

neon gas. The intensity of these lamps is about 60 candlepower per foot of tubular length. For a tube of 20-foot length the terminal voltage is 800. Although the light of the pure neon tube is excessively red, the correcting mercury tube used with it gives a satisfactory color combination.

After this hasty review of developments in electric illuminants, it is desirable to summarize the progress in the art of illumination or applied illuminating engineering; space will not permit more than a brief reference to the scientific aspects. To this country is due the credit for originating what has now become an international movement for the betterment of illumination. This began with the organization of the Illuminating Engineering Society in 1906; a few years later a similar society was organized in Great Britain; this year a similar society held its first meeting in Germany; efforts are now being made to start a society in France. This increasing worldwide interest in the subject is evidenced by the reorganization of the International Photometrical Commission, which represented only gas interests, into the International Commission on Illumination, a representative body of all interests concerned in the development of the science and art of illuminating engineering. At a number of international congresses held this year the subject of improved illumination received consideration, notably at the Fourth International Congress on School Hygiene held at Buffalo in August. Much of importance was brought out at this gathering. The subject of schoolroom lighting has also been particularly studied by a special committee of the British Illuminating Engineering Society.

A gratifying increase of interest in matters of illumination has been shown this year in this country by many vitally concerned in improved lighting, but hitherto lukewarm in furthering the movement. Among these are many prominent architects, ophthalmologists, school authorities, artists, trunk-line, interurban and urban railway companies, etc.

No radical changes have been made in street lighting, but hundreds of miles of streets have had their lighting remodeled to modern efficient equipment. Tungsten, magnetite and flame arc lamps have all shared in the lighting of the rehabilitated streets. Ornamental tungsten-cluster

lighting has been extended in some places; a greater variety of cluster standards is now on the market; some illuminating engineers seem to think, however, that this system has reached the climax of its popularity; single tungsten lamps or ornamental posts are preferred in many quarters. A unique installation of series tungsten lamps in diffusing and reflecting lanterns has been made in one of the smaller cities by an illuminating engineer; it shows new possibilities of original and economical designs. Ornamental magnetite arcs have been installed in quite a few cities with pleasing results, both by day and night. It is not likely that the movement for esthetic results in street lighting will die out; on the contrary, it will doubtless increase and be taken up by the municipalities themselves, instead of being left to the initiative of merchants. A greater variety of ornamental street-lighting systems may be looked for in the future. Although the flame arc has not lent itself to ornamental street lighting so well, its use for the utilitarian lighting of very busy streets is increasing. One large city is using thousands of these lamps for its standard equipment and is even lighting many miles of its residence streets with them, apparently with success. They are also being successfully used for the lighting of important crossings of boulevards and driveways in parks.

By the further increase in the variety of shades, reflectors and lighting fixtures of good design now on the market there has been made available for interior lighting a still greater wealth of material to select from and thus there is being produced that highly desirable diversity of lighting equipment which a few years ago there seemed little hope for. Although mercantile establishments are most in need of original design in their lighting equipment and are coming to appreciate this fact, many other installations could be improved by attention to this feature.

The improvement in lighting of commercial and industrial establishments has been extended to include not only a very considerable part of large, up-to-date buildings and plants, but a gradually increasing number of small stores and shops are being rehabilitated to modern standards of illumination. Wherever improved lighting has been installed on proper lines, it has been found to more than pay for

itself in greater safety and comfort and increased production and commercial efficiency; in many cases even actual reduction in lighting cost has resulted from such improvements.

An increasing tendency which it is pleasant to record is the more general attention to screening of brilliant light sources. Inclosed diffusing globes are in greater use, reflectors of the deep-bowl type are more in evidence, semi-indirect lighting with artistic translucent glass bowls has come into increased vogue, and pure indirect lighting has made great headway, being now used even in some railway dining cars. All these advances are evidence of the increasing extent to which the campaign for elimination of glare has met with popular approval. In other words, the public is coming to understand that better light does not mean more bare lamps and that it can be attained economically without eye strain and with more or less of beauty.

A notable sign of progress during the past year is the marked interest in illumination being manifested by the art fraternity. This was stimulated, no doubt by a number of lectures dealing with the relation of light to art that were given in several of the large cities and which evoked an appreciation of the effects of direction, quantity and color of light on works of art. These had received comparatively little study heretofore. Since attention has been directed to them there has been marked improvement in the illumination of several art galleries. It is now possible to arrange the lighting so as to bring out exactly the effect that the artist had in mind and in some cases even to enhance it; formerly the lighting in many cases vitiated the impression that the artist wished to convey.

The foregoing brief comments have merely skimmed over the recent achievements of the steadily broadening field of electric lighting and illuminating engineering. The two have worked together. Electrical men have given the more marked impetus to illuminating engineering and the latter has stimulated great advances in electric lighting. As a result of this mutual service of one to the other the art of illumination has made prodigious forward strides and the slogan "More and Better Light" has come to be practically synonymous with "Use Electric Light."

Electric Railways.

In spite of the political unrest which has characterized the year just past there has been a steady development in the field of electric traction although, financially the business of 1913 has been somewhat below expectations. This condition has been particularly noticeable during the latter months and may perhaps be attributed to the apprehension

of business interests as to the attitude of the government regarding tariff and currency legislation. These two momentous questions have been decided, however, to the apparent satisfaction of all concerned and renewed activities in all lines of business are confidently expected.

In the field of steam railroad electrification several important steps have

been taken during the past year although the influences mentioned have militated somewhat against the actual work of construction on some of the new projects.

One of the first and also most important electrification decisions made was that of the Chicago, Milwaukee & St. Paul Railway to substitute electric power for steam on the main line in

the mountainous districts of Montana. The company first expects to electrify a division of the railroad 113 miles long, extending over the Rocky Mountains between the Three Forks and Deer Lodge, Mont. Ultimately the electrification will be extended to that portion of the main line between Harlowton, Mont., and Avery, Idaho, a distance of 450 miles. It is practically certain that a 2,400-volt direct-current system will be used. Electrical energy has been contracted for from the Montana Power Company and the Thompson Falls Power Company.

Of equal importance to the Chicago, Milwaukee & St. Paul electrification is that authorized early in 1913 by the Norfolk & Western Railway from Bluefield, W. Va., across the summit of the Alleghenies to the town of Vivian, W. Va., a distance of 30 miles. An unusual feature of this project is that only coal trains will be operated by electric locomotives, passenger trains being handled through the electric zone by steam engines. Electric power will be generated in a steam power house being erected by the company at Bluestone. The system will be 11,000 volts, 25 cycles, single phase and 25 electric locomotives of unusual design are being constructed. The motors of these locomotives are being built without commutators and follow the principles of the standard polyphase induction motor, retaining all the advantages of ruggedness and absence of complication which are characteristic of the latter type. The service on this road will be of the heaviest class yet considered in connection with electrification, as 3,250-ton trains are contemplated and these, on two-per-cent grades, will require a total drawbar pull per train of approximately 150,000 pounds. It is expected that all work will be completed for service in the summer of this year.

In the East one of the most important happenings in the field of heavy electric traction was the authorization by directors of the Pennsylvania Railroad on March 12, of the electrification of the company's main line for suburban traffic out of Philadelphia as far as Paoli, a distance of 20 miles. This is a further step in the general electrification projects of the Pennsylvania which has for its object the electrification of all trains entering Philadelphia and which will ultimately mean the electrification of the entire main line from New York to Washington, D. C. It is stated definitely that power for the initial project will be purchased from the Philadelphia Electric Company.

The Washington & Old Dominion Railway, a typical suburban steam road extending from Washington, D. C., to Bluemont, Va., a distance of about 30

miles, was another convert to electric power, during 1913. This company originally owned the Great Falls & Old Dominion Railway, a double-track trolley line from Washington, D. C., to Great Falls, and when electrification of the main steam line from Washington to Bluemont was considered, it was decided to use the 600-volt direct-current system because considerable of the equipment of the former road, which was 600 volts, could be used.

Mention must also be made of the electrification plans of the Great Northern Railway for a section of the main line from New Rockford, N. D., to Lewistown, Mont., a distance of 530 miles. No definite announcements have been made by the directors of this road and it may be years before the project is completed. The roadbed, tunnel and other construction contracts have, however, already been awarded.

It is also a matter of record that the Butte, Anaconda & Pacific electrification was completed in 1913 and is operating with great success. This is a 2,400-volt direct-current system using the geared type of locomotive.

In Chicago the agitation for terminal electrification continued throughout the year, although very little was accomplished. The committee of the Association of Commerce, which is making an exhaustive study of conditions from a financial and engineering standpoint, will be ready to present a report early in 1914. An ordinance introduced in the City Council, requiring the abatement of smoke on or before July 1, 1915, by all railroads entering the city, was held pending the report of the former committee.

No event has happened more significant of the near approach of general steam railway electrification than the establishment, in 1913, of the Pennsylvania Railroad's correspondence school of electricity. This school is designed particularly to instruct those employees who will have to do with the construction and operation of the company's electrification from New York to Washington, D. C.

In the field of interurban and suburban traffic several important events have transpired. Work was completed on the high-speed line of the Kansas City, Clay County & St. Joseph Railway, between Kansas City, St. Joseph and Excelsior Springs, Mo. The total mileage of the system is 80 miles. The 1,200-volt direct-current system is used. About 500,000 people are served by the line which is considered the most important development in the Middle West.

The Nashville-Gallatin Interurban Railway, a new 1,200-volt direct-current system between Nashville and Gallatin, Tenn., is another of the important developments of the year. The

line is 27 miles long and since beginning operation the earnings have far surpassed those anticipated by the promoters.

In Iowa, the Waterloo-Urban extension of the Waterloo, Cedar Falls & Northern Railway was completed during 1913. This is a 40-mile addition to an already successful 600-volt direct-current system serving a prosperous farming district. No expense was spared in making the new line a model of approved construction.

The Oregon Electric Railway, which was completed in 1913, is interesting, as it is one of the longest electric railways recently put in operation. It extends between Portland and Eugene, a total distance of 122 miles. This line operates trains with observation and sleeping cars, making direct connections with the Spokane, Portland & Seattle Railroad, a steam railroad of which it is a part. The 1,200-volt direct-current system is employed.

Interurban electric systems are fast supplanting the steam railway in the vicinity of San Francisco and many important projects are being planned. One recently completed is the Oakland, Antioch & Eastern Railway, a 1,200-volt direct-current line ultimately to extend between Oakland and Sacramento, Cal., a distance of 85 miles. At present service is maintained between Oakland and Bay Point, 31 miles. An interesting feature of this line is a tunnel, 3,458 feet long, through the Coast Range.

Progress must be reported on work for the new 2,400-volt Kalamazoo-Grand Rapids (Mich.) line of the Michigan United Traction Company, which will connect these two cities. This is a 92-mile line and it will be ready for operation early in 1914.

Mention must also be made of the inauguration of high-speed service by the Public Service Railway, between Newark and Trenton, N. J. This was accomplished by the construction of long sections on right-of-way in place of former highway routes.

Subway and elevated transit has received great impetus during the year just closed. Construction work on the additions to subway facilities are rapidly progressing in New York City and in Chicago another subway program has been outlined by the municipal authorities. In the elevated field the most important happening was the merger of all elevated railroads in Chicago and the establishment of universal transfers and partial through routing. This consolidation was effected under a general merger ordinance, which also provides for the unification of street railways and the financing of a subway for the city.

In considering important happenings of the year just closed in the field of