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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.


### GUARD RAILS IN THE SUBWAY.

The contemplation of what would happen if a train of cars were to jump the track in the Subway and strike the wall of columns which supports the roof, has led a correspondent to forward to this office a sketch of a section of the Subway, showing two continuous lines of guard rails riveted horizontally to the vertical columns, one line being at the level of the floor of the car, and the other at about the height at which the side of the car rounds off into the roof. The object of the guard rails is to prevent a derailed car from striking, end-on, one of the columns, and so precipitating a serious wreck.

The question as to how far the supporting columns would be endangered in the event of a derailment is not a new one, and, indeed, it was given consideration by the engineers when they were working out the plans of the Subway. It was found that the clearance between the sides of the car and the columns is so small, and the cars are so long, being over 51 feet between the bumpers, that a derailed car could not become slewed around very far from its normal position parallel to the tunnel. Moreover, the columns are spaced so closely, being only five feet apart, that when a derailed car had become slewed around as far as it could go, it would be impossible for the forward end of it to strike a square blow against any particular column. The car, it is believed, would slide along the inner face of the columns as though they presented a continuous wall.

It has been suggested that in case of a derailment, especially of an express train, two or three of the columns might be carried entirely away, and thus permit the street above to fall in upon the cars. The engineers of the Subway, however, do not anticipate that the posts would be knocked out, or, if they were, that the roof would come down. The great power of resistance afforded by these columns, riveted as they are at top and bottom to the tunnel roof, and floor, was shown on one occasion during construction, when a train of cars laden with rock ran away down an incline, and crashed into a line of columns. In spite of the fact that the rock train was running at very high speed, only one of the posts was bent and none was carried away. Moreover, during the course of construction a large mass of rock torn loose in blasting operations would occasionally hit the columns and bend them out of plumb; but in no case was a column entirely carried away.

Although the above facts are not to be disputed, it must be remembered that the columns have never been subjected to an impact that would be comparable to that of an eight-car express train weighing about 350 tons, and moving at a speed of 40 miles an hour; and although on tangents it might be difficult for a derailed car to get a "bite" on any particular column, on curves and turn-outs the offsetting of the successive columns would bring them into a position more favorable to receive an end-on blow. The SCIENTIFIC AMERICAN is of the opinion that on such curves as those at the Grand Central Station and Times Square; and at all turn-outs, such as that at Spring Street, which are liable to be taken by express trains at high speed, it would be advisable to attach some form of guard rail to the line of posts on the outer side of the curve. A still better provision would be to use the protection which the Subway engineers have already installed at points where there is a crossover and the continuity of the line of columns is broken. Here they have incased the lower half of the columns in a wall of concrete, with the result that if a derailed train should hit the end column the blow would be resisted by the united strength and inertia of the wall and the columns that it included. It is particularly desirable that lateral guard-rail protection should be given wherever the Subway tracks pass between the foundation columns of tall buildings, such as the Times Building and the Belmont Hotel, and we understand that such protection is being put in place.

### AN ALL-DAY RACE BETWEEN BATTLESHIPS.

Shortly before the opening of the recent war, the British government, it will be remembered, purchased from a South American republic that was retrenching its naval expenditures, two battleships which had recently been constructed in English yards. One of these, now known as the "Swiftsure," was built at Elswick, and the other, now named the "Triumph," at the Vickers yard. Both of these battleships, which are of the very moderate displacement of 11,800 tons, carry an armament practically as heavy and, as some experts think, heavier than that carried by the government-designed battleships of the "Duncan" class, which are of 14,000 tons displacement. Therefore, they are excellent representatives of the Elswick school of design, which, like that of our own navy, seems to be able to secure very heavy gun power in proportion to the displacement. Sir William White, the designer of the "Duncan" class, has been criticised for not securing greater offensive and defensive elements on the large displacements which he has given to his ships; but he has always contended, and we think with reason, that what his ships have lost in gun power, they have gained in endurance and reliability. The "Swiftsure" and the "Triumph" had shown, in the course of trials held in 1904, a speed under full power of over 20 knots an hour as against the designed speed of 19 knots. The "Duncan" had developed on trial a speed of 19.1 knots, and the average speed of the rest of the class was about the same. It should be mentioned that the armament of the 14,000-ton "Duncan" is four 12-inch and twelve 6-inch guns; while that of the "Swiftsure" is four 10-inch and fourteen 7.5-inch.

Naturally, the introduction of the Elswick-built ships into the British navy led to keen rivalry between them and the fast "Duncan" class, and this culminated in a twenty-four-hour race (carried out under the recent Admiralty provision for a quarterly full-power trial of all ships of the navy) which recently took place between the "Duncan" and the "Swiftsure." The battleships started on their all-day race on even terms. They were driven at full power for the whole twenty-four hours, and at the end of that time the "Duncan" was 30 miles ahead of the "Swiftsure," having put to her credit the remarkable performance, for a battleship, of maintaining for a whole day an average speed of 20.1 knots an hour. An average speed of 19.6 knots an hour was sustained by the "Swiftsure." That a 14,000-ton battleship could be able to steam for 482½ knots at an average speed of over 20 knots an hour, constitutes a record that will probably stand for some time to come.

To enable our readers to form an intelligent estimate of the relative performances of the two ships, we may mention that the "Swiftsure" is 436 feet in length, by 71 feet beam, and 24 2-3 feet in draft, and that on her official trial she made 20 knots an hour with 14,018 indicated horse-power; whereas the "Duncan" is 405 feet in length, by 75½ feet beam, and 27¼ feet draft, and on her official trial made 19.1 knots with an indicated horse-power of 18,232.

### THE GROWTH OF OUR RAILROAD SYSTEM.

A sure indication of the advancement of a people is the extent and quality of the provision which it makes for transportation, and there is a pretty close relation between the growth of that system and the advancement of the people it serves. The rapidity with which the network of railroads that now covers the United States has been woven over the entire face of the land, is a subject of justifiable pride on the part of those who clearly appreciate what the upbuilding of that system has really involved in time, labor, and money. For the most part, its growth has been a healthy one, although there have been periods of wild-cat speculation, such as that of 1882, when over 11,000 miles was constructed in a single year, and again that in 1887, when nearly 13,000 miles was built. In each case these years of extravagance were followed by others of comparative stagnation, as, for instance, in the period from 1894 to 1897, when an average of only 1,700 miles was built per annum. These years of limited construction were marked by a steady increase in the freight and passenger business over the roads already constructed, and the low record of new construction simply proved that the roads were waiting for the traffic to catch up with the over-rapid construction of previous years. According to the figures which have just come to hand in Poor's "Manual of Railroads" for the fiscal year 1904, there has been a decided increase in the amount of new construction over the five years preceding, the amount of new road constructed having increased from 4,397 miles in 1903 to 5,014 miles in 1904, the total number of miles of railroad now in operation being 212,349. This vast system represents total liabilities of over $15,000,000,000, of which six and a quarter billions represent capital stock, and six and three-quarter billions the bonded debt. Among the assets, the cost of the railroads and their equipment represents over eleven and a quarter billion dollars. During the year 715,654,951 passengers were carried, and the total number of tons of freight moved reached the enormous figure of 1,275,321,607 tons. The passenger earnings amounted to $455,067,129, the freight earnings were $1,367,119,507. Other sources of income brought up the total traffic revenue for the year to just under two billion dollars. The net earnings for the year were $640,000,000, and other receipts raised the total available revenue to $721,000,000.

### THE HEAVENS IN DECEMBER.

The magnificent group of constellations which adorns the winter sky is now fairly visible in the east and southeast. Orion, the finest of them all, is also the best one to use as a pointer to help us to find the others. At 9 o'clock in the evening in the middle of December, it is almost due southeast, and about one-third of the way from the horizon to the zenith. Its two brightest stars, Betelgeuse and Rigel, lie to the left and right of the line of three which form Orion's belt. Two others, not quite so bright, complete a quadrilateral which incloses the belt and also the smaller group on the right, known as the sword. The middle one of these last three stars is perhaps the most remarkable object in the heavens. A field-glass will show it double, and a small telescope resolves the brighter of the three stars seen with the field-glass into four components, to which a powerful instrument adds two more.

The whole system is surrounded by an enormous nebula, familiar to all students of astronomical literature. Part of it can be seen even with the naked eye, and more with the telescope, but it requires photographs of long exposure, made with large lenses of short focus, to bring out its faint extensions. They reveal it as a huge mass of nebulosity connected with one of the bright stars in the belt, and extending over almost the whole constellation.

The line of Orion's belt points downward to Sirius, which even at its present low altitude is easily the brightest star in the sky, and upward to Aldebaran, and beyond it to Jupiter, near which to the northward are the Pleiades.

The very bright star in the Milky Way, north of Aldebaran, is Capella, in the constellation Auriga. Below this is Gemini, marked by the twin stars Castor and Pollux, from each of which a line of fainter stars runs toward Orion. Below these again is Canis Minor, with the bright star Procyon.

The southern and southwestern sky is less interesting. Next to Orion is Eridanus, a very large constellation consisting of a crooked line of faint stars which begins close to Rigel, runs westward, then south, then southeast, and then southwest to the horizon, terminating in a bright star, Achernar, invisible in our latitude. West of this again is Cetus, which contains one pretty bright star, which stands alone about two hours west of the meridian at an altitude of about 25 deg.

The great square of Pegasus is well up in the west. Aquarius is below it. Saturn, Mars, and the bright star Fomalhaut are all in this part of the sky, but now they are just setting, and to see them we must look earlier in the evening.

Cygnus is low in the northwest, and Lyra is still lower, Vega being near setting. Cepheus, Cassiopeia, and Perseus lie in the Milky Way between Cygnus and Auriga, and Andromeda and Aries are south of them, almost overhead. Ursa Major, Ursa Minor, and Draco lie below the Pole, and so are not conspicuous.

#### THE PLANETS.

Mercury is evening star until the 15th, when he passes through inferior conjunction and becomes a morning star. However, he is so near the sun and so far south that he will not be visible to the naked eye this month.

Venus is morning star in Scorpio and Sagittarius, but she is also inconspicuous, rising only about an hour before the sun.

Mars is evening star in Aquarius and Capricornus, and sets at about 9 P. M. on the 15th. On the evening of Christmas day he is in conjunction with Saturn. The two planets are only half a degree from one another, and they are easily observable, as they do not set till about 8:30 P. M. They appear about equally bright, but it does not follow that viewed telescopically they would look equally large. Mars presents a very small disk, only 5½ seconds of arc in diameter, so small that it would be hidden by a silver dollar a mile distant, while the diameter of the disk of Saturn is nearly three times as great, to say nothing of his rings, which nearly double his apparent area. So if Mars and Saturn looked equally bright, *area for area*, the latter planet would appear to the eye about fifteen times as bright as the former. But they both shine by reflected sunlight, and, since Saturn is at present