

mon red-clay bricks stood the heat better than any other material; but according to Mr. Gilbreth the floor blocks and partition blocks showed that terra cotta, in spite of the fact that it is incombustible, is a very unsatisfactory material to use in connection with steel. It expands so much more quickly than steel that it breaks up and falls apart by buckling long before it is ruined by fire or water.

The condition of the steel work of a steel frame building thirteen years old is, of course, the most interesting feature of this reconstruction. The structural steel had originally been covered with red metallic paint, and where this paint was in contact with lime mortar, the steel was found to be in very good condition and showed little indication of rust. This excellent preservation was due to the fact that the joints in the brickwork were exceptionally well filled, and the mortar well rammed in around the columns. There were some instances where the mason had been unable to slush in the mortar as well as might have been wished around the columns, and in one of these instances there was found a piece of rust scale larger than a man's hand; but this was the very rare exception. Indeed, the beams from which this particular piece of rust was taken would stand comparison with the average steel beam that had been in stock in a steel yard for several months. Where the steel had not been thoroughly cleaned before painting, there were occasional instances of some rust under the paint. Such cases were comparatively rare; and Mr. Gilbreth sums up with the statement that with these exceptions, the rust had not developed in thirteen years beyond a negligible amount, the straight columns, beams, tie-rods, and bolts being subsequently sold for use in new buildings now in progress of erection.

#### GLASGOW AND MUNICIPAL OWNERSHIP.

BY DAY ALLEN WILLEY.

The city of Glasgow is the most notable community in the world from the standpoint of municipal ownership, owing to the various enterprises in which it engages, from housing its people to providing them with transportation. The operation of its street railway system through municipal control was one of the first ventures of this kind, being inaugurated in 1889, when animal power was utilized entirely for hauling the street cars. At that time but three communities in Great Britain operated their street car systems. In 1904, however, no less than fifty communities controlled these utilities, the majority of them adopting the municipal ownership idea on account of the success which attended the experiment in Glasgow. The street railway system in this city serves a population of about 1,000,000 in Glasgow and its suburbs. At the present time it comprises 169 miles of surface track and a double-track subway, which is about  $6\frac{1}{2}$  miles in length. All of the surface lines are operated by electric motors, the cars being propelled by the overhead trolley system so familiar in the United States. The cars, which are also constructed and equipped at plants owned and operated by the municipality, are of two kinds, one having seats on the top to accommodate passengers who may desire to ride outside. These are known as "double-deckers," and will seat about forty people, the cars provided with seating capacity inside only accommodating but twenty-five. As in other cities in Great Britain and on the Continent, a car is considered full when all of the seats are occupied, and no more passengers are permitted to enter, in contrast to the American system of crowding people into the cars until all of the available standing room is occupied.

To furnish adequate service in the city and suburbs about 800 cars are provided, each equipped with a series of motors developing about 50 horse-power on the average. Although the number of cars is small considering the extent of the traffic, the service is such that there is little cause for complaint as to the frequency of the trips or the speed maintained. Yet during the year ending June 1, over 208,000,000 passengers were carried, an increase of nearly 100,000,000 since 1899—illustrating how the traffic has expanded in less than ten years on account of the facilities afforded for cheap trips. This is indicated by the number of persons who have been carried during the year at the different rates of fare charged. No less than  $29\frac{1}{2}$  per cent paid an average of but one cent in American money, while 60 per cent paid an average of two cents a ride, and only 7 per cent three cents a ride. Actually less than one per cent of the total number of fares collected averaged five cents, the usual rate on street railways in American cities.

The Glasgow street-car system has not only been noted for the low rates of fare charged, but for the remarkable success it has attained from a financial point of view. To show how the venture pays the city, a few statistics of the receipts and expenses may be given. During the year ending June 1—the last complete year reported—the total income amounted to \$4,100,000 in American money. After deducting the operating expenses amounting to \$2,280,000, a balance was left of \$1,820,000. Out of this, \$300,000 was ap-

propriated for taxes and interest, and \$850,000 for estimated depreciation of property and maintenance of way and rolling stock. From the balance, \$175,000 went to what is known as the "fund of common good." After deducting all of these payments there was placed to the credit of the general reserve fund about \$200,000. Contrasting these items with the amounts allowed for depreciation and other expenses in connection with the operation of American street railways, it is apparent that the Glasgow corporation pursues a very generous policy as to renewals and betterment, but the fund of common good is being accumulated in connection with the sinking fund, and this now amounts to such a sum that the entire indebtedness incurred in purchasing, rebuilding, and equipping the railway system has been reduced to \$8,500,000. As there are no dividends to be paid, the portion of the surplus available for such payment is practically included in the sinking fund provided for the liquidation of all indebtedness. It may be added that the sums appropriated for maintenance and depreciation represent no less than 6 per cent of the total capital invested.

Not only the city itself, but the principal highways leading into it are served by the electric railway system, the corporation securing permission to lay its tracks on the suburban roads from the local authorities. In return for this privilege it guarantees to keep a certain portion of the highway properly paved and in good condition. While the overhead trolley system, as already stated, is used entirely on the surface, the poles are of an ornamental pattern and the overhead construction is very different from the unsightly work so often seen in American cities. Soon after the municipal authorities took control of the street railway system, it was decided to discontinue the use of any of the cars for advertising purposes. This meant an annual loss of about \$50,000, but the improvement in the appearance of the cars has compensated for it at least in part. The total number of employees is about 3,200. It is an interesting fact that since the city assumed control of the service it has reduced the time of working hours from twelve hours out of twenty-four to an average of nine hours per day, the average wages of motormen and conductors being \$1.16 in American money.

From the main power station during the last year a total of 26,340,000 kilowatt-hours were generated, of which about 1,000,000 were utilized at the station itself. The percentage of current lost in transmission and conversion was about 11 per cent, the current supplied for operating street railway motors aggregating about 20,000,000 kilowatt-hours, the average cost per hour for electricity after allowing for loss, taxes, insurance, and depreciation of the equipment was about 2.1 cents per kilowatt-hour. This estimate is based on a charge of one-fifth of a cent per hour for fuel, the coal averaging about \$1.75 per ton in American money. In addition to supplying the street railway service the corporation sold electricity for industrial and other purposes at a price averaging three cents per kilowatt-hour, indicating the profit which it obtained from the disposal of the current in this way.

The success attending the operation of the system has caused the Glasgow corporation to plan several extensions to the present system. It has obtained authority to construct lines within the city and suburbs which will aggregate 27 miles and will be completed in the near future. These extensions have necessitated the enlargement of its plant for manufacturing cars which is even now very extensive. An addition is now under way which will be completed during the present year. It may be added that the municipal car factory is provided with a full equipment of modern power tools both for wood and metal working, and that nearly all parts of the cars are manufactured here as well as assembled and finished. A considerable portion of the power is electric current supplied from the station, many of the tools being driven by individual motors instead of steam power.

#### THE CURRENT SUPPLEMENT.

The electrification of the Simplon Tunnel railroad is the subject of the opening article of the current SUPPLEMENT, No. 1628. The article is exhaustive, and is accompanied by many clear photographic illustrations. Mr. A. Frederick Collins contributes the last of his series on a 100-mile wireless telegraph outfit. In this installment he writes on the management and operation of ship and shore stations, giving alphabets which are employed in this country and abroad, as well as call letters of the United States naval stations, weather symbols, wind symbols, telegraphic abbreviations in common use, and a communication chart for steamships. Mr. F. Z. Schellenberg contributes an article on "Our Coal," in which he tells not only how coal is mined, but also something of the conditions which affect the miners. Mr. C. J. C. Zintheo's elaborate paper on Corn-Harvesting Machinery is concluded. Mr. C. W. Parmelee likewise concludes his discussion of the technology and uses of peat. Of technological value is the article on gold and aluminium solders. Excellent formulas are given. The second installment of the

article on the manufacture of water-gas is published. The article on the distillation and rectification of alcohol is concluded.

#### SCIENCE NOTES.

Rich deposits of phosphate are reported to have been discovered recently in Riverside County, California, 1,500 feet above sea level, four miles from Whitewater, on the Southern Pacific. The deposits lie in a cup-shaped valley overlooking the desert and within thirty-five miles of the Salton Sea. The discoverers were prospecting when the find was made. It was before the recent storms. They were suddenly stifled by the stench, and realizing its cause followed against the wind until they stumbled upon their find in the valley. With the first rain the stench disappeared. The deposits are said to extend to a considerable depth and to cover hundreds of acres.

A little-known phase of entomology is discussed by Leinemann in his article on the number of facets in the eyes of insects, published under the title "Über die Zahl der Facetten in den zusammengesetzten Augen der Coleopteren." He has had the patience to count the facets in the eyes of 150 species of beetles. He finds that the larger the specimen, the more numerous are the facets, and that usually there is not much difference in the sexes. The male in many cases, however, has more facets than the female. In *Lampyris splendidula* the male has 2,500 facets, while the female has but 300. *Melolontha vulgaris* has, male, 5,300, female, 4,850; and *Saperda carcharias*, male, 2,200, female, 1,800. There is no general reduction in nocturnal species.

A public museum combined with a laboratory has recently been inaugurated at Brussels. This establishment was founded for encouraging the development and expansion of electrical work in the country as a result of experimental teaching, and to this end the museum has been equipped with all kinds of models and apparatus which the visitor can observe and try upon the spot. The museum contains four main halls, where all the apparatus is installed. One of the halls is devoted to the demonstration of the laws of the electric current, while in a second hall is found a collection of all the machines which give rise to electric or magnetic phenomena, as well as electro-chemical apparatus of various kinds. A gallery which forms part of the second hall contains an exposition of apparatus such as lamps, agricultural machines, etc., and the latter are driven by motors. The sections of telegraphy, radio-telegraphy, and telephony are well equipped with modern apparatus. In the third hall is installed the reading room, which is large in size. Many scientific publications are received here. The fourth hall contains the heavy electric machines, such as dynamos and motors. A number of professors is attached to the establishment, both for lecture and laboratory work.

The Austrian explorer Dr. Erich Zugmayer, who for some time past has been engaged upon important explorations in the unknown parts of Thibet, and who was compelled at last to abandon his journey only because of pronounced hostility on the part of the natives acting upon instructions from the Grand Llama at Lhasa, and intense privations due to climatic influences, achieved success from geographical, zoological, and botanical points of view. The hardships encountered on the journey were of an exceptional character, due chiefly to the climatic conditions prevailing and the rough character of the country traversed. His route extended toward the south and southeast and led through an entirely unknown part of the country. For two months the party continued its way with extreme difficulty at an altitude of 16,000 feet. Great suffering was entailed by the transport animals because of the hardships and abnormally severe weather encountered at those altitudes. When the party had reached a point at an elevation of 20,000 feet above sea level, Dr. Zugmayer, owing to the mortality among his animals, was compelled to abandon his projected route, and struck off in a westward direction to Kashmir, which had been his original objective by the more circuitous route. Despite the difficulties encountered and the enormous losses among the transport animals, the explorer was enabled to preserve the many valuable specimens he had collected. The return journey was made past the Rudok and the Panggong lakes. Upon arrival at Kashmir the explorer had only twelve emaciated yaks left, testifying to the arduous nature of his journey. In addition to mapping out a considerable portion of Thibet, hitherto unknown, Dr. Zugmayer has collected considerable data which will enable revisions of the existing maps of the country to be carried out, since he states that the latter are very erroneous. One fact he has conclusively established, and that is the recent volcanic conformations that have taken place in Thibet, a point which has been the subject of great discussion recently. At altitudes ranging between 16,000 and 20,000 feet he secured numerous botanical specimens which are of great value, while he also discovered twenty new species of animals and fifty new groups of smaller animals.