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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ELECTRIC LOCOMOTIVE OF THE FUTURE.

The announcement has recently been made that the New Haven Railroad Company is about to extend its electric zone from Stamford to New Haven, a distance of over forty miles. It is understood that in all its essential features the same system will be employed as that which has now for nearly two years been in successful operation from Stamford to New York; and the announcement is taken to indicate that the bold experiment which the New Haven Company made in equipping its four-track trunk line with an alternating-current plant and overhead conductors transmitting current at 11,000 volts directly to the locomotives has proved to be thoroughly successful. This important extension of the electric zone is particularly significant in view of the fact that, contemporaneously with the change of power on the New Haven system, the New York Central Road, which uses the same terminal station at 42nd Street, New York, equipped its own four-track road with a direct-current system, using 650-volt direct current, and that the two roads have been operated side by side under practically identical conditions.

Under each system, alternating current of high tension is generated at a central power station. On the New York Central line it is stepped down and converted into direct current in sub-stations. On the New Haven road the transformers are carried upon the locomotives themselves, each of which, therefore, may be said to act as its own sub-station. In the latter case there is the disadvantage that there is a great increase of weight in proportion to the power delivered to the axles. This is shown by the fact that, whereas the New York Central locomotives can develop 2,200 horse-power for a weight of 102 tons, the New Haven locomotives can develop only 1,000 horse-power on 107 tons. Consequently, it is necessary to employ two locomotives to make schedule express time with a New Haven express train of from eight to fourteen cars, whereas a single New York Central locomotive can haul the same, and indeed an even larger number of cars, and maintain the schedule.

Because of the fact that the New York Central Company has not as yet extended its electric zone beyond High Bridge, which is about seven miles from the 42nd Street terminal, no opportunity has been afforded to test the behavior of the locomotives in hauling heavy trains over long distances; and the question has been raised as to whether they will be able to stand up to this service with the same regularity as has been shown by the New Haven locomotives, which have been regularly making the run of 35 miles to Stamford without developing any trouble in the way of overheating of the motors, etc.

Up to the present time neither company has shown any disposition to make public the details of the cost of operation. Both have declared that in point of convenience and regularity of service the electric has shown a decided superiority over the steam service; and it is conceivable that these advantages are such as to more than offset any increased cost due to the heavy initial outlay. It is certainly significant that although the mechanical, electrical, and indeed all the physical elements of the installations have been made public with surprising candor, absolutely no definite statement has been given out as to economy of operation. It is to be hoped that, in the interests of electrical science and for the furtherance of this most important question of the electrification of steam railroads, the two companies concerned will consent at an early date to publish this eagerly awaited information.

DRYDOCKS FOR OUR BIGGEST BATTLESHIPS.

In raising the displacement of its battleships to 26,000 tons, the United States government has produced a ship which far exceeds the largest contemporary battleships built or building of any foreign navy, not even excluding Great Britain. If the new vessels are constructed with a rapidity equal to that of the foreign navies, our navy will possess in the "Wyoming" and her sister, at the time of their completion, the largest and most powerful battleships afloat.

This extraordinary increase in size brings with it some serious responsibilities, prominent among which is that of the provision of drydocks capable of accommodating these monster vessels, not merely when they are loaded to their full displacement but when, as the result of the terrific wounds which even a victorious "Dreadnought" of the future is bound to receive, the vessel may have sunk some six or seven feet below her maximum draft.

The foreign governments, notably Great Britain and Germany, are fully alive to the importance of this question. Great Britain possesses on her eastern and southern coast eight drydocks, which are available for ships of the "Dreadnought" class, and four are in course of construction, this estimate including both government docks and those owned by private shipyards. On the west coast there are six docks, making eighteen in all, whose depth and entrance width are sufficient to accommodate the largest battleships. Germany has under construction or already completed twelve docks of the requisite capacity.

In considering our own docking facilities it will be well first of all to state the dimensions of the 26,000-ton "Wyoming." Her beam will be 93 feet 2½ inches, her draft on full load displacement slightly less than 30 feet, and the length 566 feet. At the present time the depth of water over the sills of our largest drydocks would be sufficient to float the "Wyoming" over the sill on her full-load displacement only at high water and even then with but a slight margin to spare. The navy yard docks that could accommodate her and their depth of water over sills are: Portsmouth, 30 feet; Boston, 30 feet 7½ inches; New York, 33 feet 6 inches; League Island, Pa., 30 feet; Charlestown, 34 feet; Mare Island, 30 feet; Puget Sound, 30 feet; and the new Pearl Island dock, 35 feet depth, at Hawaii. To these must be added two private docks, one at Newport News and another at San Francisco, each with a depth of 30 feet. The rest of the naval drydocks, seven in all, are either too narrow or shallow to admit the "Wyoming" at full load draft. The new docks which are now under construction or have lately been completed were originally designed to take a battleship of any size; but the dimensions of our ships have increased so rapidly that it becomes an interesting question as to what clearances of breadth and depth these docks would offer, if any, in docking the "Wyoming."

We understand that the Bureau of Yards and Docks has been endeavoring to keep pace with the work of the Bureau of Construction and Repair and that designs have been modified as far as possible to meet the new conditions. The most important consideration is that of depth, since the injuries which a warship must suffer in an engagement will in all probability involve a certain amount of perforation of the hull and starting of seams, at or near the waterline, and the entrance of more or less water, involving a proportionate increase in the draft of the ship. In a discussion of this subject, as affecting the British navy, our contemporary, Engineering, estimates that if the boiler rooms of one of the British "Dreadnoughts" of 20,000 tons displacement were flooded, her displacement would be increased about 2,500 tons and about five feet would be added to her draft; and if the engine room and side compartments were also flooded the draft would be increased seven feet above the original draft of 26 feet. It is conceded to be possible that even the wings might be also flooded in addition to the engine and boiler rooms and the ship still remain afloat; in which case the displacement would be increased from 20,000 to 32,000 tons and the draft from 26 to 38 feet.

Now at her mean draft our own "Florida" draws 28½ feet, and at full load displacement about 30 feet. It is conceivable that at the close of a fierce engagement with a "Dreadnought" of her own power, whose guns were served by such well-trained crews as are found in the navies of one or two of the leading naval powers, the "Florida," even if victorious, might get back into harbor drawing 35 or 36 feet of water. In this condition she would be barred from every one of the drydocks which we at present possess, and before she could be docked temporary cofferdams would have to be built and a part of the water pumped out.

It may be said in answer to this that it is useless to give to a drydock a greater depth than that of the entrance channels to the harbor or port in which it is located. The point would be well taken, if it were certain that the existing channel depths would be the depths for all time. As a matter of fact, the entrance channels of all of the important harbors of this country are certain to be continually deepened in response to the demands of navigation. The entrance channel to New York has been deepened from 32 to 40 feet; and in the construction of drydocks, whether for government or private yards, a due regard for the future should lead to the construction of all first-class drydocks with depths over sills and widths at entrances greater than the needs of the hour would seem to call for. At the same time it is only just to the Bureau of Yards and Docks to state that our present drydock accommodations are fairly comparable with those of the other leading powers.

THE RAILWAYS OF THE WORLD.

America still continues, by a wide margin, to lead the world in the extent of its railway system. Out of a total of 594,867 miles of railroad in the whole world, 268,058 miles are located in North America. This is but little less than the total for the three continents of Europe, Asia, and Africa; Europe having 199,385 miles, Asia 56,294 miles, and Africa 18,519 miles, a total of 274,198 miles for the Old World. South America has a total of 34,911 miles, and Australasia of 17,700 miles of railroad, which added to the figures for North America, make a grand total for the New World of 320,669 miles.

The above figures form part of a report compiled by the Prussian Ministry of Public Works, for the year 1907, which shows that, compared with the previous year, the largest percentage of increase is that of 998 miles or 5.7 per cent in Africa, followed by 7,637 miles, an increase of 3 per cent, in North America, and 2,917 miles, representing an increase of 1½ per cent in Europe. The greatest amount of construction in European countries was that in Russia, where 1,625 miles of new track were built; France was next with 431 miles; and Germany built 411 miles. The largest additions in Asia were made in British India, where 909 miles were built, China coming next with 464 miles. In South Africa, the largest addition was in British South Africa, where the mileage was increased 5¼ per cent by the addition of 352 miles.

During the decade from 1897 to 1907, there was extraordinary activity in the building of railroads throughout the world, 140,137 miles of new railroad being built in that time, representing an increase of 23½ per cent. The largest gain was in North America. The statistics of 85 per cent of the railroads owning the total mileage given above show that there is a total capital invested of nearly $42,000,000,000. If the same rate of cost has obtained in the railroads of which statistics were not available, the total outlay on railroads, from their inception to the present time, must be nearly $50,000,000,000. This would represent an investment of about $31.50 for each inhabitant of the globe at the present time.

THE DIRECTIVE SENSE OF BEES.

The directive sense which is possessed by bees is the object of researches made by M. Gaston Bonnier, of Paris, and he seems to prove that bees possess a special sense like that of carrier pigeons. Bees can fly for two miles from the hive and are then able to return after gathering their supply of honey. Langstroth and others suppose that vision comes into play and that bees can see for a great distance and can also note objects on the way so as to find their path. Others, with Dadant, suppose that the bees are guided by the sense of smell, and that they can smell flowers at distances of 1½ miles. The author makes experiments to prove that bees can return to the hive without using either sight or odor. As to sight, he takes bees to a distance of 1.2 miles from the hive, in a closed box. They always fly back to the hive when released. The same is true when their eyes are covered, so that sight is not essential. As regards odor, experiments seem to prove that bees perceive odors at only short distances. When a needle dipped in ether is brought near the head of the bee, it shows signs of perceiving the odor, but not so when the needle is placed back of him or near other organs. Besides, when the organs of smell (antennæ) are removed entirely, the bees will return to the hive. M. Bonnier makes the following experiment: At 600 feet from the hive he places a supply of syrup, and the bees soon find it, proceeding to and fro to the hive. Such bees he marks with green-colored powder. He then places a second supply of syrup at the same distance from the hive, but spaced at 20 feet from the former. Other bees are now engaged in the to and fro movement to this point, but these are not the same individuals as the green marked ones, who are still working on the first supply, and he marks these in red. We thus have two distinct sets of bees, and we see that they can distinguish two directions which form a very acute angle. We seem to have here a special directive sense which does not reside in the antennæ, but probably in the *cerebroid ganglia*. Other facts may be cited in evidence of the directive sense of bees.