visit was paid to the works of the " Societé Anonyme des Constructions Electriques," at Ujpest, where the manufacture of telephonic apparatus and of carbon and metallic filament lamps was inspected in detail.

Thursday, September 24th: communications read and discussed:

Dr. Strecker (Germany).—" The Provision of Current for Telegraph and Telephone Purposes by means of Secondary Batteries."

M. Barth (Austria).—" Discussion of the Relative Merits of Manual and Automatic Exchanges for Telephonic Service."

M. Steidle (Germany).—" Fundamental Technical Data and Economic Results of Semi-automatic Telephone Exchange Working in Town and Country Districts."

In the afternoon an opportunity was afforded for detailed explanation and examination of illustrative working models of the automatic and semi-automatic exchanges described by MM. Barth and Steidle. Sufficient apparatus to demonstrate fully the action of both systems had been installed in the Telephone Exchange building, and was the object of much interest. The local and trunk exchanges were also inspected in detail. The former serves the whole city of Buda-Pest, and is situated in a large and fine hall. The switchboard, which was constructed by the Western Electric Co., is one of the largest ever made, and has accommodation for 20,000 subscribers. The jacks are spaced at $\frac{5}{16}$ in. centres, and are, therefore, smaller than any in use in England; the plugs and cords have, of course, to be made on a similarly reduced scale. It was stated that, in spite of the smallness of these parts, maintenance gives no special trouble, and the number of faults on the switchboards is not in any way abnormal. The leading in of the underground cables, the protective and distributing appliances, etc., are all on a very large scale and thoroughly up-to-date. The accommodation of the Trunk Exchange is strikingly inferior to that of the local central. It is situated in a small and very congested room, but it should be mentioned that arrangements are already in progress for the construction of a new and separate trunk exchange. It is a point of interest that the new trunk exchange building will be situated *outside* the city. It will thus be possible to bring all the trunk circuits up to the exchange by means of open routes. A great number of through trunk connections are effected at Buda-Pest, and the speaking efficiency of the service will thus be greatly increased by the avoidance of underground work. Communication between the trunk and local exchanges will, of course, have to be afforded by underground cables.

Friday, September 25th: On this day the Conference did not sit, but the whole of the delegates were conveyed by special train to Püspökladány, where the Hungarian administration has recently established impregnation plant for creosoting telegraph poles. Until recently untreated timber was used exclusively. The impregnating works at Püspökladány are situated on the main eastern line of railway about 180 miles from Buda-Pest at a convenient distributing point. An extensive study of creosoting methods was made before the plant was erected, and the whole, including the arrangements for handling and stacking the timber, is exceedingly up-to-date and efficient. Native Hungarian timber is exclusively used.

Saturday, September 26th: Communications delivered and discussed:

Mr. Purves (Great Britain).—"Telegraph Intercommunication and Concentration Switching, and the Applications of the Central Battery System to Telegraph Working."

Prof. di Pirro (Italy).—"The Impedance of Non-uniform Telephone Circuits."

M. Bela Gati (Hungary). — "The Measurement of Line Constants by means of the Barretter."

M. Hill (Great Britain).—"Practical Applications of the Laws of Telephone Transmission."

Afternoon: Visits of inspection to generating station of "Societé Anonyme pour Courant Continu." Three-phase current at 2000 volts, transformed to 115 volts, continuous, in several sub-stations throughout the city for electric light and power purposes. Generating station of "Societé Anonyme Hongrois," 3000 volts alternating transformed to 150 volts alternating in sub-stations; also 5000 volts alternating transformed in sub-stations to 550 volts continuous. Second power station for tramway service, overhead trolley system; fine station in course of construction, several steam turbines of 2000 horse-power being installed.

Sunday, September 27th: Visited State Polytechnic under guidance of Prof. Zipernowsky; a large and splendidly equipped educational institution which deals with, and grants diplomas in, all branches of electrical engineering.

Monday, September 28th: Continuation of discussion of papers presented by Prof. di Pirro, M. Bela Gati and Mr. Hill.

New papers read and discussed:

M. Gutzmann (Germany).—"Systems of Party Lines serving several Telephone Stations."

M. Hollós (Hungary).—"Cutting Out of Circuit of Intermediate Offices on Long Trunk Lines during Conversation."

Afternoon: Visit to the works of Messrs. Manfred Weiss; rolling of copper sheets and tubes, wire drawing, mauufacture of shells, cartridges, etc.

Tuesday, September 29th: Papers read and discussed:

M. Kraatz (Germany).—"Machine and Multiplex Telegraph Systems," and discussion of circumstances in which they should be used.

M. Bazille (France).—"Superimposed Telephone Working"; "Baudot Telegraph System" (given by M. Hollós in M. Bazille's absence).

M. Hollós (Hungary).—"Comparative Results of New Telegraph Systems."

M. Montinari (Italy).—"Improvements in Apparatus for Closed Circuit Telegraph Working."

M. Hultmann (Sweden).—"The Common Battery Telephone System as used in Sweden,

Afternoon: Closing sitting. MM. Barth and Strecker proposed the formation of a committee for the regulation of the next Conference. After an animated discussion the following resolutions were unanimously carried.

(1) The International Conference of Telegraph Technicians at Buda-Pest, 1908, institutes a committee for the management of the next Conference.

(2) The place of meeting of the Committee is Buda-Pest.

(3) The Committee shall consist of one member of each administration represented at this Conference, elected by the votes of the whole Conference; the Hungarian administration shall be represented by three members elected by the whole Conference from among the Hungarian delegates.

(4) The Committee may co-opt additional members by the vote of the majority. Such additional members must be technical officials of superior rank in a State administration, and must be proposed by the officials of two other administrations already serving on the Committee. Election must be by a majority of not less than two thirds of the votes cast.

(5) The Hungarian members of the Committee form an executive sub-committee. The President of the Committee shall be elected by the Conference and shall direct the sub-committee.

(6) The elections shall hold good until the next Conference.

(7) The Conference shall prescribe to the Committee certain

subjects to be studied, and the Committee shall designate at least two of its members to deal specially with each subject, and prepare it for treatment at the next Conference.

(8) The Committee has the right to choose additional subjects for study and to prepare them for treatment. Such subjects must be approved by at least half the members of the Committee.

The following members of Committee were then elected:

Hungary.—M. Kolossváry (President). Austria.—M. Karl Barth von Wehrenalp. Bavaria.—M. Stegmann. Bulgaria.—M. Rousseff. Denmark.—M. Krarup. France.—M. Estaunié. Germany.—Dr. Strecker. Great Britain.—Major O'Meara. Holland.—M. Collette. Hungary.—M. Vater, M. Hollós. Italy.—Dr. Mirabelli. Roumania. —M. Radacovitch. Russia.—M. Evangoulow. Servia.—M. Petrovitch. Sweden.—M. Rydin. Turkey.—M. Ferid. Württemberg.—M. Ritter.

After election the Committee unanimously co-opted as additional members: Prof. di Pirro (Italy), and M. Breisig (Germany).

The Conference referred to the Committee as subjects for special study:

(1) Automatic *versus* manual telephone exchanges.

(2) To fix the electrical constants of an international standard cable for telephone transmission measurements.

(3) The best means of avoiding damage or interference to telegraph and telephone circuits by power circuits.

It was then decided that the next Conference should be held in 1910. On the motion of the President the locality of the Conference was not fixed, it being thought advisable to leave this point to the Committee, in view of the possibility that invitations might be received from administrations interested in the matter. It was decided that the locality should be announced at least six months before the date of opening the Conference.

The President then addressed the Conference as follows:

"Gentlemen, we have arrived at the termination of our first Conference. If we now cast a backward glance upon its labours I am sure that we must each feel entitled to return to our homes with head erect and mind composed. Our work has been serious, and we may well hope that it will serve as a base for manifold future activities. If we add to that the sentiments of mutual respect and cordiality that we have seen developed during its course, I think, gentlemen, that we may look ahead with feelings of full assurance and satisfaction.

"When the fruits borne of your labours here become apparent I am sure, gentlemen, that each of you will be proud of the part he has played and will regard with pleasure the results of his efforts. Before saying farewell, which I cannot do without emotion, permit me to thank you all once again for the hearty collaboration and the strenuous goodwill which you have so ungrudgingly devoted to the purposes of our assembly. Above all I thank you for having demonstrated, by the striking success of this conference, the utility and the vitality of the enterprise which we have undertaken.

" In returning to your own countries, I trust that you will retain in full the feelings of friendship which our intercourse has engendered; this friendship and unanimity will be the best and surest pledge of the fertility of our future labour and progress. In the hope of many future meetings, gentlemen, I now declare our first Conference at an end." (Prolonged applause.)

On the motion of Dr. Strecker the unanimous thanks and gratitude of the delegates towards Monsieur Kolossváry were enthusiastically expressed.

Monsieur Barth thanked in turn Major O'Meara, Monsieur Collette, and Monsieur Hollós, whose efforts had so powerfully contributed to the success of the meetings.

Monsieur Dietl expressed the thanks of the delegates to Monsieur Vidic, who from the first inception of the idea had never ceased to work unsparingly in the interest of securing a happy and successful issue to the Conference.

The proceedings then terminated.

In the evening the delegates attended a farewell dinner given to the Conference by Monsieur de Kossuth, Minister of Commerce.

SUMMARIES OF LECTURES.

THE USE OF SUBTERRANEAN AND SUBMARINE CABLES FOR TELEPHONIC PURPOSES.

By C. E. KRARUP, Copenhagen.

The author points out that the limits of speech on telephone cables of the ordinary air-space type is defined. It is pointed out that these limits are soon reached, but that by the insertion of Pupin coils in such cables the range is very much extended. The author, however, considers that the use of loading coils in large towns where composite cables for widely differing types of telephone circuits are used, involves such complexity in calculation that a cable designed by himself and described in the " Journal Télégraphique " for June, 1905, would be preferable. This cable consists of copper wires having wound around them one or more layers of fine oxidised soft iron wire. The inductance thus obtained is four or five times that of the untreated copper wire in cables, but it is not so great as can be obtained by the use of

Pupin coils. The capacity of an iron-wound cable for alternating currents is less than that for continuous currents. M. Krarup claims that such cables can be used without considering the complex factors necessary with loaded cables, and that therefore in their use lies the real solution of the difficulty in large towns. If, however, the difficulties in calculating Pupin coils could be overcome, cables containing them would be of great use in future *in the case of wires of similar dimensions.* The ideal cable is one having distributed self-induction, but in much greater quantity than that given by present iron-wound cables. Iron-wound underground cables are in use in numerous towns in Denmark and also in some Swedish towns, and some submarine cables are also so treated. Another cable of the same type is being laid at Baku, in the Caucasus.

The details of the latest type of cable are as follows: $4 \times 4 + 12 \times 2$ conductors; 2 mm^2 (1·6 mm.) copper; 8·7 ohms per km. for continuous current, 0·37 mm. iron wire. Insulation air-space paper 0·12 mf. wire to earth, 0·06 wire to wire per km. Effective β = 0·0165 at a frequency of 940 periods calculated (actually less). Therefore, speaking distance without difficulty 120 to 160 km. (calculated). Price, June, 1908, 555fr. per 100 m. with double-wire armour.

Discussion on M. Krarup's Paper.

M. de Pirro (Rome) recognised the advantage of M. Krarup's cable over those of the ordinary type, but showed by a mathematical example that with an increase of only seven times the ordinary inductance of the cable due to the iron wire wound upon it as claimed by M. Krarup for his cable, the augmentation in efficiency which would follow if the losses in the iron were taken into account could not be greater than 15 per cent.

M. Steidle (Munich) observed that the formula $\frac{R}{2}\sqrt{\frac{C}{L}}$ to be valid depends upon the relation $\frac{R^2}{P^2 L^2} < 1$, and with the comparatively small increase in L in iron-wound cable, a small R should be aimed at.

Dr. Strecker (Berlin) said that the Cuxhaven–Heligoland cable (70 km.) gave good service when extended by open lines 400 km. in length to Berlin.

M. Béla Gáti (Buda-Pest) said he had found some air-space cables to have an insulation resistance of 28,000ω per km. at telephonic frequencies, and suggested that the diminution of capacity with alternating currents was common to all types of cable. He asked whether β was measured or calculated, and whether the cable was suitable for telegraphic purposes.

M. Krarup, in reply to M. de Pirro, said that the theoretical calculation given did not agree with observed facts as the speaking distance of his cable is three or four times that of ordinary cable. In reply to M. Gáti, he said that β was calculated from R, C, and L, and proved by the method of measurement adopted by Dr. Breisig. The cable had no special advantage for telegraph working, except in the case of high-speed automatic systems.

Note on M. Krarup's Paper.

M. Krarup seems to be under the impression that the calculation of efficiency of transmission in loaded cables is very difficult, if not sometimes impracticable, whereas in practice relatively simple formulæ have recently been developed, which render it a fairly easy matter. The real point at issue is the relative efficiency of speech transmission of the two types of cable in question. If this were known it would be a simple matter to weigh the advantages and disadvantages of the two types of cable from all other points of view. Although the exact efficiency of loaded cables is now well known in some countries, this, curiously enough, does not appear to be the case with iron-wound cables. Much ink has been spilt on the question of the exact value which should be assigned to them by calculation, but a practical test by the standard cable method does not yet appear to have been made, although it would settle the matter definitely.

METHODS OF OVERCOMING DISTURBANCES OF TELEGRAPH WORKING CAUSED BY ELECTRICAL TRACTION SYSTEMS.

By Dr. E. Mirabelli, Rome.

The author gives details showing the rapid increase of electrical traction systems, and proceeds to describe disturbances of telegraphic circuits experienced in the neighbourhood of such systems in Italy. He has conducted special experiments in connection with circuits following the route of the Valtelina Electric Railway between Lecco and Chiavenna, a distance of 110 kilomètres. The power transmission is three-phase at 15,000 volts, and the conductors follow closely the route of the railway. Ten sub-stations are placed at intervals of about 10 km., and in these the current is transformed to 3000 volts, three-phase, and fed to the electric trains by two conductors 90 centimètres apart, the rails constituting the third conductor. Generally the same supports carry both the primary and secondary power circuits.

He mentions also another railway—Milan to Porto Ceresio—with three-phase transmission at 13,000 volts transformed to 650 volts continuous for the train service, which is fed by a central rail. The three-phase supply mains follow the line at a distance of 10 to 30 mètres. This system has caused no disturbance to the telegraph circuits which run alongside the railway.

Several experiments with the circuits adjacent to the Valtelina Railway are described in detail. The main disturbance was found to be due to induction from the two service conductors forming elements of the 3000 volt secondary three-phase system fed to the trains. There was little disturbance due to leakage, except when heavy trains were running in positions close to the sub-stations. Differences of earth potential exceeding 5 volts between sub-stations were noted. The total interference rendered telegraphic communication quite impossible, and the only practicable cure was to double the wires for the whole length adjacent to the railway, and insert a repeater at each end. Even then the insulation of the lines had to be very carefully maintained to avoid disturbance. Trials of closed circuit working with fairly high current were therefore made, and found to ameliorate the conditions considerably. It was, in fact, found possible to withdraw the repeaters at one end, and simply to earth the second wire at that point. The circuits are now working in this way with fair success.

The alternatives suggested for further trial and consideration are:

(1) The application of condensers and inductive resistances in the telegraph circuits in order to separate the currents of different natures.

(2) Doubling the aërial telegraphic wires wholly or in part.

(3) Laying underground cables along the railway for loop working.

(4) Arranging that power services shall use continuous current at low voltage in the secondary circuits or three-phase secondary currents, fed to the motors by symmetrically placed conductors.

The Italian administration is continuing experiments on the subject.

In the ensuing discussion Prof. di Pirro (Rome), laid down the lines on which such investigations might most profitably be conducted. He hoped to be able to furnish the next Conference with the results of his personal experiments and deductions.

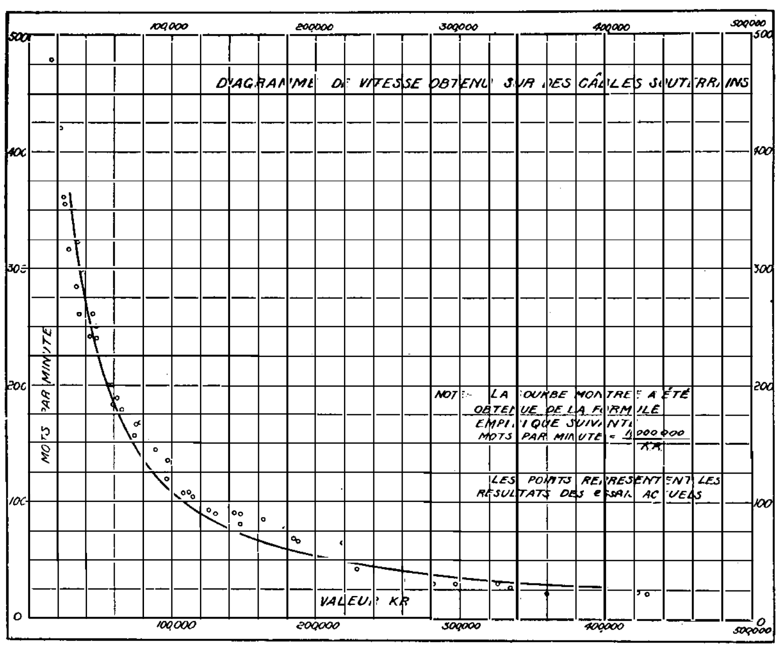
Monsieur Barth (Vienna) and Dr. Strecker (Berlin) dwelt upon the importance of the matter, and proposed that it should be one of the subjects referred to the Committee for special study and fuller discussion at the next Conference. This was agreed to.

THE MAIN TELEGRAPH CABLE SYSTEM OF THE BRITISH ISLES.

By Major W. A. J. O'Meara, C.M.G., R.E., London.

Major O'Meara gave a historical sketch of the development of underground telegraph cable working in Great Britain from the earliest days to the present time, and presented the interesting plans shown in 1 and 2.

Financial, engineering, and traffic statistics with reference to the projects now in course of execution were furnished, together with



22.—Curve showing Speeds obtainable on Submarine Cables.

complete descriptions of the materials used, the methods of planning and organising the work, the operations of trenching, constructing man-holes and joint-boxes, erecting test-pillars, cable laying, jointing and testing. The various types of cable utilised, composite and otherwise, were fully described and illustrated, together with tools and special appliances. Schedules of faults were appended, giving their nature and cause and the methods of dealing with them. The methods of eliminating inductive disturbances from wire to wire and of connecting the conductors for loop and superimposed working were also exhaustively treated. Working speeds were analysed and illustrated by the curve shown in 22, which is here reproduced.

1.—The Complete Project for an Underground Telegraph Cable System in the British Isles, prepared in 1881. (The figures indicate the Number of Wires proposed for each Section.)

2.—1908. Underground System now Existing and in Course of Construction. Dotted lines show Routes in Course of Construction.

In the ensuing discussion Monsieur Hollós and others warmly thanked Major O'Meara for having placed at the disposal of the administrations represented at the Conference so great a mass of information of the highest practical value. All were aware that large schemes of trunk cable laying were in progress in England, and, thanks to the careful and exhaustive manner in which particulars had been placed before them, they were now in a position to take full advantage of the extensive and unique experience of the British administration in connection with this subject.

TYPES OF SUBTERRANEAN CABLES EMPLOYED IN FRANCE.

By M. Bazille, Paris.

The first subterranean lines in France were constructed in 1845, and were insulated by means of vulcanised rubber. In 1855 bare wires laid in bitumen were used, but without much success. Gutta percha continued to be used, although many efforts were made to supersede it on account of its high cost, until 1890 when the first paper cables were introduced into France.

Monsieur Bazille gives mechanical and electrical data regarding gutta-percha cables, including a specification for the G.P. and a statement of the tests applied to the cables. He discusses the relative advantages and disadvantages of lead-covered paper-insulated cables, and gives schedules showing full details of the principal types which have been made and used for the French administration. He describes the tests which the paper should pass, the method of laying up, and the electrical testing of the completed cables. Methods of jointing are then touched upon and the desiccation of cables is dealt with. He also describes the usual methods of distributing telephone cables in France. Cables of "pair"-formation are exclusively used; the conductors of telegraphic cables have a uniform diameter of 2 millimètres.

Long subterranean telegraph circuits are worked on metallic loops; M. Bazille has not a high opinion of screened conductors. For telephone exchange purposes the cable conductors have a uniform diameter of 1 millimètre both for subscribers' lines and junction lines. This is larger than necessary for short circuits, but uniformity is an advantage. The standard sizes of exchange cables used are 1 pair, 7 pairs, 28 pairs, 56 pairs, 112 pairs, and 224 pairs. Special cables are used for trunk telephone purposes, the conductors having a diameter of 2·5 millimètres. They are only used for leading the circuits into large towns. Short trunk circuits are frequently led into towns on the ordinary exchange cables with 1 millimètre conductors.

M. Bazille also treats the subject of the electrolytic action upon the cable sheaths of stray currents from tramway systems. He points out that even when the rails are well bonded the proportion of the current which finds its way back through the soil is seldom less than 12 per cent. or 15 per cent. With badly bonded rails this proportion may easily rise to 60 per cent. An attempt has been made to reduce the currents circulating in the cable-sheaths by interrupting the continuity of the lead covering at intervals. This is done by removing a ring of lead about 1 centimètre in width. The cable is covered at this point by a strip of tarred cloth and is placed in a wooden trough about 3 mètres long, which is then filled up with insulating compound. Experience has shown, however, that this treatment only aggravates the evil by multiplying the points at which the stray currents enter and leave the cable. Attempts have also been made to insulate the cable by enclosing it in a trough filled with compound for the whole length of its passage through dangerous areas. This, too, has been a failure, resulting simply in concentrating the destructive action at or near the points where the cable enters and leaves the trough. A further attempted cure has been to place the whole cable in a metallic sheath so that the latter may carry off all stray currents without permitting them to enter the cable sheath. M. Bazille cites the case of one particular tramway crossing, where a main cable was exposed to very destructive electrolytic influences. About a year ago the cable was therefore insulated, as above, for a distance of about 500 mètres through the danger zone of the crossing. A ring of lead was removed from the sheath near each end of the insulated portion. At each point of leaving the insulation the cable was fitted with a metallic sheath composed of 20 mètres of lead tubing amply soldered around the cable and wrapped thickly with iron wire to ensure good contact with the soil.

Before these sheaths were fitted the difference of potential between the cable (+) and the earth (−) was from 4 to 6 volts; this has practically disappeared since the treatment described above. Further trouble beyond the insulated portion has shown that it will be necessary to extend the insulation to a greater distance in one direction; apart from this the method appears to have effected a satisfactory cure.

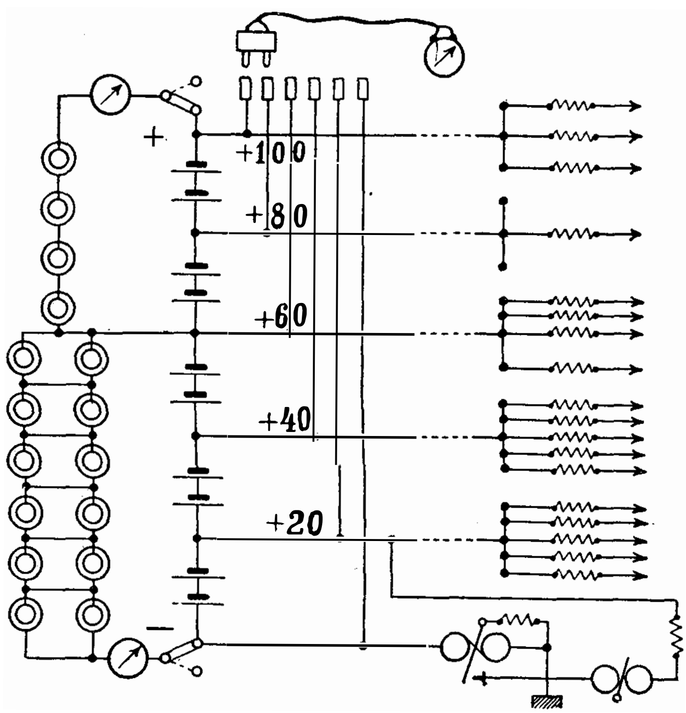
Another system tried at another point of rapid deterioration consists in employing a cable, the sheath of which is insulated by a wrapping of paper ·8 millimètres thick surrounded by waterproof canvas and protected by a wrapping of galvanised steel ribbon of the same thickness. The whole is enclosed in moisture-proof braiding.

This cable has been in use for a year without showing any signs of deterioration.

THE PROVISION OF CURRENT FOR TELEGRAPH AND TELEPHONE PURPOSES BY MEANS OF SECONDARY BATTERIES.

By Dr. STRECKER, Berlin.

Secondary cells have been used almost exclusively for telegraph purposes in all except the smallest offices in Germany for the past twenty years. For telephone exchange working they were used for eight years before the advent of the Central Battery System, the



I.—ACCUMULATORS CHARGED FROM PRIMARY CELLS.

first installations of which are now about four years old. The telegraph secondary cells in Berlin have worked since 1889 without trouble; no renewals have been required, not even of the plates. But the cells are too large and heavy, and they occupy too much space. Cells of 15 ampère hours capacity are found to be adequate in most offices. The use of primary cells for charging the accumulators, which has always been a feature of the German system at small offices, is described. One thousand primary cells used under ordinary conditions on telegraph circuits will deliver on an average only ·002 to ·005 amp. hours per day. If used to charge accumulators they will give easily ·05 a.h. without requiring much more attention. Thus 100 cells can be made to replace 1000, with great saving in space and reduction in labour of maintenance. Current provided in this way costs, however, ten times as much as when taken from power plant ; the system is thus suitable only for small offices. Connections are shown in 1. For C.B. telephone purposes in Germany 24 volts are usually employed; sometimes 22 or 20 volts. A reserve set is always provided. Charging current is supplied from a motor generator delivering at about 30 volts. In some cases Koch's converter is used for transforming. In America the cells used are generally much smaller and are charged and worked simultaneously during busy hours. The cells thus have to deliver current only at slack times. The author furnishes detailed data for calculating the size of cells required for telegraph offices of various sizes and for C.B. telephone exchanges on the basis of ascertained average traffic. He then describes the power plant used for charging purposes, and the switching arrangements for altering the grouping of the cells for working and charging. He furnishes details of the cost of all the parts and discusses the economic questions involved in the substitution of secondary for primary cells at telegraph offices, and in connection with telephone exchange systems.

In discussing the paper M. Hollós, Buda-Pest, stated that Dr. Strecker's calculations for C.B. exchanges were exactly in accord with the observed results at the Buda-Pest Central Exchange. A total current of 0·25 amps. is required for each local communication, the average duration of which is found to be three minutes. The battery thus delivers $·25 \times 20 \times \frac{3}{60} = 0·25$ Watt-hours, which is exactly the figure given by Dr. Strecker.

AUTOMATIC *versus* MANUAL TELEPHONE EXCHANGES.

By Karl Barth von Wehrenalp, Vienna.

M. Barth favours the automatic system, which is now being tried in Austria, and which he described and illustrated by means of a small working installation.

He, however, points out that a service exclusively automatic is impracticable, and he would employ manual operators for trunk service, for information service, transmission of telegrams, private branch exchanges, and, in general, wherever the method of operating does not conform to that of ordinary subscribers' circuits.

In the Austrian system, which is a modification of the Strowger system, every subscriber is provided with a special key which permits of a small manual exchange being called in the same building as the automatic exchange in case of failure of the automatic system. The attention of a called subscriber is obtained by the calling subscriber automatically in ten seconds, and, allowing three seconds for setting the figures on the telephone, a total of thirteen seconds is arrived at. At present M. Barth considers the time on the manual system in Europe to be half a minute! A 200-line automatic exchange in Vienna is found to work well, and little maintenance is required. The system will in the near future be largely extended.

M. Barth's conclusions are as follows:

(1) The Automatic Telephone System, if good apparatus is used, would give a more rapid and reliable service than a manual system.

(2) In large exchanges (over 10,000 subscribers) considerable economy would result from its use, and it would, moreover, render possible larger exchanges than could be installed on the manual system.

(3) For exchanges having between 500 and 1000 subscribers the automatic system should also be considered favourably from the point of view of its technical advantages, and for the reason that it permits of the growth, step by step, of central exchanges according to the needs of the Service. On the other hand the manual system is not nearly so elastic, and the enlargement of such exchanges in many cases involves monetary loss.

(4) In exchanges having less than 500 subscribers the automatic system is in general dearer than the manual system. It can only be recommended in those cases where quick and reliable working are considered to be the principal features of the problem.

Discussion on M. Barth's Paper.

Major O'Meara thanked M. Barth for his paper. He asked for information on the following points:

(1) The necessary dimensions for the automatic installation.

(2) The wages of the mechanics employed for the maintenance of the apparatus in these offices.

(3) The price of subscribers' sets for the automatic system.

M. Hultmann (Stockholm) said that small automatic exchanges for rural use had been used in Sweden for some years, generally with satisfactory results. He was of opinion, however, that the automatic system would in time give rise to complaint owing to the dislike on the part of subscribers to the performance of manual operations, and they would wish to return to the simpler method of operation. Notwithstanding this, however, he thought there was undoubtedly a future field for the automatic exchange.

M. Stegmann (Munich) thought the introduction of the automatic system depended more upon economical than technical conditions. The difficulty, in his opinion, lay in the possibility of distributing large networks without raising the cost of working.

M. Gutzmann (Berlin) said that the Strowger system installed at Hildesheim gave every satisfaction.

M. Hollós (Budapest) remarked that it would have been useful to have a more detailed description of the Austrian automatic system.

M. Steidle (Munich) pointed out that it might be possible to increase the practical capacity of the multiple by arranging for "group-working." Statistics showed that by grouping subscribers (as explained in his paper) a multiple of 10,000 jacks could easily be made to serve 60,000 subscribers.

Dr. Barth, in reply to Major O'Meara, said he had calculated upon 1 mètre square for fifteen subscribers; moreover, not so much light and air were required as in manual exchanges. Operators' wages were calculated at 1200 crowns per annum for large towns (24 crowns = £1), and 1000 crowns for small places. Mechanics are reckoned on 2000 crowns per annum. A subscriber's set costs 120 crowns, but it will be be cheaper when manufactured on a larger scale.

He informed M. Hollós that he would bring full details of the system to the next Conference.

In reply to M. Steidle, M. Barth observed that even supposing that M. Steidle by his excellent system could increase the capacity of a manual exchange from 10,000 to 60,000 or more, still for the very largest exchanges the automatic was the only remedy for the enormous cost of augmenting the Service by means of intermediate exchanges.

Note on M. Barth's Paper.

The "automatic *versus* manual" problem is one of the most absorbing subjects of discussion in the telephone world, and assuredly more will be heard of it in future. The great majority of telephone engineers have, however, up to the present considered that the cost of maintaining the automatic system is out of proportion to the benefit gained, but M. Barth, as the result of Austrian experience, thinks otherwise. The elasticity of an automatic system and its possibilities of large growth are all in its favour, but it should not be overlooked that there is at present a strong opinion in many quarters that the accommodation of more than 10,000 subscribers in one exchange is undesirable.

One wonders to what extent the facilities for obtaining the attention of a manual operator when the automatic fails will in actual practice increase the cost of the service.

The Austrian Administration is to be congratulated on its enterprise, and the outcome of the development will be looked forward to with interest at the next Conference.

TECHNICAL BASIS AND ECONOMIC RESULTS OF SEMI-AUTOMATIC TELEPHONE EXCHANGE WORKING IN RURAL AND URBAN AREAS.

By H. K. STEIDLE, Munich.

The problem dealt with in this paper is the best method of serving small groups of subscribers situated at some distance from a central exchange. There were a number of cases in Germany where such subscribers were formerly served by direct circuits to a central exchange at some kilomètres distance, and the author deals with the advantages to be gained by serving such subscribers by an automatic exchange connected with the nearest manual exchange by a number of junction circuits. The paper deals in detail with methods of determining the number of junction circuits necessary to carry the traffic with any given specified amount of delay; from this is deduced the most efficient and economical arrangement of junction circuits.

In order to obtain reliable data, an automatic registering apparatus was constructed to record the traffic on each subscriber's line. The details of this apparatus are as follows:

A revolving drum carries a paper register, and in the circuit of each subscriber is a pen actuated by the cut-off relay connection. The cylinder with its paper register revolves at a fixed rate, and normally all the pens make parallel straight lines upon it. During conversation, however, the pen is thrown out of its normal straight line, but makes a mark parallel to it so that the duration of each convervation is recorded.

There is also a recording ammeter in the circuit which gives the sum of all the currents circulating in the subscriber's circuits at any instant, and by the readings of this record the number of subscribers simultaneously engaged can be found.

A large number of records (comprising 100 cases) in different exchanges were taken to obtain *general* results, and from these results a graph was constructed to show what delay would result to a given number of conversations having available for their disposal one, two, three, etc. junction lines. The author finds, on the basis of the traffic figures obtained, that on the supposition that a small group had only twenty conversations per day and one junction circuit the delay would not exceed half a minute, but that if two junction circuits were available, instead of one, 100 calls could be disposed of, instead of 20, with the same delay, while with three lines and the same delay only 140 calls could be disposed of.

As a result of these studies the author finds it economical, where possible, to restrict the size of groups in such a way that calls can be satisfactorily disposed of by means of two junction circuits, unless special study shows that construction costs render this arrangement undesirable.

In the system described, each small group connected to a sub-exchange obtains intercommunication automatically, and also by similar means obtains communication over the junction circuits to the nearest central exchange; from that point communication is given by manual operators. The operators have, however, selectors in connection with the junction lines, which enable them to obtain communication with any subscriber in the sub-exchange group.

Note on M. Steidle's Paper.

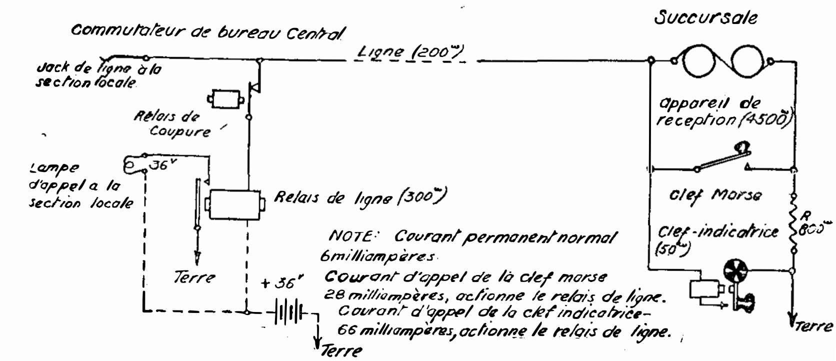
M. Steidle is to be congratulated upon having presented an interesting paper, quite out of the beaten track. The application of semi-automatic methods to small sub-exchanges certainly appears to have resulted in an improved service, and indeed to have filled in Germany the proverbial "long-felt want." M. Steidle's method of determining the necessary number of junction circuits for traffic of a given magnitude is also novel and ingenious.

CENTRAL BATTERY TELEGRAPH WORKING; TELEGRAPH INTER-COMMUNICATION AND CONCENTRATION SWITCHING.

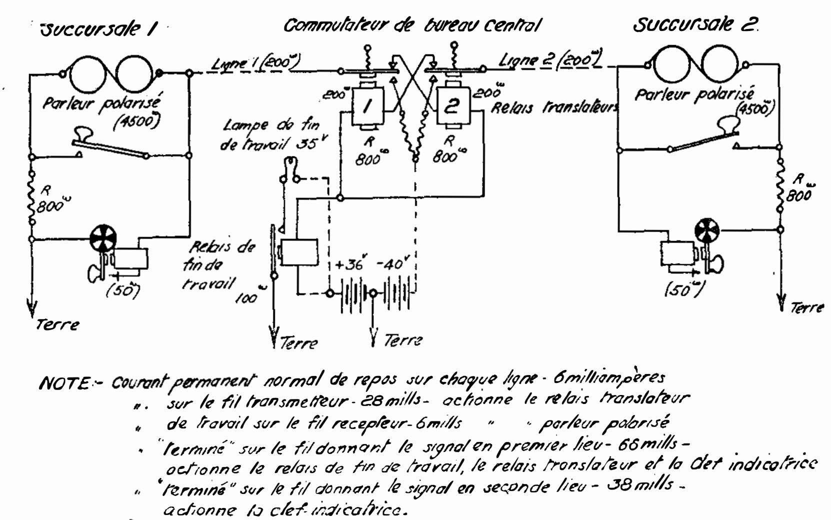
By T. F. Purves, London.

Mr. Purves discusses the economic reasons in favour of applying the Central Battery System to telegraph circuits, and proceeds to describe in detail the arrangements which the British Post Office has developed in this connection. The first step taken was the installation of the Metropolitan Inter-communication Switching System in the Central Telegraph Office, London. The latest developments of this system are described and illustrated by many carefully arranged diagrams. 3, 4, and 6 are reproduced here.

Traffic particulars are given, and the competition of the telephone system is referred to as a factor which has considerably reduced the number of messages circulating from one part of the Metropolis to another. The opinion is, however, expressed that in spite of this increasing competition the telegraph system will continue, for many years to come, to be an important and indispensable branch of the system of public communications. The recent extension of the switching system to embrace the various provincial divisions of the C.T.O. is briefly referred to. The system as a whole has allowed more than 12,000 primary cells

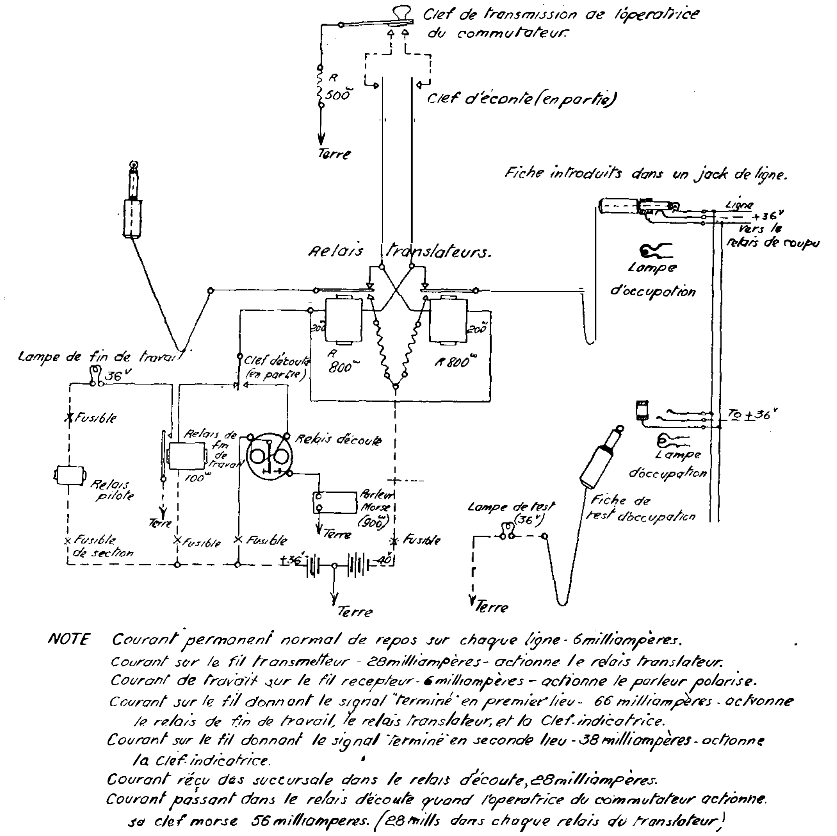


3.—Skeleton Connections of an Ordinary Inter-communication Circuit.

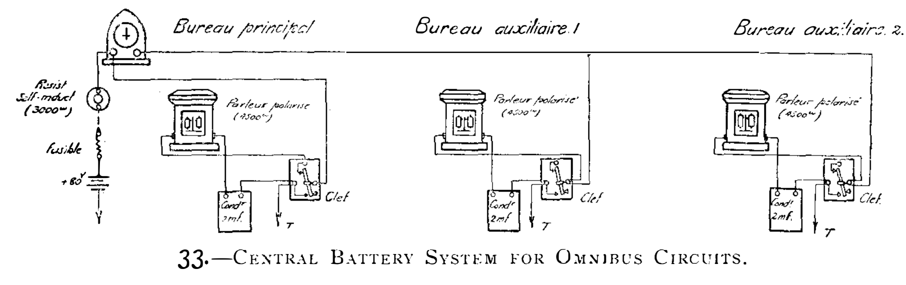


4.—Skeleton Connections of two Circuits Inter-communicating.

to be dispensed with, which in itself represents a maintenance saving of over £1000 per year. The average delay to messages passing across London has been reduced by the inter-communication switch from eighteen minutes to seven minutes. The output of messages per operator per hour has been reduced from twenty-three to eighteen. This is a drawback unavoidably associated with any system which substitutes successive through switchings for the method of dealing with messages in batches over direct wires. The slowing down is, however, much more than compensated for by the saving in re-transmission of London messages at the C.T.O.; this saving amounts to nearly 40,000 transactions a day. Arrangements for the simul-



6.—SKELETON CONNECTIONS OF PEG AND CORD CIRCUITS.



33.—CENTRAL BATTERY SYSTEM FOR OMNIBUS CIRCUITS.

taneous transmission of the 10 a.m. time signal to all London offices through the Inter-communication Switch are described, and several special items of apparatus connected with the system are described and illustrated.

Applications of Central Battery working to ordinary telegraph circuits and to circuits on concentrator switches are then described. These include various arrangements for simplex and duplex working. We extract the reference to the recently introduced method of working "Omnibus Circuits" from a central battery.

"Another recent development of Central Battery working which has proved of very great utility is shown by **33**. By means of this system an indefinite number of small offices may be grouped on a line and obtain communication with the Head Office and with each other. In this case condensers are used not only to save consumption of current, but to enable each office to signal by "double current" impulses to all its neighbours. This is probably the simplest double-current telegraph circuit ever devised, and at the same time the cheapest to instal and maintain.

"It will be seen that the apparatus sets at all stations are exactly alike, and consist merely of a polarised sounder, a Morse key, and a condenser of two microfarads capacity. We are now able to obtain these condensers for about 4 francs each."

"A single-pole battery is permanently connected to the line through a resistance which is large relative to the resistance of the line. In practice a coil of 3000 ohms wound inductively and sheathed in iron is used. The battery employed is one of about 80 volts, and the connection between the battery and the line is never broken. When the keys are at rest the line and all the condensers are charged to the full potential of the battery. The only current flowing is that due to insulation loss on the line."

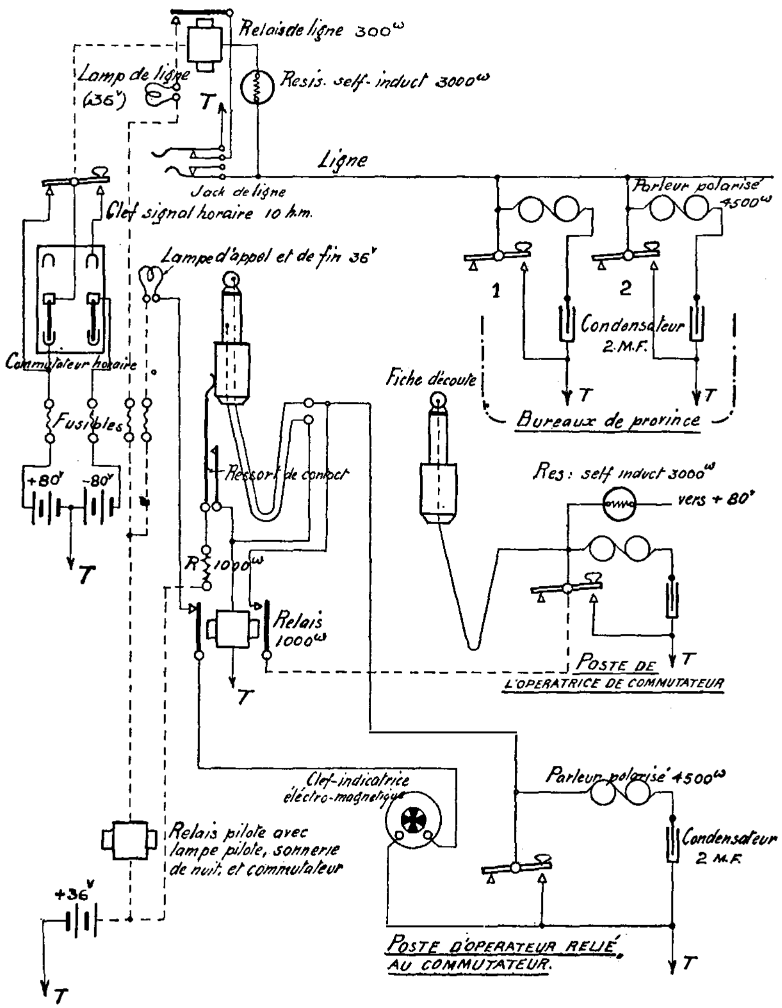
"If a key be depressed at any station the line is connected directly to earth. The potential of the whole line is thus brought approximately to zero, and the condenser at every station discharges itself through the contacts of the particular key which has been depressed. The discharge from each condenser traverses the polarised sounder, to which it is connected, and throws the striker against the 'marking' stop. When the key is allowed to rise the connection between the line and earth is broken, and all the condensers again take up their original charge. The impulse in this case acts in a reverse direction through all the polarised sounders, and throws back the striker of each to the 'spacing' stop."

"On account of the wide range of the polarised sounder, which I have already referred to, the system is workable on lines up to 80 kilomètres in length, and the insulation resistance may fall as low as 2000 ohms without stopping communication."

"This system is being rapidly introduced in England on all circuits which are of suitable character. About half of the work of conversion has been accomplished, and the saving in capital cost already effected is about 500,000 francs, while the estimated annual saving in maintenance charges is approximately 63,000 francs."

The following is extracted from the section dealing with concentrator switching :

"A proposal is now on foot to establish a concentrator switch



36.—Proposed Connections of Central Battery Concentrator Switch. C.T.O., London.

in the London Central Office capable of accommodating about 150 short provincial lines, most of which serve two or more small offices.

"It is intended to equip all the offices for central battery working, as described. 36 shows in skeleton the proposed connections of the switchboard, etc.

"Lamp signalling will be adopted, and the switch working sets will be provided with electro-magnetic Indicator Keys for calling and clearing, similar to those used on the inter-communication system.

"The lines will terminate on switch jacks with calling lamps, and the switch working sets will terminate on keyboard pegs with 'calling and clearing' lamps.

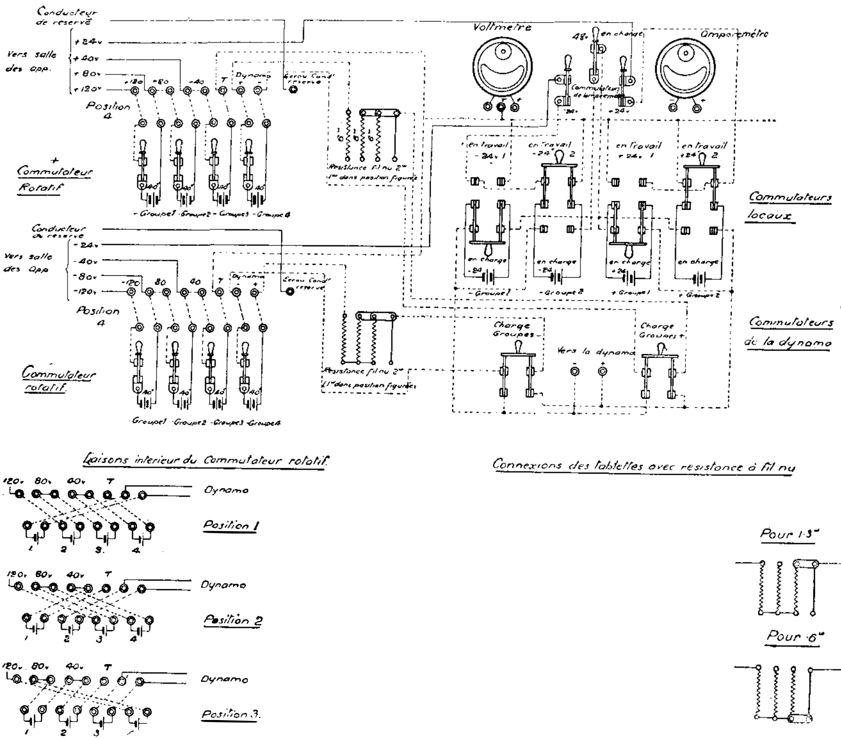
"The system of working will be as follows:

"A call from a distant station flashes the calling lamp and the switch operator connects the calling line with a working set by inserting a disengaged peg in the line jack. On completion of the message the clearing lamp is lit by means of the star key at the working set. The withdrawal of the peg automatically extinguishes the lamp and restores the star of the indicator key, informing the working set telegraphist that the line has been cleared and that a fresh call may be made.

"For traffic outwards from the head office the working set calls the switch by means of the indicator key, lighting a peg lamp; the switch operator lifts the peg, thereby closing a socket contact which actuates a double-tongued relay. This extinguishes the calling lamp, joins the switch operator's listening set to the calling instrument set, and informs the calling telegraphist, by restoring the star of the indicator key, that the switch operator is waiting to read the call. The telegraphist at once begins to call by repeating the code signal of the office wanted, and the switch operator inserts the peg in the proper line. By so doing the double-tongued relay is short-circuited (as will be seen from the diagram) and the listening set is automatically cut out of circuit. Clearing is effected as already described. The listening set is thus brought into circuit with any working set only while the corresponding peg is *travelling* (*i. e.* in the operator's hand). On restoring the peg to its normal position, or inserting it in any line jack, the listening set is automatically cut out of circuit. This simplicity in operating will considerably increase the number of lines which an operator can attend to. The listening set is also provided with a peg and a signalling key, in order that it may be used to speak on any line when necessary. It is expected that two switch operators will be able to attend to all the lines on this concentrator. It will of course not be necessary to multiple the lines."

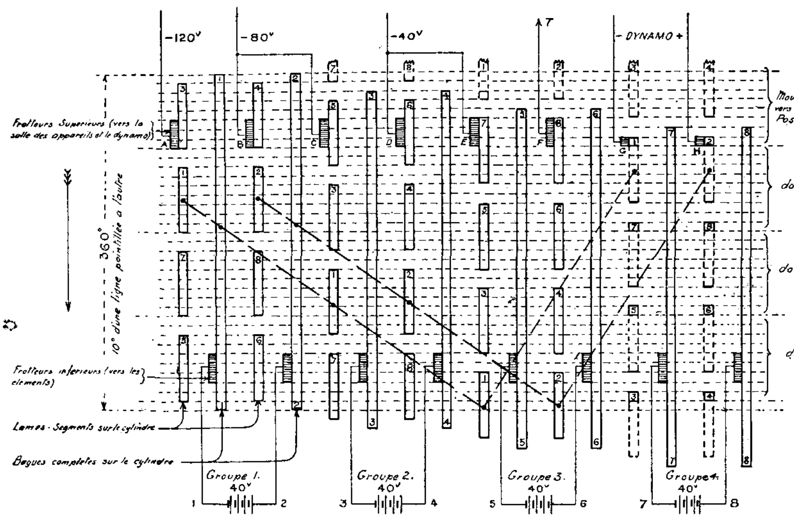
As many of our readers are probably not yet familiar with the new form of rotary switch now used for telegraph secondary cell installations, and no detailed description of it has yet appeared, we reproduce a reference to it which occurs towards the end of the paper.

"The main battery sets, supplying 40, 80, and 120 volts, consist of four groups of 20 cells each, and are manipulated by means of a rotary switch specially designed for the purpose. This switch has four positions, and in each position three of the groups of cells are joined up to the working leads, while the fourth is spare and available to be charged. The arrangement of the groups of cells and the connections of the rotary switches in each position are shown on 37. The connections are interchanged by means of a circular commutator barrel, set with contact rings and blades which engage in suitable fixed brush contacts. This commutator is mounted behind the slate tablet of the switch. The switch is turned by means of a



37.—CONNECTIONS OF SECONDARY CELL-SWITCH CABINET.

removable handle, stop pins being fitted on the side of the switch cabinet to limit the motion of the handle to a quarter of a circle. At some offices the switch is turned every day and at others every two days or three days, according to the period at which the cells require re-charging. The motion of the commutator is continuously in the same direction. When the switch is in position 1 the group of cells marked No. 1 is connected to the dynamo leads for charging; group 2 is supplying the 120-volt power; group 3 is supplying the 80-volt power, and group 4 is supplying the 40-volt power. We will now consider what happens when the switch is turned a quarter of a revolution. The first result is that the blades connected to the freshly charged group No. 1 break connection with the brushes on the leads to the charging dynamo. Group 1 is then joined to the brushes of the 40-volt power, where it is in multiple with group 4. An instant later group 4 is cut off from the 40-volt leads and joined in multiple with group 3 on the 80-volt leads. Then group 3 is cut off and joined in multiple with group 2 on the 120-volt leads. Finally group 2 is cut off and connected to the dynamo circuit in readiness to be charged up. 40 shows the



QUATRE POSITIONS DU COMMUTATEUR				
Posⁿ 1. = 1 à G, 3 à A, 5 à C, & 7 à E				
Premier displacement après 10°	1	Coupé de	G	
20°	1	prend contact avec		E
30°	7		E	
40°	7			C
50°	5		C	
60°	5			A
70°	3		A	
80°	3			G
Posⁿ 2 à 90° - 1 à E, 3 à G, 5 à A & 7 à C				
Seconde displacement après 100°	3	Coupé de	G	
110°	3	prend contact avec		E
120°	1		E	
130°	1			C
140°	7		C	
150°	7			A
160°	5		A	
170°	5			G
Posⁿ 3 à 180° - 1 à C, 3 à E, 5 à G & 7 à A				
Troisième displacement après 190°	5	Coupé de	G	
200°	5	prend contact avec		E
210°	3		E	
220°	3			C
230°	1		C	
240°	1			A
250°	7		A	
260°	7			G
Posⁿ 4 à 270° - 1 à A, 3 à C, 5 à E & 7 à G.				
Quatrième displacement après 280°	7	Coupé de	G	
290°	7	prend contact avec		E
300°	5		E	
310°	5			C
320°	3		C	
330°	3			A
340°	1		A	
350°	1			G

40.—CONNECTIONS OF COMMUTATOR CYLINDER. (BLADES IN POSITION 1.)

circular commutator barrel unwrapped as a flat surface, and indicates the relative positions of the rings, blades, and brushes. The dynamo brushes, marked " G " and " H," are made only one third the length of the other brushes, and the corresponding blades are shortened to the same lengths at the part where contact is made. This is in order that the dynamo connection to the freshly charged group of cells may be broken at the beginning of the motion of the commutator, and may remain disconnected until the end, when the group of cells thrown spare for charging is finally connected to the dynamo brushes. The above description of the successive stages of the movement may appear somewhat complex, but all the changes mentioned take place in a small fraction of a second, while the switch is being turned through a quarter circle. It will be seen that the power is not at any moment cut off from the supply leads to the instrument room, so that the working of the telegraph circuits, even by high-speed systems, is not interfered with in the slighest degree when the secondary cell switch is being operated. The different groups of cells pass through exactly the same cycle of work and rest. After having been charged each is connected, for an equal period, first to the 40-volt position where the working load is heaviest, then to the 80-volt and 120-volt positions, where the loads are successively lighter, and finally is thrown once more spare for re-charging. Want of uniformity in the work done by different groups of cells was one of the drawbacks of the system of switching which was previously in use. This has been completely overcome by the introduction of the rotary switches which I have described, and as a result the cells are now maintained much more easily in good condition."

Summary of Discussion on Mr. Purves' Paper.

Dr. Strecker (Berlin) said that in comparison with Berlin the very large number of town telegrams in London was very striking. Was not the reason for this that the telephone system is not yet developed sufficiently to meet the traffic requirements? Could the installation of this complicated system really be justified?

M. Kraatz (Berlin) said it appeared to him that the immediate answering of calls at sub-offices was essential for good service. In Germany the operators at such offices had to attend to other duties besides the telegraph, and he could scarcely see how satisfactory attention could be given.

M. Hollós (Buda-Pest) said Mr. Purves, in his admirable paper, had given diagrams applicable to present-day needs and future development. His solutions were really artistic, and he thanked him in the name of the Conference. This sentiment was greeted with applause.

Mr. Purves, in reply to Dr. Strecker, said there was some unavoidable complexity at the head office, but the apparatus worked well, and was easily maintained, whilst at the sub-offices the arrangements were simple, and very little attention was required. There was scope for cheap telegrams, as well as telephones; the former were more convenient in cases where an immediate reply was not required. Owing to the great size of London with its seven million inhabitants a very cheap telephone service was not possible, and there would probably always be many users of the telegraph service, which was both cheap and good. In the city proper, however, the telephone had largely supplanted the telegraph for local purposes, and in future it might be necessary to increase the radius of inter-communication in order to obtain the maximum benefit from it. The inter-communication switch saved the re-transmission of a very large number of telegrams a day, and its financial results justified its existence.

In reply to M. Kraatz, Mr. Purves said that at the smallest offices in London telegrams were only forwarded and not received. The operators at these offices frequently performed other duties, but as they never received telegraphic calls no disadvantage resulted. Generally speaking, at the larger offices where telegrams were received as well as forwarded, the traffic was sufficient to justify at least one assistant for telegraph duties, so that the difficulties mentioned by M. Kraatz did not exist in practice, considerable delay in answering calls being comparatively rare.

THE IMPEDANCE OF NON-UNIFORM TELEPHONE CIRCUITS.

By Prof. G. di Pirro, Rome.

This is a mathematical paper. It deals with cases of complex circuits made up of sections having different impedances in series, and with other impedances branched across the telephone loop; also the effect of transformers, etc., in such circuits.

Prof. di Pirro gives a *resumé* of the method of calculation applicable to such cases. In dealing with the question of impedance in telephone lines he has undoubtedly attacked one of the most complex problems in telephone transmission, and such studies form a valuable contribution to the existing literature on the subject. Unfortunately, however, we have available only a *resumé* of the complete mathematical argument which the professor promised, and we feel bound to express some disappointment that a more complete study is not forthcoming.

DESCRIPTION AND USE OF THE METHOD OF MEASURING TELEPHONE LINE CONSTANTS BY THE BARRETTER.

By M. Béla Gáti, Buda-Pest.

M. Gáti first briefly reviews the history of the measurement of telephone currents and then compares the different methods that have been adopted for this purpose. His conclusion is that the heating property of the current is the most useful for measuring purposes, and that the Barretter represents the most convenient apparatus for its application. A detailed description of the Barretter and auxiliary apparatus used by the author is given with particulars of the method of calibration and manipulation of the instrument. The author next gives results of tests of the line constants. They are briefly as follows: The insulation of paper cables at a telephonic frequency is less than 1 megohm per kilomètre. The capacity of a paper cable is in general less than that obtained at a steady current value, but the investigations do not yet permit of a general conclusion. For induction coils the effective resistance goes up 200 per cent. to 300 per cent. as compared with steady current measurements. In measuring attenuation on a very short cable, 5 km. in length, the received current was found to be greater than that sent out, and this was found to be so for an open line 40 km. in length. Other experiments are in progress.

Summary of Discussion on M. Béla Gáti's Paper.

Prof. di Pirro (Rome) observed that the low insulation (less than a megohm) found by M. Gáti in telephone cables had serious consequences for long-distance telephony. The smallest value of the attenuation constant was given by the formula $\beta = \sqrt{RK}$, where R is the ohmic resistance and K the conductance per unit of length.

Mr. Hill (London) asked M. Gáti what frequency he had used in obtaining his electrical constants.

M. Gáti replied that 1500 periods per second was employed.

Note on M. Gáti's Paper.

The measurement of telephone line constants is a comparatively new development, and the Hungarian administration are to be congratulated upon being in the van of progress in this respect. One of the most striking points brought out by the tests made by M. Gáti is the apparently low insulation of telephone lines at telephonic frequencies; the frequency taken (1500 per second) was, however, probably much higher than the mean frequency of speech. Low insulation is more serious in the case of loaded than unloaded lines, and yet in practice it has been found by the Post Office that speaking efficiency varies very little within wide ranges of insulation resistance.

Difficulty is, however, generally caused by low insulation—

which is usually also unequal—and this gives rise to inductive disturbance.

We hope to hear more of M. Gáti's interesting tests in future.

PRACTICAL APPLICATIONS OF THE LAWS OF TELEPHONE TRANSMISSION.

By J. G. HILL, London.

This paper is divided into two parts, the first of which explains the method of standard cable measurement and gives a diagram of connections of the Post Office artificial standard. The writer specially urges the desirability of adopting a uniform standard of transmission for international trunk communication, and points out how standard cable methods would permit of the practicability of any desired service between two given towns in different countries being determined without preliminary experiments.

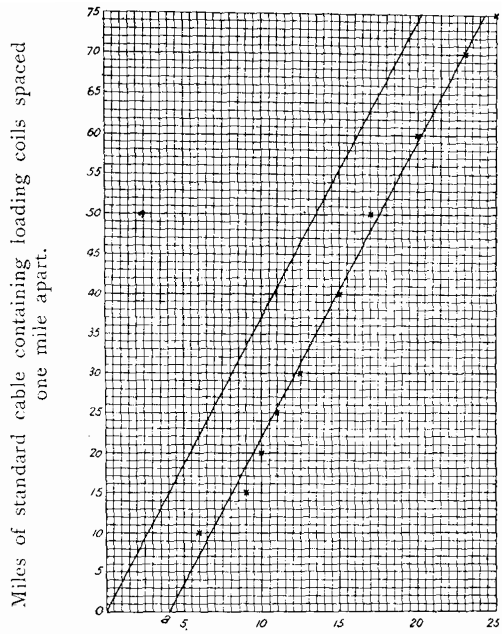
Detailed examples are given showing how to obtain the cheapest circuit which will be equal to any required standard of transmission.

The second portion of the paper deals with the insertion of Pupin or loading coils in underground circuits.

The greatest improvement obtained by loading Post Office circuits is to increase 3·7 times the length of a cable circuit which can be spoken over. The effects observed in a loaded circuit are complex and best explained by a graph 5. The simplest case is one in which a 20 lb. air-space cable is loaded and compared for efficiency of speech transmission with an exactly similar unloaded cable.

The values along the axis of x represent lengths of unloaded cable, and those along the axis of y indicate loaded lengths of the same cable, the coils being placed in the cable 1 mile apart.

The experimental results, denoted by the crosses, indicate lengths of the loaded and unloaded lines which were found to be equally efficient for speech transmission, and it will be seen that the crosses roughly follow a straight line. If, now, another straight line be drawn parallel to this line through zero it will be found that perpendiculars dropped on to y and x from any point on the line through zero have an invariable ratio, and this is the ratio of the lengths of the loaded and unloaded cables which give equality of speech transmission in the absence of what is known as "terminal loss." Loading, however, always gives rise to simultaneous improvement and loss. The loss is in this case indicated by the length oa along the axis of x, and this is the "terminal loss"; it arises from the difference in impedance between the apparatus and the line, brought about by the addition of inductance to the circuit. The heavier the loading, *i.e.* the more millihenrys per mile inserted in the cable, the greater the loss. It is a constant quantity for all lengths of circuit loaded with the same type of coil, and on very short lengths it may in certain circumstances be so great as to mask the improvement $\frac{y}{x}$. If the inductance of the coils is uniform all along the circuit the loss is greater than if the inductance is gradually tapered at the ends. It is greater



Miles of standard cable without loading coils.
Resistance of cable 85^{ω} per mile loop.
Capacity, wire to wire, per mile 0·07 mf.
Inductance of two windings of loading coil in series 250 millihenrys.

5.—Chart showing Improvement in Telephonic Speech effected by the Introduction of Loading Coils.

with the speaking apparatus joined direct to the ends of the loaded cable than if a length of unloaded line is interposed between the apparatus and the loaded line.

In fact, even if the inductance is uniform throughout the cable experiment shows that if several miles of unloaded cable, or, say, 50 miles of aërial line, are placed at both ends of the circuit between the apparatus and loaded line, the terminal loss practically disappears.

The attenuation constant of a loaded cable is given by the following formula:

$$\beta = \frac{R + \frac{R_1}{D} + A\frac{L_1}{D}}{2}\sqrt{\frac{C}{\frac{L_1}{D}}}$$

Where R = Resistance of the line loop per mile.
R_1 = The "effective" resistance of the loading coil.
D = The distance apart of the coils in miles.
C = Capacity of circuit per mile, wire to wire, in farads.
L_1 = Inductance of loading coil in henrys.
A = An empirical constant to be found by experiment.

All the electrical quantities must be effective, *i. e.* in this case they must be the apparent values observed at some frequency agreed upon as representing the mean frequency of speech.

The nearer together the coils are placed in the line the clearer is the articulation of speech, but practically they may be separated at various distances up to three miles apart or more, depending upon the amount of inductance in the coils and the electro-static capacity of the circuit. The maximum distance apart permissible may be calculated as follows:

$$25 = C_1 L_2 D_1$$

Where C_1 is the capacity in microfarads per mile loop.
L_2 the inductance of the coil in millihenrys.
D_1 the maximum permissible distance apart of the coils in miles.

This assumes that a frequency of 2000 per second represents the highest harmonic necessary for speech of sufficiently clear articulation for commercial purposes. It is an arbitrary determination and to some extent a matter of opinion.

A loaded cable of a given transmission value is generally much cheaper than an unloaded one of the same efficiency.

A number of graphs showing experimental results of tests of cable loaded with coils having iron cores and without cores are given.

Summary of Discussion on Mr. Hill's Paper.

Major O'Meara hoped that all the technical adminstrations of Europe would adopt a uniform method of comparing the transmission value of telephone lines. He thought the method adopted in England was sufficiently exact for practical purposes, and trusted that the permanent Committee would undertake the preparation of specifications for a standard cable and standard apparatus in connection with it for general use throughout Europe.

M. Krarup (Copenhagen) said that existing standard cables in different countries had at present different electrical constants. If immediate steps were not taken to secure a cable with fixed constants for general use confusion would result. He thought it would be too long to wait till the next Conference and that a small Committee should be elected to consider the matter. He thanked the English delegates for using the mètric system and hoped they would continue its use.

M. Collette (Amsterdam) objected to open a telephone service between two towns in different countries when communication could only be conducted in favourable conditions of line and apparatus as Mr. Hill appeared to favour. The service should at least be good in average conditions.

Prof. di Pirro (Rome) thought the results obtained were valuable, but did not quite see how the comparative values of wires as compared with standard cable had been obtained. He drew attention to the necessity for considering the impedance of circuits in the manner explained by Kennelly, and gave a mathematical example to show that when the impedance of two circuits is materially different, their relative value for speech transmission is not constant at all lengths.

M. Béla Gáti (Buda-Pest) asked whether any telephone speaking experiments had been made on multiple twin cable. It looked as if by bunching, say, with eight conductors, speech could be carried on over several hundred kilomètres.

M. Hollós (Buda-Pest) said the exact value of electrical constants was difficult to obtain by mere calculation, and for that reason it was more useful to rely on practical data such as Mr. Hill gave.

Mr. Hill said he agreed with M. Krarup as to the advantages which would result from the adoption of uniform electrical constants everywhere. He thought Major O'Meara's proposal to refer the matter to the permanent committee was the best way to deal with it.

In reply to M. Collette he recognised that no telephone service should be opened which only worked with difficulty, but he had laid down in his paper definite conditions which ought to be fulfilled before opening any service, and he thought them reasonable. He was of opinion that the committee dealing with the matter should determine by experiment the standard of speech to be adopted.

In reply to Prof. di Pirro, Mr. Hill said that the comparative values of different wires for telephone transmission is the comparative value of their attenuation constants. In ordinary unloaded lines the error introduced by difference of impedance is so small as to be negligible. In loaded lines, however, it was very great, but the standard cable method dealt with in his paper permitted of the losses due to it being readily determined, and this was evidenced by the curves he had given.

In reply to M. Béla Gáti he said that tests had been made on multiple twin cable, but the capacity of wires joined in parallel a pair at a time was 25 per cent. greater than that of one of the component pairs, and as a consequence it would be cheaper to use solid conductors instead of bunched pairs. The multiple twin or quad pair construction was, however, necessary in order to permit of superimposing in cables.

SYSTEMS OF PARTY LINES SERVING SEVERAL TELEPHONE STATIONS.

By F. GUTZMANN, Berlin.

The most common form of party line non-selective arrangement used in Germany is that for so-called "farmers' lines" in rural districts, where there are as many as twenty subscribers bridged on the same line. Ringing is by magneto, the signal bells being of high impedance, and having laminated iron cores instead of solid ones; this is said to give excellent results.

This type of service is only offered where the number of conversations is small and a cheap service is required.

The author next reviews some of the forms of party lines in use in America.

Exhaustive experiments have been made in Germany with the Dean Party Line System, in which the subscribers' bells only respond to impulses having a given frequency which is different for every subscriber. As a consequence of these experiments the Dean system has been modified for German use. For example, the voltage of 180 volts, which is often used in America, has been successfully reduced in Germany to 80 volts by a special design of coils and condensers in connection with the bells at subscriber's office. The frequencies in use are 1000, 2000, 3000 and 4000 per minute. Pole changers, fed by a central battery, are in use for ringing purposes at the Exchange.

Messrs. Hartmann and Braun have furnished a good frequency measurer, and this is absolutely necessary for testing the rate of vibration of the bells and the frequency of the ringers.

Small private exchanges worked by caretakers, etc., are being superseded where possible by what is called a system of "series connection with line choice." The essential features of this are as follows: The junction circuit from the exchange passes through break jacks in series in all the subscribers' offices and terminates in a bell in an attendant's office. In addition all the subscribers have separate lines to each other's stations. Inter-communication takes place on these lines. For exchange connections the subscribers come in on the junction circuit direct and an engaged signal is arranged for. If, however, the exchange requires a subscriber he must first call the attendant, who advises the subscriber to come in on the exchange line. The advantage of this system lies in the considerable saving of labour at the exchange and the disadvantage in increased cost of apparatus at subscriber's offices and lines. The subscribers must be relatively near to each other. The feeding of current to private branch exchanges is next considered. With fifty subscribers it is thought that a separate battery charged from the central exchange is best. For small offices dry cells are used. In some cases the number of cells for common battery working may be so excessive that local battery working would be preferable. Not much experience of feeding C.B. private exchanges direct from central battery exchanges has yet been obtained in Germany. A diagram shewing Siemens & Halske's method of feeding from a central exchange to a private branch exchange is given. On this arrangement the exchange connection is fed over the A line and the current for the private exchange over the B line.

An Automatic Strowger Exchange is on trial at Hildesheim. It has a capacity of 1100 subscribers with a present equipment of 900 connections. Connections between the various sub-offices are made by manual operators.

M. Gutzmann reviews at some length the up-to-date technical and financial aspects of party line working. It is quite evident that the German Administration keeps a watchful eye on all modern developments of this branch of telephony.

CUTTING OUT OF CIRCUIT (BLOCKAGE) OF INTERMEDIATE OFFICES ON LONG TRUNK LINES DURING CONVERSATION.

By JOSEPH HOLLÓS, Buda-Pest.

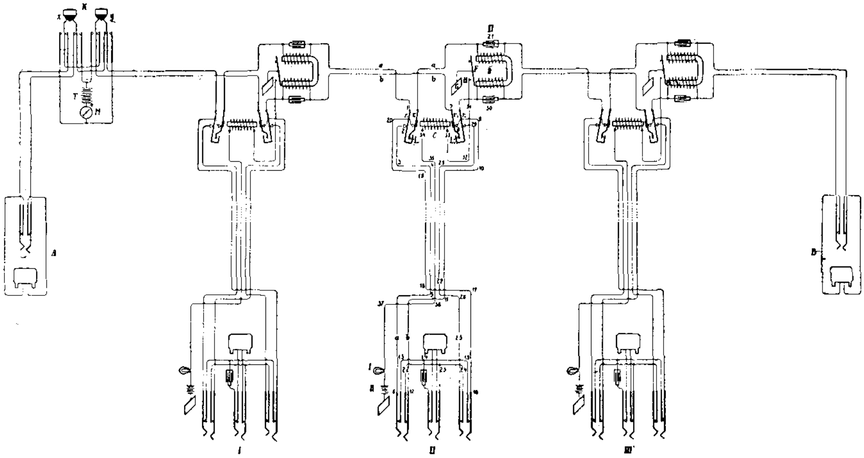
M. Hollós points out that there is a large amount of attenuation to speech currents in those portions of trunk circuits which are in towns and in trunk exchanges, on account of the small gauge wires used, apparatus bridged across the lines at the exchange, and owing to operators breaking in during conversation. He considers the effect on conversation to be so serious as to call for some device for specially cutting out all intermediate offices not actually engaged in the conversation, and an arrangement for that purpose has been developed for use on Hungarian long-distance circuits.

The arrangement is shown by 2.

The relay of the horseshoe form which we will call relay A has two independent windings, one in the A line and the other in the B line.

A condenser is, however, joined in parallel with each of these windings and it forms a shunt of low attenuation for voice currents.

The armature of relay A is, when attracted, joined in series with the winding of relay B (immediately beneath relay A), of which it completes the circuit. The armatures of relay B in turn cut out of circuit the four wires constituting the leads of the trunk circuit in and out of the intermediate telephone exchange. At the same time a lamp is lit at the intermediate office in order to give an engaged signal. The relay A can, if necessary, be placed on a pole outside



2.—CONNECTIONS OF A CIRCUIT ARRANGED FOR "BLOCKAGE."

the town in which an intermediate office is situated and it can be actuated by a current sent from a distant office. In this way M. Hollós finds attenuation reduced and speaking on long-distance circuits with intermediate offices proportionately improved.

NOTE ON M. HOLLÓS' PAPER.

One is glad to see how thoroughly the importance of reducing attenuation in long trunk circuits to a minimum is appreciated in Hungary. Probably, however, the conditions as to the number of offices in circuit, the gauge of internal wiring and the length of line led in from the main routes are different from those existing in this country, where the attenuation per office is usually not very great. In cases where long lengths of line are led into an office from a main route the small attenuation introduced by the cutting-out device itself would probably be much less than that due to the line plus office leads, etc. One of the greatest advantages of the device appears to be the prevention of apparatus shunts placed upon the line by operators listening in during conversation.

MULTIPLEX AND MACHINE TELEGRAPH SYSTEMS, AND DISCUSSION OF CIRCUMSTANCES IN WHICH THEY SHOULD BE USED.

By A. KRAATZ, Berlin.

Monsieur Kraatz states the general principles underlying multiplex telegraphy and machine telegraphy, and gives short descriptions of the Wheatstone system (with simplex and duplex repeaters), the Baudot, Murray, Rowland, Buckingham and Creed systems. Mechanical details are not touched upon, his discussion being confined to the working conditions and the electrical conditions of each system relative to the line used. He favours typewriter keyboards as conducive to the largest output per operator.

He is not sanguine as to the successful issue of the efforts now being made to work Baudot duplex.

The determining factor of speed on long lines is the time taken to transmit a current unit which will be able to actuate the distant receiving apparatus with certainty.

If the required duration of the current unit is equal to t seconds then $S = \frac{1}{t}$ current units per second can be transmitted. If, further, m current units are necessary for a letter and an average word contains n letters the speed of transmission will amount to $\frac{60\,S}{m\,n}$ words per minute. The Wheatstone system, using the Morse alphabet, requires on the average 8 current units per letter, while the Baudot and Murray systems require only 5 current units per letter. In German communications the number of letters per word may be taken as 7; in other languages the number may be 6 or 5. The number S is determined by the material, the capacity and the inductance of the line. Generally accepted values for S are:

$$\text{For iron wires,} \quad S = \frac{8{,}000{,}000}{CR}$$

$$\text{For copper wires,} \quad S = \frac{9{,}600{,}000}{CR}$$

$$\text{For cable wires,} \quad S = \frac{14{,}400{,}000}{CR}$$

As a general case we may write:

$S = \frac{A}{CR}$, where A is a factor depending on the material of the line, C is the *total* capacity, and R the *total* resistance.

The general expression for the speed of transmission is therefore:

$$G = \frac{60}{mn} \times \frac{A}{CR} \text{ words per minute, simplex.}$$

This assumes that the working capacity of the apparatus used is at least equal to the value G. In duplex working the value of G is not doubled, but after making allowance for various deteriorating factors it may be raised to 1·6 times its value for simplex conditions

Therefore, $G\,dx = 1{\cdot}6\,\frac{60}{mn} \times \frac{A}{CR}$ words per minute.

This method of expression is further developed and applied to various systems.

Advantages and disadvantages of the automatic and multiplex principles respectively are discussed, and the general conclusion arrived at is that automatic systems are, on account of their greater output, best for very long lines, and multiplex systems for shorter busy lines.

DESCRIPTION OF THE METHOD OF SUPERIMPOSING ON TELEPHONE TRUNK CIRCUITS ADOPTED IN FRANCE.

By M. BAZILLE, Paris.

The theoretical arrangement of the superimposed system is shown by **1**. It is found that if the Nos. 1 and 2 circuits are extended to other circuits inductive disturbance results and in practice transformers are inserted, as shown in **2**, in order to overcome the difficulty. The transformers at A, B, C, D **2** are considered to be necessary to maintain a proper balance when the transformer circuits 1 and 2 are extended, but those at E and F are merely inserted to avoid noise due to extension of the superimposed circuit to badly insulated lines. The transformers in use are designed by M. Cailho, a French engineer, and their efficiency is such that they do not attenuate speech to a greater extent than 500$^{\omega}$ resistance inserted in the line. The method of crossing wires on poles utilised in France for telephone circuits is similar to that employed in England, but instead of a quarter of a revolution at every pole a length of 500 mètres is the unit for a quarter revolution.

NOTE ON M. BAZILLE'S PAPER.

If the theoretical arrangement indicated in **1** could be adhered to, the transmission loss on circuits Nos. 1 and 2, due to the insertion of the coils used for superimposition, would probably be negligible, and we should have a highly-efficient superimposed system. If, however, transformers are found to be indispensable, as appears to be the case (*vide* **2**), the problem is quite altered. If the transformers are used for all extensions, long or short, as appears to be the case, it is not clear why the coils G, H, J, K could not be dispensed with as is actually done in the system adopted in this country. The transformers at E and F must undoubtedly have the effect of reducing

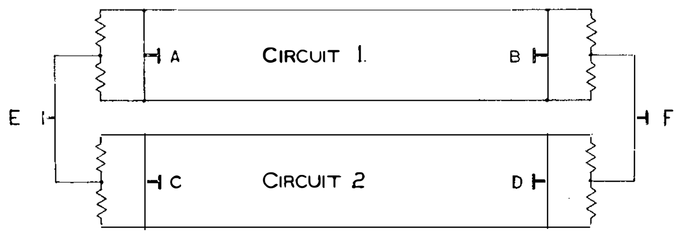


FIG. 1

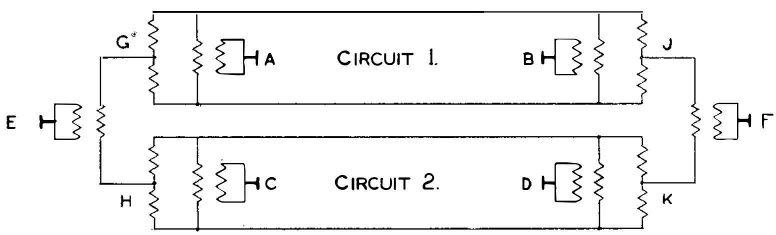


FIG. 2.

disturbance, as is actually found to be the case in France, when the plus circuit is extended to unequally insulated lines, but on the other hand these transformers cause attenuation, and it is interesting to note that they are not considered necessary in plus circuits in this country.

THE BAUDOT TELEGRAPH SYSTEM.

By M. BAZILLE, Paris.

This is mainly a description of the diverse conditions of traffic, etc., that can be met by the Baudot System in some of its special adaptations. These are divided into five categories:

(1) Between two stations served by one wire; service as double, triple, quadruple, or sextuple, the number of channels in each direction being grouped according to requirements.

(2) Three stations, A, B, C, grouped on one wire.
Double echelon, transmissions A to B; A to C.
,, ,, complete, transmissions A to B; A to C, B to C.
Triple echelon, transmissions A to B (2); A to C.

Triple echelon, complete, transmissions A to B (2) ; A to C, B to C.
,, ,, ,, special, transmissions A to B (2); B to C (2); A to C.
Quadruple, double echelon, transmissions A to B (2) ; A to C (2).
,, triple ,, ,, A to B (2) ; A to C (2); B to C.

(3) Repeator installations on two-station lines from 1150 to 1200 km. for double Baudot ; 950 to 1000 km. for triple, 750 to 800 km. for quadruple, and 550 to 600 km. for sextuple Baudot.

The *rectified* re-transmission effected by the new design of Baudot repeater is described.

(4) Installations serving three stations with re-transmission at the intermediate station. In this category are described amplifications of the conditions in category (2), necessitated by the presence of the repeater at the intermediate station.

The greatest development mentioned is quadruple quadruple on a forked circuit with re-transmissions at the intermediate station B, and comprising eight transmissions—A to C (2), A to D (2), B to C (2), B to D (2).

(5) Installations for underground lines. In general two wires are used for the same apparatus set, one for transmission in each direction. This permits of repetition at intervals of about 150 km. by the simple insertion of a relay in each line.

Communications serving two stations:

Double.—Four simultaneous transmissions.

Double and triple conjoint.—Four or six simultaneous transmissions.

Communications serving three stations :

Double echelon complete, six simultaneous transmissions.

Double and triple echelon complete, six or eight simultaneous transmissions.

Although two wires were until recently considered absolutely necessary for subterranean working, they are now found to be necessary only on long lines. This was demonstrated by experiments which practice has since confirmed.

M. Bazille also discusses operating conditions, and the output of the Baudot apparatus as compared with that of the Hughes.

COMPARATIVE RESULTS OF NEW TELEGRAPH SYSTEMS.

By J. Hollós, Buda-Pest.

M. Hollós refers to the large number of new telegraph systems recently invented, the Rowland, Pollak Virag, Murray, Siemens-

Halske, etc., and asks the reason why, in spite of this enormous output, these ingenious and excellent devices are not more widely used in practical telegraphy. It is evident that the ideal system of telegraphy must be one which will adapt itself without excessive delay on the one hand, or waste of personnel on the other, to a greatly fluctuating load.

The output of various systems per hour may be taken as follows:

(1) Morse Simplex	. 1,500 words, or in proportion of		1
(2) ,, Duplex	. 2,700 ,, ,, ,,		1·8
(3) Hughes Simplex	. 3,600 ,, ,, ,,		2·4
(4) ,, Duplex	. 5,760 ,, ,, ,,		3·84
(5) Baudot Quadruple	. 5,760 ,, ,, ,,		3·84
(6) Rowland Octoplex	. 20,000 ,, ,, ,,		13·33
(7) Murray Duplex	. 22,000 ,, ,, ,,		14·66
(8) Siemens-Halske	. 24,000 ,, ,, ,,		16·00
(9) Pollak-Virag .	. 50,000 ,, ,, ,,		33·33

But these are figures only. They show that under perfect conditions so many words can be transmitted, but they do not represent telegraph traffic. M. Hollós proceeds to discuss the practical bearings of the matter and various pros and cons in connection with machine telegraphs, multiplex telegraphs, and direct hand-worked wires. He tabulates the relative cost of various systems as follows: the figures are based on a distance of 600 km. and on a traffic of 60,000 words in 10 hours each day.

Item.	1 Hughes Simplex.		2 Hughes Duplex.		3 Braudot Quadruple.		4 Rowland Octoplex.		5 Murray Duplex.		6 Siemens Halske.		7 Pollak Virag.	
	Cost fcs.	%	Cost fcs.	%	Cost fcs.	%	Cost fcs.	%	Cost fcs.	%	Cost fcs.	%	Cost fcs.	%
(1) Line . . .	57,600	50·8	38,400	47·9	38,400	37·9	21,600	27·6	21,600	24·9	21,600	24·1	43,200	39·3
(2) Apparatus .	7500	6·7	8416	9·7	29,000	28·7	10,700	13·7	11,640	13·4	14,490	16·1	14,040	12·4
(3) Personnel (per annum) . .	48,200	42·5	33,800	42·4	33,800	33·4	46,000	58·7	53,700	61·7	53,700	59·8	53,700	48·3
Totals . .	113,300	100	80,616	100	101,200	100	78,300	100	86,940	100	89,790	100	110,940	100

These figures do not profess to be absolutely correct, but M. Hollós thinks the information they give is very instructive, and goes far to explain why so many of these brilliant and ingenious inventions have failed to find favour, and why so many circuits continue to be worked by the Morse Manual System. As a multiplex telegraph he favours the principle adopted by M. Mercadier, which permits of the use of varying numbers of ordinary manual sets on the same wire according to the fluctuation of requirements. He thinks that the future belongs to a system which will combine this great flexibility with the use of keyboard transmitters and type-printing receivers.

Major O'Meara furnished the Conference with the following information associated with the subject of Monsieur Hollós communication:

Comparison of the Murray, Wheatstone, Baudot, Hughes, and Morse Quadruplex Systems.

In order to determine the value of the Murray automatic system as compared with other systems in use by the Post Office, it was necessary to ascertain by an actual trial, under uniform conditions, the output, working expenses, and other particulars of each system under review. For this purpose returns were taken of the working of each system during a period of two consecutive weeks between the hours of 11 a.m. and 4.0 p.m. when the traffic is at a maximum.

Only experienced operators were employed during the experiments so as to eliminate, as far as possible, the personal factor.

The results of the trials have been tabulated and are furnished for the information of the Conference.

For the Hughes and Quadruplex systems figures were selected from existing returns of the best fortnight's working on record.

The Murray system is in use only between London and Dublin, and the Baudot system only between London and Paris. It was, therefore, considered desirable to make the Wheatstone experiments between London and Dublin. The Quadruplex trials had previously been made on a London–Dublin circuit and the Hughes on a London–Glasgow circuit.

The traffic conditions between London and Paris differ considerably from those existing between London and Dublin. Between the English and French capitals the stream of traffic available enables the operators engaged in the test to be kept constantly employed, but between London and Dublin one high-speed circuit will comfortably carry all the work and frequently have idle periods.

As several circuits between London and Paris are fully engaged, any delay which may arise cannot be imputed to a particular circuit; and on the other hand the absence of delay on any particular circuit cannot be solely credited to that circuit, since the expeditious transmission of the traffic is dependent on the satisfactory working of all the circuits.

Between London and Dublin there are four Duplex Morse circuits, but the whole of the work was generally disposed of upon a single test circuit, which was worked for one fortnight by the Murray system and for another fortnight by the Wheatstone system.

It was ascertained that the "circuit delay" with the Murray system, *i. e.* the average period from the time the message was placed at the circuit for transmission to the time that the same message was printed or written up at the distant station, was very nearly the same as that with the Wheatstone system. In the case of the Baudot the delay was erratic, but for the reasons already explained it would perhaps be unfair to compare it with the Wheatstone or Murray.

With regard to the output of each circuit the steady flow of traffic which was always available for the Baudot test circuit during the trial gave it a considerable advantage over the other two systems, on which the stream was by no means continuous. Therefore a comparison of actual output with the Baudot would scarcely be fair, but an attempt has been made to allow for this factor in the tabulated results by showing also the total amount of work that could have been disposed of if the test circuit had worked continuously.

The speed of the Murray was limited by the speed of the receiving apparutus, and this was about 95 words per minute, as a maximum, duplex. The Wheatstone circuit could have been worked up to about 250 words per minute duplex, but as the traffic was not sufficient to justify this speed a speed of 188 words per minute was used throughout the test. The carrying capacity of the Wheatstone circuit, so far as the line is concerned, could therefore have been increased about 25 per cent. on the figures shown in Column 12, Schedule A. The cost for staff would, however, have been correspondingly increased.

It will be seen that the Murray output per *operator* per hour worked out at 31 per cent. higher than the Wheatstone, and the Morse Quadruplex at 46 per cent. higher than the Wheatstone, but in the last mentioned case the strain on the operators is great.

The Murray circuit could not at times carry the whole of the London-Dublin traffic without incurring excessive delay, and additional wires worked by Morse sounder were then brought into use. Three wires were available for this purpose and for occasions when the Murray set stopped for adjustment or on account of apparatus defects, but it is thought that the cost of working and maintaining these wires cannot properly be debited to the Murray system. On the other hand, in comparing the value of a Murray circuit with that of a Wheatstone circuit between two centres, it would perhaps be fair to take into consideration the fact that stoppages of the former are more frequent and of much longer duration than is the case with the Wheatstone system, and that a larger proportion of expensive spare apparatus is therefore required.

SCHEDULE A.—*Return showing the Actual Amount of Traffic dealt with during Special Experiments covering a Period of a Fortnight between the Hours of* 11 *a.m. and* 4 *p.m. Mondays to Fridays, and* 11 *a.m. to* 2 *p.m. Saturdays, on the undermentioned Systems :*

Wheatstone Duplex	*between*	*London and Dublin.*
Murray Automatic	,,	*London and Dublin.*
Quadruplex	,,	*London and Dublin.*
Baudot 4-arm	,,	*London and Paris.*
Hughes Duplex	,,	*London and Glasgow.*

System.	Circuit.	Period of return fortnight ending	Actual number of messages dealt with.	Average number of words per message, including preamble.	Equivalent number of messages calculated on a basis of 21 words per message.	Number of messages per operator per hour calculated on a basis of 21 words per message.	Sum of idle periods of line due to				Calculated maximum output of 21 word messages assuming no line interruption and sufficient traffic to occupy the wire.
							Line interruptions (hours).	No traffic (hours).	Total time (hours).	Expressed as a percentage of whole period.	
1	2	3	4	5	6	7	8	9	10	11	12
Wheatstone	TS—Dublin	April 11, 1908	12,239	21	12,239	27·2	·2	21	21·2	37·8 %	*19,695
Murray . .	,,	May 16, 1908	12,994	21	12,994	35·7	1·0	6·1	7·1	12·6 %	14,880
Quadruplex	,,	Oct. 27, 1906	8,946	21	8,946	39·9	·6	No record	·6	1·0 %	9,035
Baudot . .	TSF—Paris	April 11, 1908	17,426	18·4	15,268	45·3	1·0	1·0	2·0	3·5 %	15·833
Hughes . .	TS—Glasgow	Feb. 29, 1908	6,380	21·8	6,623	29·5	*Nil*	*Nil*	*Nil*	—	6,623

* At speed of 188 words per minute. At 250 words per minute possible output would have been 26,190 messages.

SCHEDULE B.—*Schedule showing the Actual Cost incurred by the Different Systems, at the London End of the Circuit only, in dealing with the Traffic represented in Schedule A.*

System.	Circuit.	Period of return, Mondays to Fridays, 11 a.m. to 4 p.m. Saturdays, 11 a.m. to 2 p.m., fortnight ending.	Total number of messages calculated on a basis of 21 words per message.	No. of operator hours. At circuit.	No. of operator hours. Away from circuit.	Cost of staff. TS mean of scale 44s. (11d. per operator hour).	Cost of staff. TSF mean of scale (48s. 6d. (11·62d. per operator hour).	Establishment, etc., charges; 12 per cent. on Columns 7 and 8.	Cost of slip.	Engineering costs from Schedule D.	Total cost per fortnight at the London end.	Cost per 1000 messages at 21 words each.
1	2	3	4	5	6	7	8	9	10	11	12	13
						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Wheatstone	TS—Dublin	April 11, 1908	12,239	408	—	18 14 0	—	2 4 10	0 15 7	0 10 10	24 8 3	1 19 11
					42	1 18 6		0 4 8				
Murray	,,	May 16, 1908	12,994	364	—	16 13 8	—	2 0 0	1 15 0	8 3 0	28 11 8	2 4 0
Quadruplex	,,	Oct. 27, 1906	8,946	224	—	10 5 4	—	1 4 7	*Nil*	0 4 1	11 14 0	1 6 1
Baudot	TSF—Paris	April 11, 1908	15,268	336	—	—	16 5 4	1 19 0	0 3 5	5 2 10	23 10 7	1 10 9
Hughes	TS—Glasgow	Feb. 29, 1908	6,623	224	—	10 5 4	—	1 4 7	0 1 9	1 7 8	12 19 4	1 19 1

SCHEDULE C.—*Statement of Engineering Costs.*

System.	Life in years (n.).	Capital cost. Cost of apparatus, leads, etc.	Capital cost. Royalties (outright payment).	Interest on Capital (2) and (3) at 3 per cent. per annum.	Cost of maintenance.	Sinking Fund at 3 per cent. per annum for n. years. (See columns 1, 2, and 3.	Establishment charges 15 per cent. on columns 4, 5, and 6.	Contingencies $2\frac{1}{2}$ per cent. on columns 4, 5, 6, and 7.	Total annual expenditure.	Cost per fortnight.	Cost per day.
	1	2	3	4	5	6	7	8	9	10	11
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Murray	8	1020 0 0	600 0 0	48 12 0	144 0 0	167 0 8	53 18 11	10 6 9½	423 18 4½	16 6 1	1 7 2
Baudot	12	768 0 0	—	23 11 7	148 0 0	55 7 7	34 0 10	6 10 6	267 10 6	10 5 9	0 17 2
Hughes	13	330 0 0	—	9 18 9	30 0 0	21 2 8	9 3 1	1 15 1	71 18 10	2 15 4	0 4 7
Wheatstone	13	184 0 0	—	5 10 5	6 14 0	11 15 8	3 12 0	0 13 9	28 5 10	1 1 9	0 1 10
Quadruplex	17	72 0 0	—	2 3 3	3 12 0	3 6 2	1 7 3	0 5 2	10 13 10	0 8 3	0 0 8
Duplex	15	61 0 0	—	1 13 4	0 16 11	3 5 7	0 17 5	0 3 4	6 16 7	0 5 3	0 0 5
		The Royalty included on the basis of the ten years which the patent still has to run.									

IMPROVEMENTS IN APPARATUS FOR CLOSED CIRCUIT TELEGRAPH WORKING.

By S. MONTINARI, Rome.

Monsieur Montinari's communication referred principally to the difficulties experienced in closed circuit working through the failure of the operators to restore the continuity of the circuit by replacing the key switch at the end of a communication. This difficulty we can well believe to be a serious one. He described various devices for imparting an automatic character to the key switch, notably one which he had himself devised.

Under the key base he provides a permanent magnet with soft iron pole-pieces projecting through the base. On the key lever is hinged a palette provided at its lower end with an armature of soft iron, which is normally held against the pole-pieces of the magnet and thus maintains the continuity of the circuit through contacts of platinum. The upper end of the hinged palette carries a curved ebonite piece, the normal position of which is just in front of the signalling knob of the key. When the operator grasps the knob the pressure of his fingers naturally forces forward the upper end of the palette and thus breaks the contact between the armature and the magnet poles. This opens the circuit preparatory to the sending of signals from the key. When the contact has once been broken there is little or no pressure of the palette upon the fingers of the operator, but whenever the hand is removed from the key the palette swings into a vertical position, the armature comes again within the influence of the magnet and is attracted. The contact restoring the continuity of the line is thus automatically made and firmly maintained while the key is at rest.

DESCRIPTION OF COMMON BATTERY SYSTEM EMPLOYED IN SWEDEN.

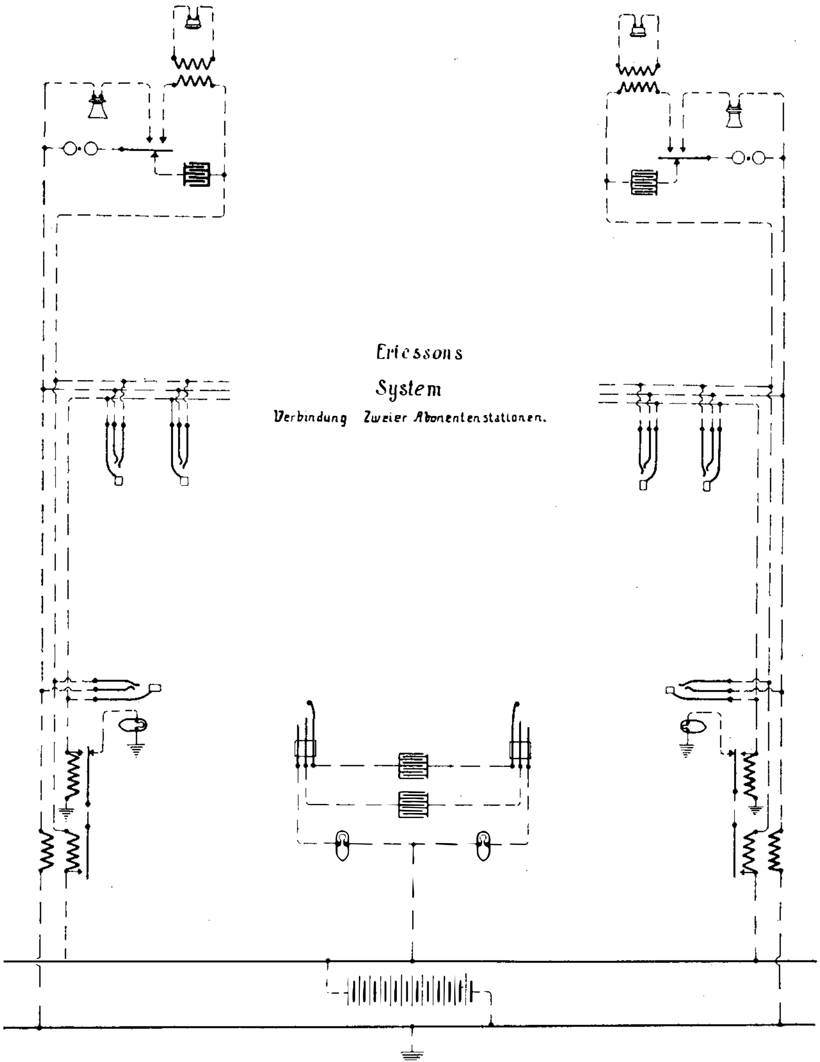
By A. HULTMANN, Stockholm.

Up to the present a Common Battery exchange has not been installed in Stockholm, but a very large exchange is now being built. On account of the large size of the plant the jacks and plugs are to be made very small, and it is considered important to reduce the number of wires in the cord circuit from three to two. It has been calculated in Copenhagen that the difference in the cost of maintenance of 2- and 3-line cords for 15,000 subscribers amounts to nearly £1000 per annum.

In many Swedish towns Common Battery switchboards of the

Ericsson type are installed, and the author gives a detailed account of the working of this system.

The main points are that the cord circuit is a 3-wire circuit, the transmission portion of which is arranged on the "Stone"



I.—ERICSSON'S SYSTEM OF CONNECTING TWO SUBSCRIBERS' STATIONS.

system with condensers on the two speaking wires and a signalling relay in the third conductor. There are no "clicks" in the subscriber's telephone as a consequence of inserting or withdrawing pegs at the exchange, owing to the fact that the battery connection with the line is never broken.

A new feature is a cut-off relay for long-distance conversations, whose function it is to cut off not only all multiple and answering jacks, but also the intermediate switchboard employed in the system and all cabling.

Space does not permit of dealing with the matter at greater length, but the theoretical diagram, 1, is fairly self-explanatory and may be of interest.

M. Hultmann went into the details of the Ericsson system very thoroughly, even going so far as to bring to Buda-Pest two fully equipped working models in order to demonstrate its working practically.

The Ericsson C.B. system is used in many places on the continent, but not in England, although its characteristic features are, of course, well known to telephone specialists in this country.

ANNIVERSARY OF INTERNATIONAL TELEGRAPH UNION.

To commemorate, in 1915, the fiftieth anniversary of the inception of the International Telegraph Union, which dates back to 1865, the recent Lisbon Conference of the Union decided to erect a monument, the cost of which will be about £8000. It was proposed and agreed that the site of the memorial should be in the city where the movement was inaugurated—Paris, but the French Government afterwards suggested that it should be erected in Berne, Switzerland, to accompany the monument about to be erected there by the International Postal Union, in connection with the commemoration of the inauguration of that Union. The amendment was passed, and therefore both monuments will be erected at Berne.

THE INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS, HELD IN LONDON, OCTOBER, 1908.

By MAJOR W. A. J. O'MEARA, C.M.G.

THE year 1908 will be memorable for the large number of International Conferences held during the twelve months in question. At the same time that the Technical Officers of the Telegraph and Telephone Administrations of Europe were attending their first International Conference at Budapest, members of the legal professions and others interested in legal questions were also gathered together at an International Law Conference in the same city; in Paris there have been held International Congresses on Roads, and also on Cold; in London official delegates representing many countries have attended an International Conference on Electrical Units and Standards and also an International Electrotechnical Commission; and this list does not pretend to include all the International Conferences of the year.

Readers of this JOURNAL will be interested to learn that past and present members of the Post Office Engineering Department have taken part, as delegates, in three of these Conferences. An article dealing with the visit of the representatives of the Engineering Department to Budapest appears in the current number of this JOURNAL, and it has been thought that a short reference to the proceedings of the recent International Conference on Electrical Units and Standards may also be of interest.

The latter conference owes its inception to a resolution having for its object the realisation of international agreement on the subject of electrical units, which was agreed to by the delegates of many countries during the Great Exhibition at St. Louis in 1904. The British Government responded to that resolution by making preparations for a Conference on Electrical Units, which was to have been held in London last year. It was, however, found desirable to postpone the consideration of the questions involved for another twelve months, and in consequence the invitations for the Conference were not issued by the British Foreign Office to the countries interested in the question of electrical units until early this year. The British Government has every reason to be gratified with the response to its invitation, for it was accepted by twenty foreign governments, and Australia, Canada, the British Crown Colonies, and India also nominated delegates. Forty-three official delegates, among whom were included many of the foremost men of science of the day, took part in the proceedings of the Conference, which was opened by Mr. Winston Churchill, President of the Board of Trade, at the Rooms of the Royal Society on October 12th, 1908.

The President of the Board of Trade, in his opening address, gave a very clear indication of the purpose for which the Conference had been called together; in his own words: "It is not within the scope of such a Conference to formulate laws for governments and nations. It is its business to define in clear and accurate expression those scientific quantities in terms of which electric energy is bought and sold, and if possible to embody its conclusions in draft articles which may form the basis of legislation and administration so far as electric units and standards are concerned. You must not rest satisfied merely with providing that the electric standards of the world shall be identical in 1908; your steps must be directed towards securing a permanent and expanding uniformity."

M. Lippmann (France) and Professor Warburg (Germany) made suitable replies to Mr. Winston Churchill's address, who then proposed the Draft Rules of Procedure, which were based on those of the recent International Conference on Wireless Telegraphy held at Berlin. This proposal was accepted unanimously. The right honourable gentleman, having appointed Lord Rayleigh President of the Conference in accordance with the rules just adopted, withdrew.

The President of the Conference, having taken possession of the chair, nominated the vice-presidents and secretaries, and also appointed a technical committee "to draft specifications, to consider any matter that may be referred to the Committee, and to report to the Conference." These formalities having been completed, Mr. A. P. Trotter proceeded to propose the first resolution, in which the Conference was asked to agree that the fundamental electrical units should continue to be determined on the electro-magnetic system of measurement, with reference to the centimetre as unit of length, the gramme as unit of mass, and the second as unit of time. In his introductory remarks Mr. Trotter explained that the delegates were only being called upon to confirm the system upon which electrical measurements have been based for nearly forty years. He pointed out that the C.G.S. System had been so universally accepted in electrical science and in electrical industry that the ohm, the ampère, and the volt occupy a position of more fixed and international character than is enjoyed by any other unit of measurement. He also took care to point out the importance of maintaining a clear distinction between the unit and the standard. It is generally recognised that it is owing to this very point having been overlooked that some countries now find themselves in trouble in connection with their legislation on electrical standards.

From the earliest days, in all human activities involving measurements, standards have always made their appearance first, and in this respect there has been no exception in the cases of electrical science and electrical industry, as was pointed out by Mr. Trotter. He brought home to the Conference that telegraphy stands in the position of the earliest pioneer in the field of electrical industry, for he reminded the delegates that the Daniell cell, which accidentally approximated to the volt, and the mile of telegraph wire of former days, which was about seventeen times greater in resistance than the ohm, formed the arbitrary and conventional standards of the early days of electrical industry. He proceeded: "But of so great scientific importance is the system of practical units derived from the absolute C.G.S. units that they have been adopted as the basis of all electrical magnitudes, notwithstanding the fact that the precision of our measurements of standards far exceeds the accuracy of our knowledge of the values of the units they are intended to represent. We know the value of the ampère to a few parts in 100,000, and it is probable that before long our knowledge of the ohm will not fall far short of an equal precision with the advance of physical science; we shall continually approach nearer to the true values, and we do so in confidence that the C.G.S. system of units is a foundation worthy of supporting the monuments which we have raised to the great men whom we honour by recalling the names of Ohm, of Ampère, and of Volta."

The first resolution, having been moved, was agreed to unanimously. This resolution contains that which has perhaps now become a fixed article of faith on the part of scientific men as to the system of units most suitable for all their purposes, and was the only one of the resolutions of real consequence before the Conference on which, it can be said with certainty, *unanimity* prevailed.

The succeeding resolutions gave rise to prolonged discussions, and in consequence a very large amount of space in the JOURNAL would be occupied if they were dealt with fully. Those who desire to go more deeply into the matter will be able to do so when the proceedings and minutes of the Conference are published. In this article it is proposed only to touch very briefly on the various matters discussed by the Technical Committee, and the action taken by the Conference on the resolutions brought before it.

The second resolution, which was also moved by Mr. Trotter, ran as follows:

"As a system of units representing the above and sufficiently near to them to be adopted for the purpose of trade and commerce, the Conference recommends the adoption of the International Ohm, the International Ampère, and the International Volt, defined according to the following definitions."

The use of the words "for the purpose of trade and commerce" in the resolution gave rise to some discussion, and M. Lippmann (France) pointed out that three propositions were included in the resolution. It was agreed that it would be premature to adopt the resolution at this stage, and in consequence its further consideration was postponed. The question was further debated at the third meeting of the Conference, and finally the resolution was amended to read:

"As a system of units representing the above and sufficiently near to them to be adopted as a *basis for legislation*, the Conference recommends the adoption of the International Ohm, the International Ampère, and the International Volt, defined according to the following definitions."

There was still some doubt in the minds of some of the delegates as to the appropriateness of the words employed, and it was suggested that the word "standards" should be substituted for "units." The resolution in the amended terms was, however, put to the vote and carried, twenty-one countries being for and three against the resolution.

The definition of the International Ohm consisted of two parts, and both resolutions dealing with this standard were moved by Professor Warburg (Germany). The first part simply declared the unit resistance to consist of a "specified column of mercury," whereas the second part gave the dimensions of the column and also referred to a specification for setting up the standard.

Lord Rayleigh felt some doubt "as to whether the introduction of the mercury column was not what we call a fifth wheel to the coach." Some of the delegates appeared to share His Lordship's views, although they did not openly declare their convictions at this stage in the proceedings.

The resolution relating to the use of a mercury column was put to the vote and carried unanimously. But the resolution dealing with details was, after some discussion, referred to the Technical Committee, for not only was an objection raised to the addition of two zeros after the "3," in the length 106·3 cm. of the column, but Dr. E. B. Rosa (United States of America) also put forward a proposition to define the length of the mercury column as exactly one metre, which also involved an alteration in the mass of the mercury employed in the standard, so as to produce the exact equivalent of the International Ohm proposed in the resolution. The Technical Committee, having fully discussed the matter, recommended that no change should be made in the length of the mercury column, and finally the resolution on the subject was carried in the form originally proposed.

It must be admitted that the Conference has laid itself open to criticism by the acceptance of the final resolution relating to the International Ohm. It has been pointed out that a vast amount of good work has been lavished upon the perfecting of mercury columns in general, and that they can now be so set up that the ideal length of 106·3 cm. and ideal mass of 14·4521 gms. will not differ from one another by more than a few parts in 100,000. It is stated that, on the other hand, too little has been done of late years to arrive at a more accurate determination of the absolute specific resistance of mercury so as to determine whether the representative mercury column should be 106·26, 106·27, or 106·3 cm. Consequently the accuracy of mutual agreement on the length of the column has outrun the accuracy with which the column needed to represent the ohm has been ascertained. The specification prescribing the method of setting up the mercury tubes renders it necessary to take the mean of three fillings of five tubes to determine the value of the mercury unit. To this the objection has been raised that "instead of a concrete standard, we are confronted with a research in which the mean of at least fifteen experiments is to be taken as defining a value, and when the mean has been calculated the value is a fictitious quantity representing an ideal column of an arbitrary length, which, for all we know at present, may be itself in error to the amount of 3 or 4 parts in 10,000!" (Professor S. P. Thompson).

The resolutions relating to the ohm having been disposed of, the Conference turned its attention to the choice of the second primary unit. The delegates of the United States of America, who were supported by M. Lippmann (France), were desirous that the volt should be adopted as the second primary unit. M. Lippmann, in supporting the amendment to the resolution before the Conference that the ampère should be the second primary unit, said: "Now I think it has been generally overlooked that the volt is an independent quantity which can be measured without any kind of resistance, measured by a direct and simple method. I will show you how that is possible. Let us consider a revolving disc, such as that of the British Association, revolving in the magnetic field of the earth and inducing an electro-motive force. When that force is at its maximum we can oppose it by the E.M.F. of a standardised cell. That can easily be done. The value of the electro-motive force is known very easily—it is H.S.ω." But M. Gèrard (Belgium) pointed out later that this method presented a difficulty, as it became necessary to ascertain the intensity of the magnetic field of the earth, which is a problem not without its own difficulties.

After a very full discussion the Conference adopted the resolution, making the ampère the second primary unit by nineteen votes for and four against.

The succeeding resolution dealt with the realisation of the ampère by the voltameter method. It was proposed by Dr. Glazebrook that the International Ampère should be the unvarying current which "deposits silver at the rate of 0·00111800 grammes of silver," *i. e.* as in the case of the mercury column it was proposed to add two final zeros (after the "8" relating to the mass of the silver deposit). This resolution was much discussed, and it was felt by many of the delegates that either the zeros should be omitted, as they were meaningless, or, if a change must be made, then the figures to follow the "8" should coincide with the latest determinations of the electrochemical equivalent of silver, in which case it was suggested that a "2" should follow the "8." It was further suggested that the International ampère should be defined as one tenth of the electromagnetic unit in the C.G.S. system. As regards the latter suggestion, Lord Rayleigh pointed out that it would be inconsistent to go back to the C.G.S. unit for the ampère in view of the fact that the Conference was prepared to accept the mercury ohm. The proposal to adopt the C.G.S. unit for the ampère was put to the vote and lost. The question as to whether the last two figures in the mass of silver deposit representing the International Ampère should be two zeros or not was referred to the Technical Committee.

Immediately after the Conference had decided to refer the questions relating to the International Ampère to the Technical Committee, Dr. Glazebrook moved a resolution which provided for the International Volt being defined according to Ohm's law, and this resolution was unanimously agreed to by the Conference.

The Technical Committee went very fully into the question relating to the International Ampère which had been referred to it, and endeavoured to provide a solution of the difficulty which had arisen. There could be no doubt that a very strong feeling existed on the question, and was openly expressed by some of the delegates at the meeting of the Committee. On a vote being taken as to the figures which should follow the "8" in 0·001118, eight members of the Committee were in favour of "20" being added after the "8" and five members voted for "00"; the Chairman of the Committee (Dr. Glazebrook) abstained from voting.

Unfortunately, when this question relating to the International Ampère next came before a meeting of the delegates, the Report of the Technical Committee on the point referred to it was not laid before the Conference, but the resolution was again moved in its original form, containing the addition of two zeros after the "8" in the mass of the silver deposit. Twenty-one countries cast their votes for the resolution whilst three countries opposed it. It became evident at a later stage of the proceedings that there was a misunderstanding on the part of some of the delegates as to the terms of the resolution on which they had been called upon to vote, and an embarrassing situation was created by the subject being again debated at some length. The rules adopted at the commencement of the Conference made it necessary that resolutions which had already been passed should be confirmed by a second vote. The resolution relating to the International Ampère was therefore brought before the Conference for confirmation, with the strange result that on this occasion thirteen countries only voted for the resolution, eight countries opposed it, whilst three countries abstained from voting.

A resolution defining the International Watt as "the energy expended by an unvarying electric current of one International Ampère under an electrical pressure of one International Volt" was moved in order to meet the views of the Canadian delegate, and was carried unanimously.

Propositions were also placed before the Conference relating to the establishment of an "International Electrical Laboratory, with the duties of keeping and maintaining electrical standards." After some discussion the wording of the resolution was altered, and in its final form became the pious expression of opinion that the establishment of such an institution was "the best method of securing uniformity for the future" in electrical standards. The amended resolution found ready acceptance, and when put to the vote was carried unanimously.

A resolution recommending that the various Governments interested should "establish a permanent International Committee for Electrical Standards" was also carried unanimously.

And finally, on the recommendation of the Conference, Lord Rayleigh appointed "A Scientific Committee of fifteen to advise as to the organisation of the permanent Commission, to formulate a plan for, and to direct such work as may be necessary in connection with the maintenance of standards, fixing of values, intercomparison of standards, and to complete the work of the Conference."

A close examination of the discussions of the Conference shows that these have for the most part arisen on the important question as to whether the international units shall be defined as closely as possible in accordance with the true C.G.S. units, or as to whether they shall continue to be arbitrary values as hitherto. Those who have been in favour of the adoption of the latter course have laid much stress on the importance of continuity in the matter of standards for commercial and trade purposes, and have admitted that for purposes of scientific investigations naturally the most exact value will be adopted in the case of the units concerned.

It must not be thought that because the Conference has added two zeros in defining the values of the ohm and the ampère—figures which it has been said have no scientific meaning whatever—that, therefore, no progress has been made. It is clearly a step in advance for the delegates of all the countries represented to have agreed no longer to regard all three units as primary, and at the same time to have come to an understanding as to which of the two out of the three units shall be regarded as primary.

It is further admitted that the definitions of the International Ohm, Ampère and Volt have been made more precise, a distinction now being drawn between the ohm—10^9 C.G.S. units of resistance, and the International Ohm—the resistance of a column of mercury; and similarly with the ampère and the International Ampère. It must not be supposed that the Conference wished it to be understood that the figures adopted in the definitions are absolutely exact; as a matter of fact it was stated more than once that it was certainly known, in the case of the figures adopted for the electro-chemical equivalent of silver, that they were not accurate.

The resolutions adopted by the Conference involve no change in the standards of this country. These standards are maintained by the Board of Trade, and legal sanction was given to them by an Order in Council in 1894. The standard ohm consists of a verified wire of alloy, the standard ampère is measured on a verified ampère balance, and the standard volt is similarly measured by a verified device.

During their stay in this country the delegates were entertained at an official banquet given by the British Government at the Hotel Ritz. The President and Fellows of the Royal Society and the President and members of the Institution of Electrical Engineers also entertained the delegates at dinner, and visits were arranged to the National Physical Laboratory, the Royal Observatory, the Board of Trade Laboratory, the Cavendish Laboratory, Cambridge; the G.P.O. Telephone Exchanges in Carter Lane, the Central Telegraph Office, and other places of interest.

The importance of the position of London's Lord Mayor is widely recognised, and it therefore gave the foreign delegates great pleasure to be entertained at the Mansion House, where Sir John Bell, the Lord Mayor, and some of the Sheriffs and Corporation, robed in all their splendour, received the guests, the foreign delegates being much impressed.

Thus opportunities were afforded to the delegates for becoming acquainted with one another, and many of us feel the richer by the friendships which we have had the good fortune to make owing to our participation in the work of the Conference.

REMINISCENCES OF OVERHEAD AND UNDER-GROUND TELEGRAPH WORKS.

By G. W. Hook,

Superintending Engineer, South Midland District.

(*Continued from p.* 185.)

In 1894–5 the Department undertook to provide for the National Telephone Company a large number of 304-wire air-space paper insulated cables in various parts of the city of London, and concurrently the Post Office had also become busy with the same class of work, so that it became necessary to devise the best form of joints, etc., and to train a special staff of jointers and cable hands. Owing to the hygroscopic properties of the paper a considerable amount of moisture was taken up by the latter at the joints during the process of jointing, not only from the atmosphere, but from the perspiration of the hands of the jointer. The National Telephone Company adopted the use of hot powdered lime, plentifully laid on the completed cable core joint and allowed to remain some time to absorb the moisture. I did not follow this example because I had found that the moisture crept up the lead sheathing at each end of the joint where the lime could not reach it, and another reason was that I was afraid that sooner or later the lime would have a damaging effect on the lead. I therefore adopted the course of applying the charcoal brazier to the main cable about a foot away from the joint, each side alternately, in order to drive out any moisture which had penetrated the cable, and then finally to dry out the joint itself and test the latter for moisture by holding over the centre of the joint a piece of cooled silvered glass, which revealed the slightest trace of vapour. This idea suggested itself to me from having read of this method being resorted to for detecting the breathing of apparently dead persons.

Another and peculiar difficulty cropped up in connection with the plumbing of the lead sleeves. The plumbers found that the heat of the metal put on one end of the sleeve expanded the air in the sleeve to such an extent that when they proceeded to put the metal on the other end air bubbles passed through, allowing microscopical veins to form through the solder which, if allowed to remain, might sooner or later let water through to the joint. In order to meet this difficulty as far as possible I had a small slot cut in the top of the sleeve to provide a vent for the expanded air, and then after the two ends of the sleeve were wiped this slot was hammered and rubbed down, and a close-fitting patch of lead sheet carefully wiped over the closed gap. This method has been universally adopted, and although the small blow-holes above referred to are still liable to appear if the seam has not been effectually closed before the patch is wiped on, they are driven to the top side of the sleeve, where they can be more readily detected than in the joint connecting the lead sleeves to the sheathing. Since the testing of plumbing work by means of air pressure and soap-suds has been introduced minute faults are frequently detected, and they are mostly found to be in the top patch, thus proving, I think, that the expanded air inside the sleeve is driven to the point of least resistance.

While the above-mentioned work was in progress it was whispered about that the laying of a paper-insulated lead-covered cable between London and Birmingham was under contemplation, and one day in December, 1896, I was called to the Chief Office, where I was informed by the Engineer-in-Chief that authority had been received for the cable to Birmingham, and that I had been chosen to superintend this important pioneer work. The work involved the laying of the line of pipes from Cricklewood (the boundary of the Metropolitan and South Midland Districts) to Birmingham Head Post Office, and the drawing-in, and jointing, of the cable between G.P.O. London and Birmingham H.P.O. The pipe-laying was carried out by contract in ten-mile sections, the contractors supplying the pipes. The pipes had to be gauged and examined on the ground by the Department's men under my control, and very great trouble and inconvenience was frequently caused owing to the numerous rejections through smallness of gauge, rough interior surface, iron scab, and other defects. I frequently had occasion to reject a whole railway truck load of pipes, and return them to the makers. Pipes are now examined, tested, and stamped at the manufacturers by the Department's officers, which is a more satisfactory arrangement in every respect. It very rarely happens that a pipe thus passed has to be rejected, which shows that great care is exercised in the work.

The first sod was turned early in January, 1897, and in March, 1897, the first length of cable was drawn into the pipes at Watford. The late Mr. Hookey (at that time Assistant Engineer-in-Chief), Mr. J. W. Woods (then Superintending Engineer S.M. District and now Assistant Engineer-in-Chief) and myself gave the first few turns of the crab winch.

During the three years the work was in progress we had many vicissitudes, but with the able assistance of the three or four officers Mr. Fleetwood (my then Superintending Engineer) kindly allowed me to take from the Metropolitan District, the principal one being Mr. J. T. Langley, now an engineer attached to the Metropolitan Central District, we managed to get over all our difficulties. We had to train our clerks of works, jointers, and others on the road.

The work which caused me most anxiety was the plumbing. There are over five thousand plumber's joints on the cable, and when it is remembered that at that time the method of testing by air-pressure had not been introduced, it is a matter for congratulation that the faults caused by defects in plumbing have been practically negligible. The last length of cable was drawn into the pipes in Hill Street, Birmingham, on April 9th, 1900, Mr. J. W. Woods and myself officiating at the crab winch for a few turns.

During the progress of the work we had many visitors—not only officers of our own department from different districts, but from many foreign countries, including Japan and America—each of whom made voluminous notes, and all were exceedingly interested in the operations.

I have given a description of the practical portion of this pioneer work, and I leave it to abler pens than mine to give the electrical results. Many well-known men I can name spent much time on experimenting as the work proceeded. Among them I may mention Mr. A. J. Stubbs, Mr. H. R. Kempe, Mr. F. Tremain (who, when I returned to London, was busy with experiments on the advantages of loading coils), Mr. A. W. Martin, and the late Mr. J. W. Leyshon. These gentlemen were frequent visitors to the work, and I wonder whether Mr. Kempe still remembers the organ incident at Great Brickhill Church one day when we were driving from Leighton Buzzard to Fenny Stratford to conduct some tests. It happened this way. Mr. Kempe, Mr. J. W. Woods, the late Mr. Leyshon and myself were passing through Brickhill, and knowing that these gentlemen were interested in old churches I asked them if they would like to visit the church, an interesting and historical old building just off the main road we were then passing along. They were quite agreeable, so we turned down to the church, alighted, and walked in. Mr. Kempe, as no doubt many of my readers well know, is a lover of music, and has a great partiality for church organs; the late Mr. Leyshon was also a man of much musical ability. After looking over the church and passing through the chancel, we came to the organ, the keyboard of which was found to be open. Mr. Kempe and Mr. Leyshon were fingering the keys and stops in dumb show, remarking as to their various merits. I cannot play the organ myself, but I thought it a pity not to make the pipes speak, so I slipped round to the back and pumped the bellows up. Immediately the sacred edifice was filled with beautiful strains from the organ, the performers being Messrs. Kempe, Leyshon, and Hook, while Mr. Woods comprised the audience. In a few minutes someone entered the church who proved to be the Vicar, and by the sound of his footstep we could tell that he was *cross*, to say the least of it. He gave us a severe rating for interfering with what did not concern us, and then shut down the keyboard with a bang, and walked out of the church. We left directly afterwards, and I am unable to recollect whether we dropped the usual coin in the church box on that occasion!

The cable is looped into test pillars, and joined up to cable connection boxes at approximately five-mile points, and these have proved to be of assistance in localising the few minor faults which have occurred, and enabled us to locate and make good the wires before the circuits have reached breaking-down point.

Towards the completion of the work I was engaged under Mr. M. F. Roberts, Assistant Engineer-in-Chief, in experiments at Leamington, to ascertain the best method of duct-formation for the approaching London telephone scheme, and I expect there are not many who are aware that the first length of duct work (sixteen ducts) lies under the roadside waste about a mile south of Leamington.

On the completion of the Birmingham cable I returned to London and took charge of some of the large contracts in connection with the London telephones, and in October, 1901, I was appointed to the post of Superintending Engineer of the South Midland District, so that I became responsible for the maintenance of the pioneer long-distance cable, the laying of which I had been so intimately connected with. I am glad to say the maintenance cost up to the present has been almost a nominal quantity, being mainly the cost of painting marking posts, and test pillars.

Soon after taking up my post in Birmingham the extension of the main cable to Nantwich was authorised; the length being approximately 58 miles, and the number of wires 103. This was built up in sections of six cables, with an air-drying nozzle at every sixth joint, the latter being enclosed in a small buried joint-box. In the case of this cable we had the advantage of being able to prove all the plumbing work by means of air pressure and soap-suds. As each section of six cables was completed and tested it was coupled up with the back section by means of a sleeve with an air nozzle fitted, and the plumbing of the latter tested by the same means as the other plumbing work. Minute defects in plumbing were discovered by this test. I have watched small bubbles grow from the size of a pinhead to the size of a pea, which clearly indicated a slight defect in the plumbing, in which case the metal was rewiped, and again tested. This cable was completed about four years ago, and the only maintenance cost has been the time of the officer taking the monthly test. This satisfactory result is a great credit to the young engineers through whose sections the cable passes, particularly as they had had little previous experience of underground work.

The cables throughout were laid in uniform lengths of 150 yards, that being considered from experience a safe and workable length, and I would caution engineers not to be over venturesome in drawing in excessively long lengths, especially into old pipes, for fear of stretching the lead sheathing. As a case in point, I would mention one which occurred in my district where a small cable had to be drawn into an old line of pipes. The cables were delivered in long lengths with sufficient margin for joints, but when I reached the ground I found that the engineer had, in order to save a couple of joints, pulled in an excessively long length. When I called his attention to the matter he pointed out that it had been pulled right up to the point where the solid plug had to be fixed for the leads to be taken into the telegraph office. I waited with him to see the jointers cut the end of the cable for the purpose of fixing the solid plug, but to the engineer's surprise no conductors could be found. Eventually they had to cut away about four feet of sheathing to get to the conductors, showing that the lead had elongated somewhere, thus considerably weakening the cable. It is a mistake to pass the margin of safety for the sake of the doubtful saving of the cost of a joint or two.

In conclusion, I would like to mention one point in connection with the London-Birmingham cable which may surprise some of my readers. On December 12th, 1901, occurred the great snow-storm in the midlands which broke down all overground lines, the only circuits working into the Birmingham Office being those brought in by the cable.

I got through to the Engineer-in-Chief in London (the late Mr. Hookey) on the centre pair of wires in the cable, and I kept the Engineer-in-Chief advised telephonically of the extent of the damage from my office to his. The speech was not *commercial*, but we were able to sustain a conversation.

ON THE PROPAGATION OF PLANE ELECTRO-MAGNETIC WAVES ALONG A PLANE CONDUCTING SURFACE, AND ITS RELATION TO WIRELESS TELEGRAPHY.

By J. ZENNECK.
(Translated by H. HARTNELL, A.M.I.E.E.)

(*Continued from p.* 220.)

B. RESULTS WITH REGARD TO WIRELESS TELEGRAPHY.

7. *Applications of the Results to Wireless Telegraphy.*

IT is obvious that the foregoing results can only be applied to wireless telegraphy with many limitations, but at great distances from the transmitter it is probable that the waves sent out glide along the surface of the earth in a manner very similar to that assumed in Section 1.

8. *Conductivities and Dielectric Constants of Various Earths, etc.*

In the literature of this subject I found among others the following values:

	σ in C.G.S.	$k = \varepsilon/\varepsilon_0$.
Sea water	10^{-10} to 10^{-11}	about 80.
Rain, river water	10^{-13} „ 5×10^{-15}	about 80.
Slate	10^{-15} „ 10^{-16}	
Marble	about 2×10^{-18}	about 6.

The dependence of the conductivity and dielectric constant of various earths on the amount of moisture contained in them has been investigated by W. Eickhoff. His results are summarised in the following table:

Material.	Percentage of water.	Conductivity σ in C.G.S. units.
Yellow river sand	0	$< 10^{-16}$
„	1·52	$2·6 \times 10^{-14}$
„	3·3	5·9 „
„	7·4	9·7 „
Garden soil	3·3	0·6 „
„	5·7	2·1 „
„	10·0	6·4 „
„	17·3	16·8 „
Clay	4·4	0·69 „
„	9·2	6·7 „
„	16·1	20·0 „
„	45·0	69·0 „

Measurements of the dielectric constants with very high frequencies gave:

	k
Yellow river sand, dry	2·5
,, ,, ,, with 15 per cent. moisture about	9
Garden soil, dry	1·9
,, ,, with 19 per cent. moisture about .	8
Clay, dry	3·5

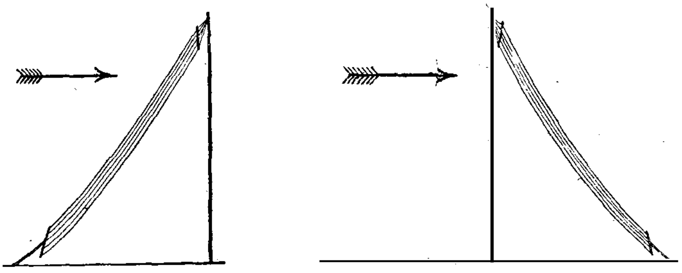
For practical purposes we may assume:

Sea water .	$\sigma = 10^{-11}$.	$k = 80$
Fresh water .	$= 10^{-14}$.	$= 80$
Moist earth .	$= 10^{-13}$ to 10^{-14}	$= 5 - 15$
Dry earth .	$< 10^{-15}$.	$= 2 - 6$

9. *The Electric Fluid at the Surface of the Earth.*

(*a*) The case of propagation over the surface of water is of little interest. The direction in which the electric field strength has its greatest amplitude never deviates much from the vertical; about 6° is the maximum. Practically speaking the field is always an alternating field perpendicular to the surface.

(*b*) In the case of dry ground the case is quite different (*v.* **5** and **6**). Here there may be a strong turning component or the alternating field may be considerably inclined with respect to the vertical.



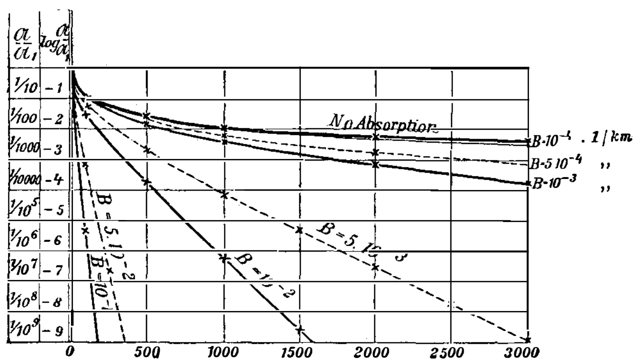
9 **10**

In both cases the direction in which the amplitude of the electric field-strength is a maximum, varies considerably from the vertical. In the case shown in **5**, for example, the angle may be 35°. In this case it is therefore desirable to incline the receiving antenna as shown in **9**, in which the arrow shows the direction of the incoming waves. With the constants of **5** a vertical position of the antenna would give about 18 per cent. less amplitude than the position shown in **9**, and the position shown in **10** about 66 per cent. less.

10. *The Absorption of Waves along the Surface of the Earth* (*cf.* *Section* 4).

(*a*) If there were no absorption the amplitude would be very nearly inversely proportional to the distance x from the transmitter. This decrease of amplitude ($\sim 1/x$) is therefore always present. It is only when, in comparison with this, the reduction of amplitude due to absorption is appreciable that absorption is of practical importance.

With reference to **11**, the curves give the common logarithm of the ratio of the amplitude a at the point x to the amplitude a_1, at a point 1 kilomètre distant from the transmitting antenna. As will be seen up to a value of $B = 10^{-4}$ the absorption is without appreciable effect.



Distance x in kilomètres.

11.—THE UPPER CURVE IS THE LINE OF NO ABSORPTION.

(*b*) With sea-water, and even with fresh water, the absorption does not play any part in the maximum range. Taking the frequency used in wireless telegraphy a maximum effect is obtained when the value of σ lies between 10^{-13} and 10^{-14}. With dry soil, on the contrary, the absorption may become very important. This is in accordance with experience. This result is due as much to the high value of the constant k as to low conductivity.

(*c*) Considering the curves (**11**) in the manner indicated in paragraph 4 it is seen that powerful stations with long wave lengths are more advantageous from the point of view of absorption than small stations giving shorter wave-lengths, when the conductor consists of slightly moist ground, or even of fresh water. In the case of sea-water or very dry ground the superiority of powerful stations disappears since absorption becomes either of little importance or is independent of the wave-length.

11. *Influence of the Conductivity of the Air.*

(*a*) According to the observations hitherto made the conductivity (σ_0) of the air near the earth's surface is approximately $\sigma_0 = 2 \times 10^{-25}$ C.G.S. units. If we make this mean value the basis of the calculation $\beta = \frac{\sigma_0}{\sigma}$ will be very small not only in comparison with unity, but also in comparison with q_0. We consequently obtain from equation (7) the following expression:

$$s = -\sqrt{aq_0 \frac{1 + \iota q}{1 + \iota (q + q_0)}} \left[1 - \frac{\iota \beta}{2q_0} \frac{1 + \iota q}{1 + \iota (q + q_0)} \right].$$

In Section 4 we saw that so long as we could assume that $\beta = 0$, s might be written $s = -(A - \iota B)$.

If now for a given value of β we write it in the form $s = -(A^1 - \iota B^1)$, the relation between the absorption co-efficient B^1 and the former value B approximates to—

$$B^1 \doteq B + A \frac{\beta}{2 q_0}.$$

A, under the assumed conditions, never varies greatly from $\frac{\pi}{3} \times 10^{-4}$ C.G.S. units ($\nu = 10^6$/sec.). $\frac{\beta}{2 q_0} = \frac{\sigma_0}{2 \nu \varepsilon_0}$ has for the assumed magnitude of σ_0 the value $0{\cdot}36 \times 10^{-9}$. Consequently the increase of the absorption co-efficient on account of the conductivity of the air—

$$\frac{A \beta}{2 q_0} = \frac{\pi}{3} 10^{-} \times 0{\cdot}36 \times 10^{-9} = 0{\cdot}4 \times 10^{-13} \text{ per cm. approximately.}$$

(*b*) The conductivity of the air at the surface of the earth may rise to about five times the mean value (2×10^{-25} C.G.S.) assumed above, and at a height of 6000 mètres may in favourable circumstances rise to about ten times the value at the earth's surface. If we take as an extreme value 100 times the mean value assumed above, the increase of the absorption co-efficient will be:

$$\frac{A\beta}{2 q_0} = 0{\cdot}4 \times 10^{-11} \text{ per cm.} = 0{\cdot}4 \times 10^{-6} \text{ per km.}$$

therefore $B^1 = B + 0{\cdot}4 \times 10^{-6}$ per km.

(*c*) A glance at the value of $\frac{1}{B}$ in 7 shows immediately that the conductivity σ of the ground $\leqq 10^{-12}$ C.G.S., *i. e.* in the case of fresh water and solid earth the conductivity of the air does not play any part.

In the case of sea-water of high conductivity ($\sigma = 10^{-10}$ C.G.S.) $B = 1.5 \times 10^{-5}$ per km. In the case of sea-water of very low conductivity ($\sigma = 10^{-11}$ C.G.S.) $B = 1.5 \times 10^{-4}$ per km. The increase of the absorption coefficient, therefore, amounts in the first case to about 2 per cent., and in the second case to 0·2 per cent. In the first case also the increase in the absorption through the conductivity of the air is therefore without practical significance.

(*d*) There is, as is well known, a remarkable difference between the range of action of a station by day and by night. According to Marconi, the range by night is 2½ times greater than by day. As a possible explanation of this fact, Marconi points out that the absorption of the waves is increased in consequence of the air becoming ionised by sunlight. From this it would follow that layers of air which are less than 6000 mètres from the surface of the earth are not responsible for the phenomenon. Until it can be proved that layers of air at a greater distance from the earth than this are, by the action of sunlight, rendered conducting to a much greater extent than has yet been observed, this explanation cannot be considered satisfactory. A second explanation, to which also Marconi has called attention, is that in consequence of the action of sunlight the discharges of the antenna and the consequent losses of energy are increased. The preference must be given to the former explanation.

12. *Influence of Fog.*

In connection with the favourable effects of fog on the range of action of a station the following causes may be considered:

(*a*) The dielectric constant of air containing a considerable amount of moisture must be greater than that of air free from fog, and, as a consequence, the capacity of the antenna must be increased. Assuming that this increase in the capacity always takes place, its effect would not always be favourable, especially in the case of stations worked by means of loose coupling and sensitive tuning. An examination of equation (7) shows that the effect on the absorption of waves caused by an increase in the di-electric constant of the air is, as a rule, unfavourable.

(*b*) The greater humidity of the surface of the earth during fog must, generally speaking, increase the range. This explanation cannot, however, account for the beneficial effect experienced when telegraphing over the sea during foggy conditions.

(*c*) It is a fact *that the conductivity of the air during fog is extremely small.* The absorption of the waves must therefore be less in foggy than in clear weather, but this (*vide* Section 11) is of no great practical significance. It is highly probable that in consequence of the low conductivity of the air the discharges from the antenna are greatly reduced. The reason for the favourable effect of fog must probably be sought in this, and also perhaps in the protection which the fog affords against discharges caused by solar rays.

13. *Passage between Water and Land.*

It is easy to see that a plane wave passing from water to land, and the reverse, must suffer a partial reflection. The amplitude of a wave at any point is conditioned not only by the distance which the wave has travelled over land and sea, but also by the form of the shore. In this, perhaps, lies an explanation of the frequently-observed phenomenon, that better effects are sometimes obtained at stations far removed from the sending station than at nearer stations.

NOTES AND COMMENTS.

THE BUDA-PEST TECHNICAL CONFERENCE.

THE present number contains a report of the proceedings of the first International Conference of Government Telegraph and Telephone Technicians, held at Buda-Pest in September last. A preliminary announcement appeared in our issue of October, but the date of going to press precluded the possibility of furnishing any details of the Conference itself.

Such an event calls for more than passing comment, as it most probably inaugurates a permanent system of closer co-operation among the technical officers of the various state administrations than has ever before been found possible. Such co-operation can be founded on no surer basis than that of personal friendship, and it is a great pleasure to be able to record that this first conference has contributed most powerfully to that condition by the establishment of relations of cordial fraternity among numerous representatives of the leading telegraph and telephone services of Europe.

On witnessing the inception of such a wide-reaching organisation, one naturally asks, What is its *raison d'être* and its scope? The answer is simple. The primary object of the conferences is the discussion of the more important and difficult technical problems of general interest to our profession which await solution. Although the technical literature of to-day is rich and voluminous, there are numberless points of great practical importance which fail to find expression in magazine articles, and which can only be brought out and made to yield their full significance in the more free and ready conditions of personal intercourse, where the light and shade of opinion and experience from many different sources is available. Even the most advanced administration has much to gain from knowledge of the progress and invention of others, and it is remarkable to what an extent the problems with which each different country is confronted are found to have their counterpart in the general experience of all.

It is not desirable, nor is it proposed, that these conferences shall be strictly official in character; their objects are solely the furtherance of personal intercourse, and the discussion of technical matters of practical bearing; the results of their deliberations are not in any sense binding upon any administration which participates. Neither is it desirable that they should resolve themselves into meetings for the consideration of questions of general electrical science or the presentation of theoretical treatises; such matters may well be left to the medium of the technical press. The utility of the conferences can only be maintained, and their success assured, by the concentration of attention upon matters of practical importance tending towards the solution of the increasingly difficult technical problems which confront our engineers. In this direction the conferences will result in placing the accumulated knowledge and skill of the combined administrations of Europe at the disposal of every one of them, and in making common property of the latest developments and improvements, no matter where they may have originated.

The individual with an axe to grind must be carefully excluded. It is not an easy matter to draw the correct line in this respect, but the respective administrations can, no doubt, be trusted to provide adequately against any improper exploitation of the conferences without excluding any contributions of real value or interest.

Our services, dealing as they do with national and international systems of communications, are happily free to a remarkable extent from anything in the nature of conflicting interests. They do not compete one with another, their objects are identical, and the prosperity and efficiency of one contributes directly to a like condition in all.

The fact that the recent Conference was confined to representatives of European nations suggests the inquiry whether future Conferences might not be framed to embrace a wider sphere. Is the co-operation of America too much to hope for? It is true that in the United States there is no Government service of Telegraphs or Telephones, but we cannot recognise any difficulty from that standpoint. The services are organised on a truly national scale and have much to teach, without perhaps excluding the possibility of something to learn. We may therefore be permitted to hope that in the years to come it will be found that not only the nations of Europe, but the United States, the British Colonies and many others may participate from time to time in a great world's Congress of Telegraph and Telephone Engineers. The days of Esperanto are not yet effectively with us, and in a polyglot assembly the language question has its difficulties. Even the recent limited Conference had the defect of being bi-lingual. It was originally understood that the proceedings would be wholly in French, but it was found that some very interesting papers were read and partly discussed in German. As all, except some of the German-speaking delegates, adopted French as their medium of expression, we think it would be well to have a definite understanding on this point, and as French is the generally accepted international language, it naturally suggests itself as the most suitable language for future conferences.

Coming now from the general to the particular, we have placed before our readers a summary of the proceedings of the first conference which will fully illustrate its character and scope. A large number of papers of an important and interesting nature were read and discussed. These have been printed by the Hungarian administration, with abridged discussions, etc., and form a large-sheet volume of 400 pages. Even this wealth of material cannot be taken as representing the technical value of the Conference; the informal exchange of views among delegates with common interests in particular directions is, we think, a factor of even greater importance in estimating results. The difficulties associated with the organisation of a conference of this magnitude for the first time can readily be imagined, and it only remains to say that these difficulties were surmounted in the most admirable, and, indeed, triumphant manner by the Hungarian officials. The supplementary programme of excursions and visits of inspection which they had drawn up combined technical information and pleasurable interest to a unique degree. It is safe to say that few of the delegates can point to a period more full of rich experiences, and that all of them will look back to the time spent at Buda Pest as among their pleasantest recollections. The sympathetic co-operation of many outside organisations, educational, industrial, and social, had been enlisted in the service of the Conference, and the project was especially fortunate in having secured from its inception the powerful and enthusiastic support of the Hungarian Minister of Commerce, François de Kossuth, a worthy son of a famous sire. Monsieur de Kossuth's kindness and encouragement will not readily be forgotten. And what can we say of our hosts themselves, of the colleagues who so spontaneously undertook the labour of organisation, save that their unbounded hospitality and courtesy adequately reflected the well-known characteristics of their charming nation. In such a case it would be invidious to select any individuals for special praise; all according to their opportunities worked indefatigably for the common good. To Monsieur Kolossváry, the technical director of the service, fell the important position of President of the Conference, an office which he discharged with unvarying tact and discretion. The British Administration was honoured by the election to the vice-presidential chair of Major O'Meara, who, in Monsieur Kolossváry's absence, presided most acceptably over several meetings of the Conference.

Special thanks are due to the Hungarian Society of Engineers and Architects, who so kindly placed their handsome and commodious premises at the entire disposal of the Conference, and to the principals of the many manufacturing firms, who not only opened their works for inspection, but displayed an amount of attention and hospitality which were truly remarkable. Chief among them, perhaps, we recollect our visit to the copper working establishment of Messrs. Weiss & Co., a steamboat trip of five or six miles down the river. Not only were we met by the *usual* lavish decorations, but a special floating landing-stage had been constructed to save us the trouble of getting ashore in small boats. From this a highly decorated avenue, lined by the firm's employees, led to their large and interesting works. Many hours were spent in inspecting the various processes, in viewing a turn-out of the fire brigade, and in amply attending to the wants of the inner man. On sallying forth once more we found the way to the river, marked out by hundreds of men with torches, who after our departure ranged themselves along the shore and waved a picturesque farewell in response to the strains of our orchestra. When our good little ship had once more brought us back to the myriad lights of Buda, the noble façade of the Royal Palace was found to be brilliantly illuminated at every window. What the imperial function was we know not, but our general frame of mind was such that this also was unhesitatingly hailed as a tribute to the Conference.

At the final meeting the question of the next Conference was discussed, and it was decided that it should be held in 1910. An international committee was appointed to settle the place of meeting, and to select the most suitable subjects for consideration and discussion.

T. F. P.

Institution Meetings.

A full report of the Meeting of the Institute which was held on November 9th and which was attended by the Postmaster-General is given on other pages, and will, we feel sure, be read with great interest. The little function of presenting the medals was carried through very gracefully by Mr. Buxton, and the successful authors were heartily applauded by their colleagues.

Both Mr. Buxton and Major O'Meara took occasion to give expression to appreciative criticism of the Institute and its work, and their remarks cannot fail to encourage those officers who spend much of their time on work of this nature. It cannot be too fully realised that the Institute has not attained to its present dimensions without a large amount of labour by its many officers, and it may be good for them to know that their work is not entirely unseen.

After the presentation Mr. Buxton remained for some time listening to the reading of Mr. Henley's paper on "The Examination of Wrought Timber." It is a pity that the paper for the evening was not one more intimately connected with the main line of our work, and it is perhaps fortunate that Mr. Buxton did not remain to hear the discussion. But few of the speakers brought any further light to bear on the subject, and most of them had carefully scanned the paper so as to be able to point out omissions. Several seriously exceeded the time limit, thus prolonging the discussion to the point of tediousness.

The severely critical point of view which has been adopted by many of the speakers at these meetings will not tend to encourage the production of further papers, as the task seems to be a thankless one.

We sincerely hope that all concerned will unite in an effort to introduce a different atmosphere into the proceedings. Comments of a personal nature, and especially when of an undignified character, should be rigorously repressed, and all should endeavour to make the meetings an opportunity for the interchange of opinions and friendly counsel. One other suggestion: Why should not the Chairman have the support of the Committee on the platform? This course is usual at other meetings of a similar kind and tends in the direction of giving dignity to the assembly.

Colonial Notes.

We have been favoured by Mr. J. K. Logan, Superintendent of Electric Lines for New Zealand, with copies of the New Zealand Postmaster-General's recent reports, and also with an advance copy of the mileage return for the official year ended March 31st, 1908. We have printed the last-named in full, and several extracts from the former which will, we think, interest our readers as showing the state of affairs in the Colony which has earned so great a reputation for progressiveness.

We would draw the attention of our readers to three paragraphs: (1) The regulation as to a minimum salary for married officers, which practically puts a premium on marriage; (2) the restrictions as to the use of the telegraphs for betting purposes; and (3) the decision to supply typewriters for the use of telegraphists when receiving messages.

In connection with the latter it will be remembered that our first number contained an article describing the use of the typewriter for this purpose in the United States.

Our First Volume.

This number completes our first volume, and it is perhaps a fitting occasion on which to depart from the reserve which has hitherto characterised our editorial pronouncements, and take our readers into our confidence as to the health and progress of the year-old infant.

Commenced with a list of 600 subscribers it was thought a bold step to order 1000 copies of No. 1, but two reprints were necessary, and so great was the demand for the Journal that for Nos. 2 and 3 3000 copies were printed. Letters of kind commendation and encouragement have been received in generous plenitude, not only from the homeland, but from all over the world, and we have been made to realise that the desire for such a linking-up medium as the Journal provides, was much greater than we had estimated.

While much has been accomplished, we do not wish it to be understood that we have reached our ideal. We have not. We hope from time to time to introduce new and better features, and to make the Journal more worthy of the great and dignified profession which it strives to represent. To attain that end, however, it is essential that we have the assistance of our readers, and especially of the members of the Institution. The Journal should be much in their minds, and they should keep alive to every new experience in order that they may relate it through the Journal for the benefit of their comrades. The life of an engineer is full of interesting events, but the great majority of them pass unrecorded. This need be so no longer, and we will look forward to vol. 2 in the hope that we shall have the pleasure of discovering other new writers who will aid us no less willingly and ably than those who have contributed to the success of No. 1.

STAFF CHANGES.

BRITISH POST OFFICE. ENGINEERING DEPARTMENT.

Promotions.

District.	Name.	Appointment.	Previous Service.
E. in C.O.	Mountain, W. S.	Prin. Clk.	Tel., Manchester, 1885; Jr. Clk., Engr. Dept., 1892; Draughtsman and Shorthand Writer, 1895; Cl., 2nd Cl., 1898; 1st Cl., 1903.
E. in C.O.	Freeman, S. M.	Clk., 2nd Cl.	Tel., C.T.O., 1895; Exr., 2nd Cl., T.S.O., 1898; Clk., 3rd Cl., Engr. Dept., 1902.
E. in C.O.	Hardham, H. A.	Clk., 2nd Cl.	Tel., C.T.O., 1893; Jr. Clk., P.S.D., 1901; Clk., 3rd Cl., Engr. Dept., 1902.
E. in C.O.	Longheed, W.	Clk., 3rd Cl.	Sr., L.P.S., 1903.
E. in C.O.	Regan, D.	Clk., 3rd Cl.	Sr., L.P.S., 1902.
E. in C.O.	Rogers, F.	Clk., 3rd Cl.	Sr., L.P.S., 1903.
E. in C.O.	Spottiswoode, D.	Clk., 3rd Cl.	Sr., L.P.S., 1905.
E. in C.O.	O'Conner, D. J.	Clk., 3rd Cl.	Sr., L.P.S., 1903.
E. in C.O.	Maguire, J. J.	Clk., 3rd Cl.	Sr., L.P.S., 1904.
E. in C.O.	Bayly, A. E.	Clk., 3rd Cl.	Asst. Clk., S.B.D., 1903; Clk., 2nd Div., 1904; Clk., Factories, 1907.
E. in C.O.	Hart, A. B.	Engr., 1st Cl.	Tel., Cambridge, 1893; Ju. Clk., Engr. Dept., 1896; Clk., 3rd Cl., 1898; Engr., 2nd Cl., 1901.
E. in C.O.	Fraser, J.	Engr., 1st Cl.	Tel., Aberdeen, 1877; Relay Clk., Engr. Dept., 1896; Engr., 2nd Cl., 1901.
E. in C.O.	Stevenson, B. J.	Engr., 2nd Cl.	Tel., Edinburgh, 1895; Sur. Sta. Clk., 1902; Clk., 3rd Cl., Engr. Dept., 1903.
E. in C.O.	Anson, B. O.	Engr., 2nd Cl.	Tel., Hull, 1896; Clk., 3rd Cl., Engr. Dept., 1903.
E, in C.O.	Ramsay, F. G.	Engr., 2nd Cl.	3rd Navg. Offr., "Monarch," 1905; 2nd Navg. Offr., 1906.
Suptg. Engr. Offices, London	Kirby, J. W.	Clk., 2nd Cl.	Tel., C.T.O., 1887; Ju. Clk., Engr. Dept., 1899.
Suptg. Engr. Offices, London	Brockett, A. W.	Clk., 2nd Cl.	Tel., C.T.O., 1886; Ju. Clk., Engr. Dept., 1900.
E. in C.O. (Cable Ship "Monarch")	Hutchons, E. R.	Second Navg. Officer.	1907.

Retirements.

District.	Name.	Appointment.	Previous Service.
E. in C.O.	Harrison, T.	Suptg. Engr.	M.T. Co., 1861; P.O., Hull, 1870; Insp., Engr. Dept., 1880; Asst. Suptg. Engr., 1896; Suptg. Engr., 1901.
E. in C.O.	Jarvis, P.	Engr., 1st Cl.	Tel. Manr., 1879; Ju. Clk., Engr. Dept., 1882; Senr. Clk., 1890; Engr., 2nd Cl., 1895; 1st Cl., 1902.
E. in C.O.	Cullen, J.	Engr., 2nd Cl.	1871; Engr., 2nd Cl., 1888.
E. in C.O.	Bell, H. S. T.	Engr., 2nd Cl.	Tel., Belfast, 1875; Dublin, 1881; Relay Clk., Engr. Dept., 1887; Engr., 2nd Cl., 1892.
E. in C.O.	Ogden, H.	Clk., 3rd Cl. (Suptg. Engr. Office).	S.C. and T., Liverpool, 1893; Clk., Engr. Dept., 1902.

DEATH.

District.	Name.	Appointment.	Previous Service.
E. in C.O.	Coakley, J. T.	Clk., 3rd Cl. (Suptg. Engr. Office).	Sr. Cir. Offr., 1898; Asst. Clk., S.B.D., 1899.

TRANSFERS.

Name.	Rank.	District. From.	District. To.
Moir, A.	Suptg. Engr.	I. S.	Met. S.
Whitehead, J.	Engr., 1st Cl.	Met. N.	E.
Eames, E. J.	Engr., 1st Cl.	Met. C.	S. (R.E.)
Haynes, J. H.	Engr., 1st Cl.	Sc. E.	S. (R E.)
Partridge, G. N.	Engr., 1st Cl.	Met. C.	S. Wa.
Vooght-Cornish, H.	Engr., 1st Cl.	E. in CO.	E. L. and P.
Billingham, G. W.	Engr., 2nd Cl.	N.W.	E. in C.O.
Hook, G. H. J.	Engr., 2nd Cl.	N.M.	E. in C.O.
Horton, F. D.	Engr., 2nd Cl.	Sc. E.	E. in C.O.
Baxter, J.	Engr., 2nd Cl.	N. Wa.	E. in C.O.
Bramwell, J. T.	Engr., 2nd Cl.	N.W.	E. in C.O.
Partridge, T. T.	Engr., 2nd Cl.	S. Wa.	E. in C.O.
Simmance, J. H.	Engr., 2nd Cl.	Met. C.	E. in C.O.
Picker, H. F.	Engr., 2nd Cl.	Sc. E.	E. in C.O.
Bassett, S. W.	Engr., 2nd Cl.	S.M.	E. in C.O.
Giles, H. W.	Engr., 2nd Cl.	N. Wa.	E. in C.O.
Sanger, P. M.	Engr., 2nd Cl.	Met. C.	S. (R.E.)
Hammond, G. W.	Sub-Engr.	N.E.	E. in C.O.
Leigh, C.	Sub-Engr.	N.E.	E. in C.O.
Gibbon, A. O.	Sub-Engr.	E.	E. in C.O.
Fletcher, J. E.	Sub-Engr.	N.	E. in C.O.
Waller, J.	Sub-Engr.	Met. C.	E. in C.O.
Hay, C. E.	Sub-Engr.	Met. C.	E. in C.O.
Lock, F.	Sub-Engr.	N.W.	S. Wa.
Jack, J. A.	Sub-Engr.	I. S.	Sc. W.
Hansard, A.	Sub-Engr.	Sc. W.	I. S.
Coxon, J.	Sub-Engr.	E. L. and P.	E. in C.O.
Morgan, J. A.	Sub-Engr.	Met. N.	E. in C.O.
Colthurst, H. W.	Clk., 3rd Cl.	N.E.	I. N.
Betts, G.	Clk., 3rd Cl.	N.	N.E.
Jackson, R.	Clk., 3rd Cl.	Met. S.	Met. N.
Camp, A. W. K.	Clk., 3rd Cl.	Met. C.	Met N.

FOREIGN AND COLONIAL NOTES.

DOMINION OF NEW ZEALAND.

Summary of miles of line, miles of wire, number of offices, number of Exchanges, number of subscribers and extension telephones connected to Exchanges, miles of Exchange wire, and knots of cable laid for year ending 31st March, 1908.

DISTRICT.	Miles of Line.	Miles of Wire.	Number of Offices.	Number of Exchanges.	Number of Subscribers, including Extension Telephones.	Miles of Telephone Wires erected, including Metallic Circuit.	Submarine Cables, length in knots.
	m. ch.	m. ch.				m. ch.	
Auckland . .	2,402 30	6,555 60	374	11	4,077	5,403 18	20·523
Wellington . .	2,477 39½	9,256 22½	425	44	9,896	7,770 63	293·739
Nelson . .	1,411 69	3,643 15	230	9	1,416	652 23	10·660
Christchurch . .	1,180 57	4,155 48	234	21	4,111	4,126 7	1·518
Dunedin . .	2,182 60	5,732 60	340	26	4,381	4,048 38	25·101
	9,655 15½	29,343 45½	1603	111	23,881	22,000 69	351·541
Totals, Mar., 1907	8,953	27,031 0	1446	105	19,882	12,921 10	297·013
Increase for 1908	702 15½	2,312 45½	157	6	3,999	9,079 59	54·528
Percentage . .	7·27	7·88	9·79	5·40	16·74	41·26	15·51

EXTRACTS FROM POSTMASTER-GENERAL'S REPORT DATED JUNE 22ND, 1908.

STAFF.

"The Post and Telegraph Classification Act, 1907," makes important changes in the classification of officers of the Department. Instead of there being twenty-five classes, some identified by number and some by name below the First Division, the Department has now thirteen classes. This in itself makes greatly for simplification of treatment of the scheme of classification; but when it is considered that the former distribution of officers interposed arbitrary reasons to keep apart officers doing work of the same relative importance and value for the Department, the amelioration appears still more clearly. For instance, officers of the First Grade in the First Class and Chief Postmasters at the four principal centres were formerly separated, and some slight difference in salary marked the separation. The separation was purely arbitrary, and hampered the Department in filling vacancies. Now these Chief Postmasters come into the scheme in line with other officers doing work of equal importance, and the title " First Grade " and its limits of salary cover all. This will have the effect, it is believed, of enlightening and contenting officers. The same reasons have dictated the fusion of following classes, and will no doubt produce the same results.

An Order in Council renewing Classification Regulations was made on the 29th July, 1907, with effect from the 30th July, 1907. Among changes made were the following:—An educational certificate of proficiency is required from applicants for employment in the Clerical Division. The age for appointment to the Clerical Division was reduced from sixteen to fifteen years. Experts may be appointed at an age over twenty years. An officer who joined the Department before the passing of the Post and Telegraph Classification and Regulation Act of 1890 is not now required to pass the senior examination before receiving promotion to any class higher than the Fifth Class (£190—£250), (by a later Order in Council, of May 2nd, 1908, the Sixth Class—£200—£260), also persons skilled in electricity or telegraphy, or in literature, science, or art, to the satisfaction of the Minister, are not required to pass any further examination other than the usual departmental ones. Any person over thirty-five years of age who has been temporarily employed previous to reaching such age, and whose employment has been continuous, is eligible for appointment to the Non-clerical Division. Power is given the Ministers to fill vacancies requiring, in his opinion, special experience or special knowledge, in the most suitable way, regardless of seniority of officers. Officers transferred in the same financial year to any *grouped* class retain the same relative positions as before such transfer. Female officers are granted the same periods of leave as male officers. Non-clerical officers of ten years' service and upwards receive three weeks of annual leave instead of two weeks. Cadets passing an examination in shorthand are granted six months' seniority. Examinations in departmental requirements are specified for postal and telegraph officers and cadets.

Every male officer who is married, or who is a widower with a child or children, is to receive a salary of not less than £130. But he is not entitled to claim, and may not be paid, the additional sum of £10 mentioned in the next paragraph until the salary attached to his official position in the Post and Telegraph Departmental List reaches £130. Any sum representing the difference between the salary attached to his official position and a salary of £130 is regarded as a gratuity only.

An officer who is married, or is a widower or a widow with a child or children, and is drawing a salary less than £150 per annum, is paid a sum additional to salary of £10 per annum until the salary reaches the sum of £150 per annum. When the difference between the annual salary and £150 is less than £10, a sum equal to the difference only is paid.

Officers in the Second, Third, and Fourth Grades of the Twelfth Class who have been fifteen years or upwards in the service of the Department, if favourably reported upon in regard to conduct and efficiency, may be granted, at the discretion of the Minister, good-conduct money at the rate of 6*d*. per day.

An efficiency test, as provided for by the Classification Regulations, applying to Post and Telegraph officers before receiving salary in excess of £165 per annum, and a further efficiency test, applying to Postal officers, and a technical examination applying to Telegraph officers before receiving salary in excess of £200 per annum, took place in April—May, 1908, at which also the results were satisfactory.

Telegraphs.

The charge for ordinary Press telegrams transmitted on departmental holidays for evening papers was reduced from 1*s*. to 6*d*. from the 19th August, 1907, for each hundred words or fraction thereof.

Telegrams in plain language relating to betting or to investments on the totalisator or in coded language reasonably supposed to relate to betting or to investments on the totalisator are forbidden by "The Gaming and Lotteries Act Amendment Act, 1907," to be delivered on any racecourse. Money-order telegrams addressed to a racecourse are refused. Telegrams or money-order telegrams addressed otherwise than to a racecourse are accepted, even though they relate to betting.

Typewriters for receiving telegrams have been in use for some years now, but their use has been confined to a few officers who supplied their own machines. It has been decided to supply at an early date a number of typewriting machines for the use of officers receiving telegrams, and to make a special payment to the officers selected to use them. Officers who at present own their machines may sell them to the Department.

The telegraph receipts for the financial year, including telephone-exchange subscriptions, private-wire rents, etc., amounted to £344,251 0*s*. 6*d*., compared with £307,520 15*s*. 11½*d*. in 1906–7, an increase of £36,730 4*s*. 6½d., or 11·94 per cent.

The expenditure was £357,581 1*s*. 3*d*., as against £291,359 12*s*. 6*d*. for the previous year, an increase of £66,221 8*s*. 9*d*., or 22·73 per cent.

There were 9656 miles of line and 29,344 miles of wire at the close of the year—an increase of 703 and 2313 miles respectively.

The net expenditure out of Public Works Fund for telegraph-extension was £155,491 8*s*. 6*d*., as compared with £114,067 19*s*. 9*d*. in 1906–7.

The number of private wires and subsidised lines was 389, compared with 351 in 1906–7. The amount received for rent, maintenance, etc., was £2205 6*s*. 4*d*., as against £2123 3*s*. 8*d*. in 1906–7.

The total number of telegraph and telephone offices open at the close of the year was 1611. Of these, 280 were telegraph offices and 1331 were telephone offices.

The number of telegrams of all codes forwarded during the last financial year was 7,042,923, an increase of 646,591, or 10·11 per cent. over 1906–7.

The proportion of paid telegrams per head of population was 7·42, and 6·84 the previous year.

The number of ordinary telegrams forwarded was 5,040,044, of the value of £159,244 3*s*. 7½*d*., compared with 4,548,532, of the value of £148,659 5*s*. 3½*d*. in 1906–7, an increase of 491,512 and £10,584 18*s*. 4*d*.

The urgent telegrams numbered 255,525, of the value of £15,621 13*s*. 2*d*., an increase of 19,794 in number and £1281 14*s*. 10*d*. in amount.

The average value of each ordinary telegram was 7·58*d*., and of each urgent telegram 1*s*. 2·67*d*.

452,536 Press telegrams, of the value of £21,201 8*s*. 1½*d*., were forwarded in 1907–8, as compared with 389,917, valued at £18,089 1*s*. 4*d*., forwarded in 1906–7—an increase of 62,619, or 16·06 per cent., in number, and an increase of £3112 6*s*. 9½*d*., or 17·2 per cent., in value.

The value of each Press telegram averaged 11·24*d*., as against 11·13*d*. in 1906–7.

The bureau messages numbered 1,210,174, of the value of £26,858 13*s*. 6*d*., as compared with 985,900, of the value of £21,212 15*s*. 6*d*., in 1906–7—an increase of 224,274 in number and £5645 18*s*. in amount.

The average value of each bureau message was 5·33*d*., as against 5·16*d*. in 1906–7.

Wireless Telegraphy.

The first message by wireless telegraphy despatched from New Zealand to an oversea country was transmitted on the 3rd February, 1908, from the Prime Minister of this Dominion to the Hon. Alfred Deakin. The message was despatched from H.M.S. "Pioneer," at Wellington, to H.M.S. "Psyche," in Port Jackson, the battleship "Powerful" acting as "repeater" at sea within twelve or fourteen hours' steaming-distance of Sydney. The interval of time between losing the New Zealand signals and picking up the Australian was six hours.

Telephone Trunk Wires.

The demand for telephone trunk wires to connect outlying places with exchanges and the exchange in one locality with that in another does not diminish. In most cases telegraphic communication exists between the towns, but this does not always satisfy the public. A perusal of the record of works carried out in the different Inspectors' districts will show that much has been done during the year to meet these requirements, and the general extension of the telephone system has been on a scale in excess of the extension in previous years.

As stated in former reports, the carrying-capacity of a telephone circuit is limited to about fifty spoken communications a day, so that the growing requirements of the public for telephonic facilities between centres of population can only be met by a large capital outlay. Telegraph revenue shows a tendency to shrink where telegraph and telephone communication exist side by side.

The superimposed circuits introduced from time to time work satisfactorily, and wherever facilities exist in connection with new wires telegraph circuits are, when considered advisable, superimposed upon the new wires.

STUDENTS' SECTION.

In this section, so far as space allows, answers will be given to any questions of general interest from an educational point of view. Queries should be addressed to Mr. A. W. Martin, Engineer-in-Chief's Office, G.P.O. West, E.C.

Question 1.—Find the number of lines of force developed in a round bar of iron 18 cm. in length, 0·5 sq. cm. in cross section, and having a permeability of 150 if the current strength be 250 milliampères and the number of turns of wire 500.

Answer.—The number of lines of force through the iron is called the magnetic flux.

$$\text{Magnetic flux} = \frac{\text{magneto-motive force}}{\text{reluctance}} = \frac{\dfrac{4\pi C n}{10}}{\dfrac{l}{a\,\mu}}$$

Where C is the current strength in ampères,
n ,, number of turns of wire,
l ,, length of the iron in cms. assumed to be evenly covered by the coil of wire,
a ,, sectional area of the core in sq. cms.,
μ ,, permeability of the iron,

$$\text{Magnetic flux} = \frac{\dfrac{4\pi \times 0{\cdot}25 \times 500}{10}}{\dfrac{18}{0{\cdot}5 \times 150}}$$

,, = 654·5 maxwells.

This method of determination is only approximately correct in the case of a bar whose length is twenty times as great as its diameter. For greater lengths than twenty diameters the formula is more applicable and for lesser lengths there is no general solution.

Question 2.—A copper disc of 10 cm. radius revolves 300 times per minute in a plane at right angles to the horizontal component of terrestrial magnetism (H). Find the potential difference between the rim and the centre of the disc assuming H = ·18.

Answer.—(2) When any conductor moves so as to cut 10^8 magnetic lines of force per second an E.M.F. of one volt is produced in it. The disc may conveniently be regarded as consisting of an infinite number of radii joined in parallel and the E.M.F. produced is that set up in any one radius. It is therefore necessary to find the number of lines cut by a radius in one second.

Let r be the radius of the disc in cms.
,, n ,, revolutions per second.
Lines cut per revolution $= H \pi r^2$
,, ,, second $= H \pi r^2 n$

$$\text{P.D. in volts} = \frac{H \pi r^2 n}{10^8} = \frac{0{\cdot}18 \times \pi \times 10^2 \times \dfrac{300}{60}}{10^8}$$

$$= \frac{283}{10^8} \text{ approx. or } 2{\cdot}83 \text{ micro-volts.}$$

LINE CONSTRUCTION WORKS.

THE following figures are indicative of the extent of the open line construction works which have been carried out in the provinces during the past four months:

	Approximate number of poles erected.	Approximate number of miles of wire erected.
July	2800	1500
August	3070	1770
September	3020	1902
October	2900	2190

These figures include upwards of 2000 H Poles, which are counted as one pole each. Minor works and ordinary renewals are omitted.

The number of skilled workmen and labourers employed in October, exclusive of those employed in the Metropolitan districts, were approximately 1620 and 3680, which is an increase of about 30 per cent. on the number of men employed on construction work in November, 1907.

PROFESSIONAL PAPERS.

READERS are politely requested to peruse the particulars of professional papers on page 2 of cover.

INSTITUTION NOTES.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

ON Monday, November 9th, 1908, the Rt. Hon. Sydney Buxton, M.P., H.M. Postmaster-General, officiated at St. Bride's Institute, Ludgate Circus, at a special meeting of the Post Office Electrical Engineers' Institution, and presented medals to the gentlemen whose papers, delivered in 1906, had been adjudged by the Council to be of highest merit.

The Engineer-in-Chief, Major W. A. J. O'Meara, C.M.G., presided, and said he knew it was the desire of the meeting that he should express to the Postmaster-General on their behalf a most hearty welcome, and say how much they appreciated the great interest shown in them by coming to present the medals when he was so full up with engagements. The medals were awarded in connection with the first session of 1906-7, and there might be some who questioned the wisdom of presenting medals, and who might think that engineers should take sufficient interest in their profession, and not look for the award of a medal. It was true that papers would be prepared and read in any case, but he thought it was only right that medals should be presented. If these awards did nothing else they had the very beneficial effect that they helped the members of the Institution to see the standard at which the Council was aiming, that is to say, the standard of excellence, and it was for this reason that he was glad of the presentation of the medals. He hoped that when the Council got into its stride, it would see its way to promote the interests of the Department in other ways. For instance, the Council might decide that it would be a useful thing to institute a special medal for presentation each year in connection with the solution of important problems which from time to time may perplex the Department. That is to say, the Council would invite essays from the members of the Institution on some definite subject, and award the special medal to that member who provided the best solution.

Major O'Meara stated that he would not that evening attempt to descrihe the extent of the field covered by engineering. On Tuesday last the new President of the Institution of Civil Engineers had given some indication of the field which was covered by the engineers who dealt with problems connected with transport alone, and was justly proud of the achievements in this field. They, as communication engineers, were glad that in their small way they probably had assisted in the realisation of the projects on which the transport engineers had been engaged. Without the electric telegraph there could be no trains at sixty miles an hour; without the electric train staff it would not be possible to utilise single line railways to their fullest capacity; without the electric telegraph between the bridge of a ship and its engine-room the captain would not possess the power easily to manœuvre his vessel.

He said that the Postmaster-General had expressed the desire that the P.O. engineering enterprises should be conducted on a commercial basis. The P.O. engineers welcomed this proposal; nothing would give them greater pleasure than to play the same part in the engineering enterprises of the P.O. that the members of their profession played in commercial organisations. Lest unfortunately an impression might prevail that the engineers of the P.O. were not interested in the financial side of their work, not only would he draw attention to the fact that papers on the commercial aspect of P.O. engineering had been read before this Institution, but he would also like to draw attention to Appendix R, page 96, of the Postmaster-General's 'Annual Report' for 1908, where it was shown that the maintenance of the telegraph system in 1898-9 cost £617,616, and had increased in the year 1903-4 to over a million, but since then the expenditure had decreased so that in 1906-7 it was £947,657. The period of the decrease synchronised with that during which the P. O. engineers had become and remained responsible for their own accounting. The estimated expenditure for the present year has again gone up to over a million, but this could be accounted for by a reference to page 31 of the Report, where it was shown that various increases of pay had been granted as a result of the Report of the Select Committee of the House of Commons under the presidency of Mr. Hobhouse.

He then went on to say that there may be some who might ask what has accounting for engineering expenditure to do with engineers? His answer to this question could be given in words very similar to those used by the President of the Institution of Civil Engineers on Tuesday last. It has as much to do with them as the consideration of the materials used by them has to the design, user, and efficiency of the mechanism of the telephone switchboard in which these materials are used.

Major O'Meara then asked Mr. Buxton to present the medals.

The Postmaster-General apologised for his martial attire, stating that he was going to the Guildhall to defend his country against suffragettes and other people. He had much pleasure in accepting the invitation to present the four medals, and congratulated the Institution on its accomplishments, stating that he had followed its efforts since its inception. He was glad to think that the Department had given it encouragement. Referring to the increase in membership, he thought its rapidity augured well for the future of the Institution. He thought everyone would agree that an Institution of this sort was an advantage both for the officers concerned, for the Department, and thus also for the public at large, and one of the most interesting features about it—he thought the most satisfactory feature—was the great interest which had been taken in the various papers which had already been read in the various branches throughout the country. The great variety of papers on various abstruse questions showed the interest taken, and the discussions which followed the reading of the papers showed that the members took an interest in the various addresses, which were rather Greek to him.

From time to time he went round to visit the various post offices and the various telegraph stations and telephone stations in London and elsewhere. He had the matters explained to him, and he always looked very wise and said as little as possible. He thought that all would agree with the Chairman that an Institution of this sort was certainly of great help to those who were engaged in the difficult and complicated work of P. O. engineering, and it provided a kind of co-operative education for the whole of them. He thought that it had a great future before it, since its educating effects would help the officers to advance in knowledge. Looking to the fact that engineering is the one branch of the Postal Service in which there are changes from year to year, he thought the Institution would help to keep the Department abreast of the times, and not allow it to fall behind outside engineering works in the various matters of telephone construction, wireless telegraphy, etc.

Mr. Buxton referred to the additional responsibilities and work which would fall on the P. O. engineering staff when they had all the telephones of the country to maintain in three years' time or possibly sooner. He said that the engineering work was at present increasing more rapidly than they could secure additional staff. This was unfortunate, and he quite realised that many of the engineering staff were over-burdened with work. There was necessarily some delay in obtaining additional staff owing to the necessity for seeking Treasury sanction, which took some little time. He said that the matter was being carried through as quickly as possible, and the subject of a revision of the Engineering Branch was in hand. The delay was solely owing to the physical difficulty of arranging such matters.

The Postmaster-General mentioned that the Institution had a very excellent library, and he was glad to hear from the Secretary that it was used to its fullest extent. Owing to the large number of books recommended to the library the task of choosing the books to be purchased was very difficult, and consequently many suggestions had to be rejected. He said that he could not obtain the acceptance of his book on fishing, yet he assured them that from the scientific, from the mental, or from the physical point of view it was much better than even engineering works.

He then went on to mention that the Institution was extending its membership to foreign and colonial engineers. He said that this was a good thing, as it tended to improve international relationships. He mentioned that engineering was doing much in this direction, and instanced the recent International Conference on Electrical Units, at which Major O'Meara represented the Post Office.

Mr. Buxton was pleased to have the honour of presenting the medals. The recipients, whose names are given below, were in each case congratulated by Mr. Buxton on their achievements, and heartily applauded by their colleagues.

Senior Division, Silver Medal.—Mr. J. E. Taylor for a paper on the "Propagation of Electro-Magnetic Waves"

Senior Division, Bronze Medal.—Mr. J. G. Hill for a paper on "Telephone Transmission."

Junior Division, Silver Medal.—Mr. A. O. Gibbon for a paper on "Underground Construction in the Provinces."

Junior Division, Bronze Medal.—Mr. J. S. Brown for a paper on "Post Office Lamp Signalling Trunk Exchanges."

A vote of thanks to the Postmaster-General which Major O'Meara had proposed was carried with hearty acclamation, and the meeting turned its attention to a paper by Mr. F. L. Henley on "The Inspection of Wrought Timber."

COUNCIL NOTES.

A meeting of the Council of the Institution was held at Shrewsbury on the 23rd September, 1908. Mr. A. J. Stubbs presided, and, from the large volume of business transacted, the following items of general interest have been extracted.

Colonial and Foreign Corresponding Members.

A supply of forms of application for membership has been obtained, and over 250 forms distributed to various colonial and foreign administrations.

Submarine Staff.

It has been decided to invite members of the submarine staff at Woolwich and Dover respectively to attend meetings of the Metropolitan Centre. The question of the provision of a separate Reference Library for the use of the Submarine Staff is under consideration.

University Engineering Degree.

The Principal of the London University has been written relative to the desirability of including Telegraphy and Telephony as optional subjects for the Engineering Degree of the University. The matter will be placed before the Governors at their next meeting.

Financial Position.

A report from a Sub-committee appointed to review the present financial position of the Institution was considered and adopted.

The Council have decided to effect certain economies in printing.

Date of Annual Meeting.

The Metropolitan Committee have agreed to a suggestion from the Council that the Annual General Meeting of the Institution should be arranged for a later date than has been the practice heretofore. The next Annual Meeting has been fixed for the 26th April, 1909, at St. Bride's Institute Hall, E.C.

Reprint of Rule Book.

A reprint of the Rule Book having become necessary, it has been arranged for a new issue to be obtained at once. The Rule Book will be produced in a size uniform with the other Institution publications.

Arrangements for Winter Session.

Reports received from the various local centres indicate that the interest is being well maintained.

Full programmes have been arranged at most of the centres, and in several districts a series of interesting visits to manufacturing works, etc., arranged. The Council considered that the prospect for the winter session was of a most encouraging nature. In one or two instances, owing to extreme pressure of official business and the difficulty experienced in reaching the place of meeting, full programmes have not been arranged, and in these cases it may be found possible to render assistance from headquarters. This matter is receiving consideration.

Membership.

The membership now stands as follows, viz.:

Number on Roll, March 31st, 1908		755
Resignations	2	
Deaths	9	
		11
		744
New members:		
Home	45	
Colonial	9	
Foreign	1	
		55
Total		799

RETIREMENT OF MR. JARVIS.

The Council regret to report that, owing to continued ill-health, Mr. P. Jarvis has been retired from the Service. The Council unanimously resolved that a letter of regret at his enforced retirement be sent to Mr. Jarvis, together with the best thanks of the Council for his past services, and that the Council's appreciation of his work be recorded in the minutes.

Arising out of this matter, the Council proceeded to fill the vacancy created, by the co-option of Mr. E. T. Titterington as the Provincial First Class Engineers' representative.

TRANSFER OF MR. GIBBON.

The transfer of Mr. A. O. Gibbon to the Headquarters Staff rendered his retirement from the Council necessary. In this connection it was resolved that the Council place on record their sense of appreciation of the valuable services rendered to the Institution by Mr. Gibbon, both on the Council and in Committee. As the election of Mr. Gibbon to the Council was unopposed, it was decided that a formal election take place in order to appoint a successor. (This has been done subsequent to the meeting, and Mr. Wyatt elected as the Provincial Sub-Engineers' representative.)

LOCAL CENTRE NOTES.

METROPOLITAN CENTRE.

THE meetings of the Metropolitan Centre have lost nothing of their popularity during the recess, and excellent attendances have, so far, been the rule. A paper by Mr. E. W. J. Todd entitled "The Engineering Aspect of Finance" was the subject of the October meeting, and an animated discussion took place. The theme of Mr. Todd's treatise was the underlying principles rather than the detailed operations of the Department's financial system, and he strove to show, step by step, the considerations and requirements upon which the expenditure-policy of the Post Office is based. One marked result of the discussion was the general demand for a codification of the accounting *principles*—in form similar to the "Technical Instruction" series, for the better understanding of the constantly changing details of accounting work.

On Monday, November 9th, the meeting was called somewhat earlier than usual to meet the convenience of the Right Hon. Sydney Buxton, M.P., who presented the Institution medals for papers read during session 1906-7. Major W. A. J. O'Meara presided, and Mr. F. L. Henley contributed a paper on "The Inspection of Wrought Timber." Though limited in its scope the paper was of excellent quality, and the speakers who followed were for the most part of an inquiring rather than of a critical mind, criticisms being generally directed against the limits which Mr. Henley had set himself in the title of his paper. On the motion of Mr. J. W. Atkinson it was resolved that the Secretary be instructed to express to Mrs. Hertha Ayrton the deep sympathy of the Metropolitan Centre in the loss of the late Professor W. E. Ayrton, himself an old telegraph man.

Mr. S. C. Bartholomew's paper entitled "Protection from Power Circuits," which was read on December 14th, was the embodiment of much experience and careful study of the subject. Too lengthy for reading without abridgment, the paper was full of good things, and is something more than a compendium of official instructions. Mr. W. Noble presided and, as usual, a good discussion ensued.

EASTERN CENTRE.

There was a very full attendance on the occasion of the opening meeting of the session, which was held at Cambridge on the afternoon of Tuesday, October 13th, when a paper was read by Mr. W. J. Stubbs on "Secondary Cells." The Chair was taken by the President, Mr. J. Jenkin.

Mr. Stubbs' paper dealt with the general principles of the storage cell, and explained the method of construction of the plates, the chloride cell being chosen as an example. The general arrangement of a battery room for very large cells was indicated, and the method of installing the cells detailed. Then followed an outline of the method of charging, and an explanation of the relative advantages of a shunt and a series wound machine for this purpose. The nature and treatment of the electrolyte was next dealt with, and the range of specific gravity allowable given. The maintenance of the cells including chemical tests of the purity or otherwise of the electrolyte, and the general precautions to be taken in order that the best results might be obtained were also treated at considerable length.

NORTH-WESTERN CENTRE.

The third session of the Institution, so far as the North-Western Centre is concerned, gives promise of being as equally successful as the previous ones. Six meetings have been arranged, three of which will have been held by the time this appears in print.

At the first meeting the inaugural address was given by the Vice-Chairman, the Chairman being unavoidably absent, after which an interesting paper was read by Mr. R. Cunningham entitled "Control and Discipline." At the second meeting a paper upon "Time Checks and Calculagraphs" was read by Mr. W. J. Medlyn, and proved both interesting and instructive. A working example of the time check in general use was fitted up to illustrate the paper, together with a calculagraph.

Mr. A. F. Guy will, upon the occasion of the meeting to be held on December 21st, read two short papers entitled "The Manchester Electrical Exhibition" and "Transformer Efficiencies."

The title of only one of the papers to be read at the three remaining meetings has, up to the present, come to hand, viz. "The Chemistry of Telegraph Engineering, by Mr. W. B. Smith. It may be stated, however, that the number of papers promised is in excess of the number required.

NORTH-EASTERN CENTRE.

The first meeting of the session was held on the 2nd November, when Mr. Pickering cleverly handled a paper on "Wayleave Observations" and "The New Telegraph Construction Act of 1908."

The meeting was well attended, and keen discussion followed the speaker's remarks.

Mr. Bailey is to address a meeting on the 14th December on "Some Notes on the Huddersfield Underground Work."

A visit to Messrs. Greenwood and Batley's Engineering Works has been arranged for the same day.

There is every promise of a successful session.

We are pleased to welcome the return to duty of Mr. J. Lunn after a long absence on sick leave, and trust his health is permanently established.

NORTH MIDLAND CENTRE.

The first meeting of this Centre for the present session was held on the 26th October, when Mr. T. E. Herbert communicated a paper on "The Organisation of an Engineer's Section." A general discussion followed, which proved both profitable and interesting.

The next meeting will be held on the 7th December, when Mr. G. E. Fletcher will read a paper on "Engineering Expense Accounting."

On a date to be arranged later, Mr. W. W. Smith will contribute a paper on "Underground Distribution for Telephone Exchanges." It is hoped that it will be possible to arrange for other contributions during the session.

SCOTLAND WEST CENTRE.

Institution Meetings: Up till the present definite dates have not been fixed, and it looks as if the hand-to-mouth arrangements of last year are to be repeated. So far as results are concerned no great fault could be found with those arrangements, and it is hoped, despite the many conflicting interests, that an equally satisfactory and enjoyable session will be the experience. One of the best features of last session, socially, was the engineers' dinner, following Mr. Hetherington's paper the same afternoon. One felt invigorated by the complete relaxation afforded by the combination. The more social function in the evening undoubtedly put a top on the afternoon's proceedings, and made the day more complete and satisfying. There must be general regret, with such a pleasant memory clinging to one, that, so far, there are no indications of a repetition of that pleasure, but of course it is not too late to flame the sparks and serve up once more the genial and vivifying glow of a social evening.

As happened last session Mr. Hetherington will lead off the session's meetings, probably during the third week of December, with a paper on that important subject "Telephone Transmission."

IRELAND CENTRE.

The first meeting of the session took place on October 26th before a good attendance of members from all parts of Ireland. Mr. Sheridan, Superintending Engineer, North Irish District, occupied the chair, and delivered the opening address on the subject of "The Personal Equation."

An interesting discussion took place, in which Messrs. Fossett, Evans, Kinsey, Dwyer, and Patterson took part.

Several papers have been promised by members and the session is likely to prove successful.

NORTHERN CENTRE.

The prospects for the 1908-9 session are exceedingly good, seven papers having been promised, including two from members of the Clerical Staff.

Our first meeting was held on October 26th, 1908, when the chairman, Mr. F. Tremain, read a paper on "The Economic Aspect of Open Line Construction."

Some interesting figures, which had been obtained in connection with several large rebuilding works at present being carried out in this district, were quoted by the lecturer in support of his contention that the employment of large gangs had proved economical. A useful discussion followed.

The second meeting of the session was held on November 16th, the lecturer being Mr. T. B. Johnson, and his subject, "Protection from Power Circuits."

The lecturer dealt with his subject in a very able manner, his explanations of the different types of "guarding" being very clear. A number of diagrams illustrating these were thrown on a screen.

Considerable discussion followed, in which a large number of members took part.

Our next meeting will be held on December 14th, when Mr. J. A. Motyer will read a paper on "Paybills."

COVERS FOR BINDING.—Please see announcement on page 7 of Supplement.

VISITS TO MANUFACTURERS' WORKS, ETC.

METROPOLITAN CENTRE.

The excellent programme of visits arranged by the Metropolitan Centre Committee under the energetic chairmanship of Mr. W. Noble, has evoked an enthusiastic if somewhat inconveniently large response. Visits have already taken place to the Stores Department Central Depôt, Messrs. Siemen's Works, and the Mount Pleasant General Factory, and the attendance has averaged nearly double the average of last year's visits.

Over one hundred members were present on Monday, December 7th, at Brook Green Works, by invitation of the Robertson Electric Lamps, Ltd. Ample arrangements had been made for the guidance of the party, and the interesting processes involved in the gradual building up of the complete lamp were most interesting. Not the least of the attractions was the huge new building, in which it is intended to accommodate 1200 employees on the manufacture of the new "Osram" lamps. The Chairman of Directors, Mr. Hirst, welcomed the visitors, and extended a similar invitation to members of the Institution to inspect the Company's other Works at Witton and Manchester. Messrs. J. W. Woods and W. Noble expressed the thanks of the members for their kind reception. South Midland and North Western Centre Committees might profitably note Mr. Hirst's remark when future programmes of visits are being compiled.

Arrangements have been completed for the following visits on the first Monday in each month:—

January.—Holloway Factory.

February.—Chelsea Power Station.

March.—Submarine Depôt and Cable Ship.

Second visit to Central Depôt Stores Department on the third Monday in January.

SOUTH WALES CENTRE.

On November 10th the members of the South Wales Centre visited the Cardiff New Exchange. Mr. Devereux conducted the assembled large party over the building, and explained the latest form of switching equipment in a very able manner.

NORTH-WESTERN CENTRE.

A visit was paid to Messrs. The General Electric Company's Works, Salford, Manchester, on the 16th and 17th October. This Company is at present engaged upon work in connection with the Glasgow new telephone installation for the Department, and the various parts of apparatus were shown to the members of the Institution.

The greatest courtesy was extended by the Company's officials, and the visitors were exceedingly interested. Two other visits are on the programme for this session, viz. to Messrs. Glover's Cable Works on the 21st and 22nd December, 1908, and to the Manchester Municipal School of Technology on the 22nd and 23rd February, 1909.

NORTH MIDLAND CENTRE.

On the 7th December a visit will be made to the British L. M. Ericsson's Company's Works at Beeston by those members who were unable to avail themselves of the opportunity last year. The managing director of these up-to-date works extends a cordial invitation for visits by members of other centres, and as every facility is given for a thorough examination such visits could not fail to be instructive.

NORTH WALES DISTRICT.

The following visits have been arranged, viz.:

December 9th—British Insulated and Helsby Cables Company, Ltd., Instrument Factory, Liverpool.

Dates not yet fixed { L. and Y. Railway Co.'s. Power Station, Formby.
Cunard R.M.S., Mauretania or Lusitania.

LOCAL CENTRE PROGRAMMES, 1908-9.

METROPOLITAN CENTRE.

SECOND MONDAY IN EACH MONTH.

December.—" Protection from Power Circuits." Mr. S. C. Bartholomew.
January.—" Loading of Underground Circuits." Mr. A. W. Martin.
February, March.—Not yet definitely arranged.
Annual meeting of Institution, April 26th, 1909.

IRELAND CENTRE.

October 26th.—President's Inaugural Address. Mr. J. Sheridan.
December 14th.—" Reconstruction of a large Telegraph Office." Mr. A. T. Kinsey.
January 18th.—" Wireless Telegraphy." Mr. J. J. Dwyer.
February 15th.—" Concrete and its Uses." Mr. W. Pennington.
March 15th.—" Renewal of G.P. Underground by P.C. Cable." Mr. R. A. Weaver.

SOUTH WALES CENTRE.

November 10th.—Visit to Cardiff No. 2 Exchange. Demonstration and explanation. Mr. Devereux.
December 8th.—Cardiff new underground. Laying of cement conduits. Mr. Youngs.
January 12th.—" Condensers." Mr. Hart.
February 9th.—" Estimates." Mr. Scott.
March 9th.—" Regulations and Accounts." Mr. Bound.

NORTH-WESTERN CENTRE.

October 19th.—Inaugural address by Mr. W. J. Medlyn. Paper, " Control and Discipline." Mr. R. Cunningham.
November 23rd.—"Time Checks and Calculagraphs." Mr. W. J. Medlyn.
December 21st.—"The Manchester Electrical Exhibition." "Transformer Efficiencies." Mr. A. F. Guy.
January 25th.—" The Chemistry of Telegraph Engineering." Mr. W. B. Smith.
February 22nd, March 22nd.—Titles of papers not yet received.

EASTERN CENTRE.

October 13th.—" Secondary Cells." Mr. W. J. Stubbs.
December 8th.—" A Visit to a Wireless Station." Mr. E. T. Titterington.
February.—" Copper Wire Manufacturing and Testing." Mr. E. H. Shaughnessy.
April.—" Notes on Building Construction." Mr. G. W. Bannister.

NORTHERN CENTRE.

October 26th.—" The Economic Aspect of Open Line Construction." Mr. Tremain.
November 16th.—" Protection from Power Circuits." Mr. T. B. Johnson.
December 14th.—" Paybills." Mr. Motyer.
January 11th.—" Some Alternating Current Measuring Instruments." Mr. Lee.
February 1st.—" Central Battery Systems with Modifications." Mr. Bellwood.
March 1st.—Mr. Andrews.
March 29th.—" The Unit Maintenance Cost Return." Mr. Williams.

NORTH WALES CENTRE, PROGRAMME 1908-09.

December 9th, 1908—Presidental Address. Mr. W. Slingo.

Dates not yet fixed:
- " Electro-Magnets." Mr. H. Hinton.
- Paper on Selected Subject. Mr. T. Plummer.
- " Gas and Hot Air Engines." Messrs. Osborne and Whiteside.
- " The Economical Carrying Out of Works by the Concentration of Gangs." Mr. G. H. Vaughan.
- Paper on Selected Subject. Mr. J. S. Elston.

SOUTH MIDLAND CENTRE, PROGRAMME 1908-09.

September 9th, 1908—"A few Practical Hints on Underground Work." Mr. G. W. Hook.

October 14th, 1908—"Engineering Accounts." Mr. T. E. Matthews.

December 16th, 1908—"The Birmingham Telephone Switch Room." Mr. A. H. Roberts.

SOCIAL NOTES.

METROPOLITAN (SOUTH) DISTRICT.

Retirement of Mr. T. Harrison, late Superintending Engineer of South Metropolitan District.

The retirement of Mr. T. Harrison, after a service of forty-seven years with the Department, took place on the 16th October, 1908.

On Friday, November 20th, the Staff took the opportunity of presenting to him a handsome solid silver tea service, salver, and cruet, together with an illuminated address, as a token of their respect and friendship. A smoking concert was held at the French Horn Hotel, Wandsworth Common, at which Mr. Sinnott, Assistant Superintending Engineer, presided. All sections of the District were represented; several engineers who had recently left the District were also present, and the company was honoured by the presence of Messrs. M. F. Roberts and A. J. Stubbs, Assistant Engineers-in-Chief; Messrs. Stockwell, McIlroy, and Purves, of the Engineer-in-Chief's office; Mr. Stretche, of the Southern District (R.E.'s); and Mr. Chapman, Holloway Factory.

During the evening Mr. Sinnott spoke of Mr. Harrison's long and honourable career in the public service, and he stated that one and all envied Mr. Harrison in his possessing, at such an age, the full strength and vigour of a young man. He would a little later in the evening ask Mr. Stubbs to be so good as to make the presentation.

Mr. McIlroy said he had known Mr. Harrison for a considerable number of years, for a part on paper only; but since Mr. Harrison came to London in 1899, having been specially selected to carry out the inauguration of the London Telephone Service, he had had the pleasure of closer acquaintance, and for about three years occupied the position of Assistant Superintending Engineer under Mr. Harrison. There never was a harder worker, and the harder the work the more pleasure there seemed to be for Mr. Harrison; and he was sure he voiced the feelings of those present when he said that they were proud to think that he had been able to do all this, and still retain such vitality. It was rarely that capable men in the public service were left with the health that is Mr. Harrison's on their retirement, and few have had such prospects for enjoying a well-earned pension.

Mr. Stubbs, making the presentation on behalf of the Staff and a few outside friends, said it was a great pleasure to everyone to see Mr. Harrison in such good health, and with every prospect of being able to enjoy his rest on a pension so well earned.

Mr. Harrison, in rising to reply, was very heartily received. He said he must first apologise for the manner in which he left headquarters on the last day of his official life. It had been his intention to take farewell of every member of the Staff, but he found, when the time came, he was so overcome by the many expressions of appreciation and goodwill that reached him, that he found the task too difficult—in fact, physically impossible. He assured them that he appreciated their good wishes, and he hoped that this would explain his apparent neglect on the day of his retirement. This was the proudest moment of his life. He felt that his endeavour to do his duty, both to the Department and to the Staff, had been realised, and he should treasure the beautiful present and illuminated address, not only for their high intrinsic value, but also for the spirit in which the presentation was made. Never during his life had he imagined having control of such a highly qualified Staff as had been his lot, and he had often taken the opportunity of expressing to Sir John Gavey (the late Engineer-in-Chief) his grateful thanks: and he never would have carried through the enormous amount of work which had been done in connection with the telephoning of London without the hearty and willing co-operation of that Staff.

Mr. Roberts congratulated Mr. Harrison on the very valuable present he had received, and remarked that he felt that the gathering was somewhat onesided, inasmuch as Mrs. Harrison was not present. He was sure that, in wishing Mr. Harrison good health in his retirement, all coupled with it the name of Mrs. Harrison, as this lady's cheery welcome at the very pleasant functions held at the South Metropolitan headquarters made everyone feel at home. He could testify to the kindliness of heart and solicitude for the welfare of his staff which Mr. Harrison always displayed.

Mr. Harrison, who was visibly affected, thanked Mr. Roberts for his very kind remarks and appreciation of his services to the Department. He also added a few words recording the able assistance he had received from Mr. McIlroy (late Assistant Superintending Engineer of the District), Mr. Sinnott (present Assistant Superintending Engineer)—who was described as the "scientific man"—and Mr. Heath, the Chief Clerk. His humorous reference to the latter gentleman's memory for dates was greatly relished by the company. He said that he never realised until this evening the effect on his feelings his retirement would have when the time came to say good-bye to his colleagues in official life.

A concert followed, and broke up with the singing of "Auld Lang Syne," and three ringing farewell cheers for Mr. Harrison.

A series of whist drives and dances have been arranged by the "Metso" Sports Club. The first whist drive took place at Stanley's Restaurant, Clapham Junction, on October 17th, 1908.

Mrs. Sinnott distributed the prizes, which were gained by Miss Dodds (1st), Miss E. Little (2nd), Mrs. Radcliffe (Consolation); Mr. Lilwall (1st), Mr. J. Sinnott (2nd), and Mr. C. W. Impett (Consolation).

Misses Bryce, Claydon and Wheeler, Messrs. Cox, Edwards, Gamgee, Hibberd, Lilwall, Leckie and Parker afterwards contributed to a very successful musical programme which was much appreciated. Whist drives have been arranged to take place in December, 1908, February and April, 1909.

METROPOLITAN (NORTH) DISTRICT.

An interesting social gathering took place at the Metropolitan (North) District on Wednesday, November 25th, when, in the course of a musical evening, Mr. E. A. Pounds was presented with a gold watch as a mark of esteem from his late colleagues of the district. Mr. E. Catley, who was supported by Messrs. E. J. Eldridge and G. H. Downing, made the presentation, and very neatly expressed the feelings of himself and staff with regard to the loss sustained by Mr. Pounds' transfer to the London Telephone Service. A clock with ornaments and a Worcester vase were also presented to Mr. A. Hart, assistant clerk, on the occasion of his marriage.

IRELAND CENTRE.

PRESENTATIONS.

On the 13th October last Mr. Alexander Moir was presented with a silver rose-bowl and salver by the Staff of the Southern Irish District prior to his departure from Dublin to take charge of the South Metropolitan District, London. The chair was ably filled by Mr. W. H. Cross, Assistant Superintending Engineer, who paid a high tribute to Mr. Moir's professional and administrative abilities, and to his personal charm of manner, which had endeared him to the whole of the staff. Messrs. Highton (Secretary's Office), W. M. Evans, A. T. Kinsey (Assistant Superintending Engineers, North Irish District), J. J. Dwyer, H. C. McCormack, and C. Burge (late Superintending Engineer, South Irish District) testified to the esteem in which Mr. Moir was held, and to the loss which the district would sustain by his departure. Mr. Moir, in reply, said he left Ireland with much regret, and heartily thanked the staff for their loyal co-operation and support.

The occasion was also made the subject of a presentation of a silver tea service to Mr. J. Cullen, late Sectional Engineer, Wexford, as a token of the respect in which he was held by his colleagues. The presentation was made by Mr. Moir, who congratulated Mr. Cullen on earning a well-deserved rest after a strenuous life spent in the service of the Department during a period in which many changes in the science of electrical engineering had taken place.

An excellent musical programme was afterwards provided.

SCOTLAND EAST CENTRE.

Mr. F. D. Horton has been transferred to London for Telephone Survey work. Prior to leaving he was presented with travelling bags and a fountain pen by the Superintending Engineer on behalf of the staff. The usual felicitous speeches were indulged in, extolling Mr. Horton's amiable qualities, and hopes were expressed that his transfer might prove beneficial.

ANNUAL DINNER.

The Sixth Annual Dinner of the Post Office Engineering Department, London, will be held at the Grand Hotel, Trafalgar Square, on the third Tuesday in February, 1909 (February 16th).

Mr. H. North, Survey Section, Engineer-in-Chief's Office, the Honorary Secretary, will issue a circular on the subject in due course.

LONDON UNIVERSITY EXAMINATIONS, 1908.

Congratulations are extended to Mr. F. Addey, 2nd class engineer, Engineer-in-Chief's Office, and Mr. W. H. Matthews, 3rd class clerk, Engineer-in-Chief's Office.

These gentlemen have recently obtained their B.Sc. degrees at London University.

CORRESPONDENCE.

To the Editors of THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

THE CULT OF THE CLERK.

THE writer of the above article in the October issue of the JOURNAL suggests that unless a clerk in a Government Department can foresee that any contemplated change be in his interests, he will relapse into quiet desperation, and the article is written with a view to dispelling any such feeling.

May I ask—Is there no limit to the time when a man may be excused for falling into such a state? Hope is a great incentive to study and work, and the Service would be a poor one if every individual were deprived of it. "To cease to hope is to begin to die," but hope in the Department must be given an impetus, or it must vanish. Can I be admonished for falling into quiet desperation if, after spending many hours in acquiring a knowledge of French, shorthand, book-keeping, drawing, mathematics, and technical subjects, I find myself at the end of seven years' service on one class of clerks, with prospects no better than when I entered that class? May I not argue that the spare time so spent might have been more profitably employed, and that to continue in such a course is morally wrong? There are plenty of fields for labour during one's spare time for the good of the community, and one would have the satisfaction of accomplishing something worthy. To spend all one's life in the study of subjects in general, on the chance that some of those subjects may assist promotion, is useless to the officer concerned, the Department, and the world. To the officer concerned—because it makes him selfish. To the Department—because students are apt to concentrate their thoughts on their studies during office hours. And to the world—because men who give up their lives to the study of one subject only are greater authorities, and it is they who enlighten the world.

Let the Department indicate its requirements for a clerk, and I have no doubt the majority will respond, whether it include the Cherokee or Greek. But let it be definite, so that an officer may give his mind to it with certainty. A few years ago one was led to suppose that if a clerk wished to make progress he must study technical subjects. Now it is "accounting," "banking," etc. One wonders what next! If one follows up the different policies, one will at the finish be in a position to look back and think of the "time elaborately thrown away."

General intelligence and acuteness are of greater value to the Department than a knowledge of any foreign language; but a course of study will not produce either of the former, although it may enable one to pass examinations in which is included the latter.

I suggest that if the Department desire to be in a position to learn the value of a clerk, it would be better accomplished by a study of official papers which had passed through his hands. Or, as an alternative, let the Department present imaginary difficulties which are likely to be met with, and let the officer indicate the best method of dealing with them.

In conclusion, I would like to point out that the attempt to compare an insurance office clerk with a Government clerk is futile under existing conditions. A clerk in an insurance office is rewarded according to his ability, and his incentive to study is "hope," which is stimulated periodically by promotion, enabling him to realise the benefit of his labours by being in a better position to provide for those depending on him. Instead of devoting his whole life in obtaining knowledge which may perhaps be useful, he commences on definite lines, and gives up a few years to the study of those subjects which are necessary and recognised.

Yours faithfully,

H. J. BULLARD.

To the Editors of THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

LOCALISATION OF FAULTS ON UNDERGROUND CABLES.

SIR,—I should esteem it a favour if you would permit me to correct the formulæ in the article mentioned above which appeared on pp. 174–5 of the JOURNAL. The capacities K and K_1 were inadvertently transposed in the first equation mentioned, and the error was carried to the second equation. The following corrections are necessary:

$$\frac{R}{R_1} = \frac{K}{K_1} \text{ should be read as } \frac{R}{R_1} = \frac{K_1}{K} \text{ and}$$

$$K_1 = \frac{R_1 K}{R} \text{ should be read as } K_1 = \frac{RK}{R_1}$$

H. P. BROWN.

20th November, 1908.

CHESS CLUB NOTES.

THE Annual General Meeting of the G P.O. (Engineering Department) Chess Club was held on the 22nd September at the Club's headquarters, "Ye Mecca," 140, Cheapside, E.C. Major W. A. J. O'Meara, C.M.G., was re-elected President, and the names of Messrs. H. Hartnell and A. Moir were added to the list of Vice-Presidents.

Mr. S. C. Bartholomew will this season act as Match Captain and Mr. W. H. Stephenson as Hon. Secretary. Mr. M. F. G. Boddington will again fill the position of Hon. Treasurer. A vote of thanks to Mr. W. D. Frewin, the retiring Hon. Secretary, and Mr. E. Turner, last season's Match Captain, was carried unanimously.

The Club has this year entered the Second Division of the Civil Service and Municipal Chess League, and opened the season on October 27th with a match against the National Telephone Company. This was won by 6 games to 4. The results of three other League matches are appended.

In the match played November 10th the Engineering Department lost to the Metropolitan Water Board by 3½ games to 6½, and in the match played November 24th the Engineering Department and the G.P.O. North II tied with 5½ games each.

The Local Government Board II were met and defeated by 6 games to 4 on December 8th.

Very good entries were received for the Club Championship and Handicap Tournaments which are now in full swing. The Championship was instituted last season, when the conditions were that each competitor should play all the other competitors. As there were sixteen entries this proved too big a task for most of the players, and, as a consequence, the competition is this season being conducted on the cup-tie principle. The trophy consists of a set of chess-men, and a large chess-board with a deep moulding, on which silver shields bearing the winner's names will be affixed. The first holder is Mr. R. A. Wells, to whom the President presented it on December 11th.

The 1907–8 Tournament, the completion of which was unavoidably held over until the beginning of this season, resulted as follows:—Mr. W. D. Frewin (Class A) 1, Mr. W. H. Stephenson (Class C) 2, Mr. A. L. DeLattre (Class A) 3, Mr. F. E. Mitton (Class B) 4.

The display given by Dr. Lasker last year proved so popular that arrangements have been made with Mr. T. Gunsberg for a similar exhibition on Tuesday, February 2nd, at 140, Cheapside. Mr. Gunsberg will deliver a short lecture, and afterwards play twenty games simultaneously. Ten of the boards will be taken by members of the G.P.O. North Chess Club, in conjunction with whom the engagement has been made.

Anyone desiring to join the Club is invited to communicate with the Hon. Secretary at the G.P.O. West. The annual subscription is 3*s*.

W. H. S.