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NEW YORK, SATURDAY, MAY 2, 1903.

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 SUBWAY CONTRACTOR AND THE SUFFERING PUBLIC.

The contractors of the New York Subway are rapidly losing the public good-will which they had unquestionably secured by the expedition with which they carried out the work of excavating and building the new tunnel. They are losing it because of the inexcusable indifference to the convenience of the public which they have shown, and are showing to-day, by making no attempt to clean up the streets as soon as they are through with their work.

We are not sure that the engineers of the Rapid Transit Subway are not also somewhat to blame for this discomfort; for in order to protect the public there was a special clause inserted in the first general contract and specifications of the Subway covering this very point—a clause which, as we know to our cost, is "more honored in the breach than in the observance." It was stipulated in the first contract that any given stretch of the cut-and-cover work was to be open for only a limited period of time, sufficient presumably for putting in the steel work and concrete; and it is expressly directed that "at his own expense, and as directed from time to time by the Engineer, the Contractor is to *clear the work, streets, and all public places occupied by it from all refuse and rubbish, and leave them in a neat condition.*" Now, when we consider that some stretches of the work, such for instance as that through 42d Street, will have been "open" and encumbered for between two and three years, it is evident either that the contractor has been willfully obstreperous, or that the engineers have not fully exercised the authority conferred upon them under the contract. We are inclined to think that the fault lies with the contractor more than with anyone else for in spite of the storm of public indignation which has found its expression of late through the press, and despite the fact that the Chief Engineer of the Commission has recently called special attention to the shocking condition of the streets, there are scores of blocks along the route of the line which, although the Subway beneath them has been completed for many months, are to-day in a disgraceful state of disrepair and disorder.

Nothing could be more admirable than the patience with which the merchants and property owners, to say nothing of the pedestrians of New York city, have endured the enormous inconvenience arising from the construction of the Subway; and they have certainly deserved something better than the total disregard of their interests and convenience which has been shown during the progress of this great work. We commend this subject to the special and immediate attention of Messrs. Parsons and McDonald, respectively the Chief Engineer of the Rapid Transit Commission and the Chief Contractor for the Subway.

FAILURE OF THE "IOWA'S" 12-INCH GUN.

When the deplorable accident to one of the 12-inch guns of the "Iowa" occurred, it was generally credited to the bursting of a shell in the bore of the gun. Although the official report of the Board of Investigation has not yet been made, there is now a general belief that the failure of the gun was not due to a defective shell, but either to the inherent weakness of the gun itself, or to abnormal pressures set up in the chase of the gun by the smokeless powder employed. The gun was one of the pieces with which the "Iowa" was originally supplied, and as this vessel went into commission in the summer of 1897, it has seen nearly six years of service. During this time the gun has had to do duty in the regular courses of target practice each year, and it also endured the severe test of the Spanish war, during which the "Iowa" was engaged in the bombardment of San Juan, the blockade at Santiago, and the naval battle which ended in the destruction of Cervera's fleet. In all these years the 12-inch gun that failed has been fired between two hundred and three hundred times; and if there were anything in the theory that the life of a modern built-up gun of large caliber is restricted to between one hundred and fifty and two hundred rounds, there might be some truth in the suggestion that the strength of the gun was exhausted. For our part we do not believe that there is anything in the suggestion, provided, of course, that during its six years of service the gun has not been subjected to powder pressures exceeding the limit which it was designed to stand.

Now, it is just here, in connection with the question of powder pressures, that the probable cause of the explosion will be found; for although the most modern smokeless powder is stable and reliable in its results, some of the earlier powders, especially if they have been for any considerable time in storage, are liable to a more rapid combustion with consequent higher pressures than they were intended to give. The "Iowa's" 12-inch gun was designed for the old brown powder, which was relatively quick-burning, and did not give such high pressures during the latter part of the travel of the projectile down the bore as the later smokeless powders. Hence it was not necessary to give so much tangential strength to the chase of the gun as would be the custom in designing a modern, high-velocity gun using slow-burning smokeless powder. Hence the smokeless powder employed would be somewhat more trying for the gun than the brown powder, and if there were any sudden combustion of the remaining unburnt powder shortly before the shell left the gun, the chase might readily have proved unequal to the extra duty put upon it.

TESTS OF OIL FUEL ON LOCOMOTIVES.

At the time that the preliminary report of the elaborate tests of oil fuel now being carried out by the Naval Department was made last year, we gave a brief account of the findings reached at that time. During the intervening months a series of tests has been carried out to ascertain the value of oil fuel for use on locomotives, the trials being made on the Florida East Coast and the Boston & Maine Railroads. Particular value attaches to the results, from the fact that the work of the locomotive was tested when it was hauling its regular load, and the results represented, not merely a single trip, but the work of a whole month. On the first-named railroad, on level track the engine consumed 6¾ gallons of oil per mile run, the oil weighing 7.55 pounds per gallon. The same engine in doing the same work burned 2,000 pounds of Tennessee coal for every 19.6 miles that was covered; the result showing that under those particular conditions 132.3 gallons of oil did the work of one ton of coal. When the same locomotive was tested on freight service, where the speed was lower and the loads greater, the consumption was 10.6 gallons per mile on oil, and 2,000 pounds of coal per each 13 miles, thus giving a ratio of 131.8 gallons of oil to 2.000 pounds of coal. The test on the Boston & Maine Railroad was made on a helper used in assisting trains in the Hoosac tunnel. The work was done by the engine on an upgrade of 42 feet per mile, the engine returning without any load. On this test the oil weighed 7.75 pounds per gallon, and 11.45 gallons were used per mile. When burning coal, this engine ran 12.25 miles for every 2,240 pounds used, thus showing a ratio of 140.26 gallons of oil to 1 ton of coal. An important fact developed in these tests was that the engine could be urged to a greater capacity with oil fuel than with coal, and that this could be done with a smokeless fire. It is considered that there is no reason why equal results should not be obtained in marine service.

ENGLISH REPORT ON THE AMERICAN RAILWAYS.

The Board of Trade, London, recently authorized Col. Yorke, its Chief Inspecting Officer of Railways, to visit the United States and make an extended tour over our railroad systems. The report of his investigations has recently been published in pamphlet form, and taken altogether it may be regarded as one of the most fair-minded and valuable documents of its kind that has ever appeared.

It is pointed out under the head of steam railways, that there is a fundamental difference between English and American track in the fact that in England the bullhead rail, laid on cast-iron chairs, is in almost universal use, whereas in the United States the T-rail is almost exclusively used, the latter being laid either directly on the ties or upon tie-plates, and the rail secured by ordinary rail spikes. The weight of the rails on first-class track is about the same in both countries, varying from 80 to 100 pounds in the United States, and from 85 to 103 pounds in England. Although American roads use from 14 to 16 ties to a 30-foot rail, as against only 12 ties to the same length of rail in England, the larger dimensions of the English ties give a slightly larger total bearing surface, there being 85.3 square feet of such surface with 16 ties on American track, and 90 square feet for the 12 ties used on an English rail. The bearing surface of the rails on the ties is 768 square inches in American practice, as against 1,260 square inches bearing surface of the cast-iron chairs in English practice. Attention is drawn to the fact, however, that on the best eastern roads in America, the ties are of hard wood, which has better wearing qualities than the Baltic timber ties used in Great Britain. The report speaks favorably of the American practice of breaking joints when laying the track, that is to say, bringing the joint in one rail opposite the center of the adjoining rail. In discussing the advisability of abolishing the chairs and using hard-wood ties, Col. Yorke considers that the extra cost of the ties would be greater than any saving gained by discontinuing the use of the chairs.

Perhaps the most interesting portion of the report is that which deals with the question of signaling. This was found to be in a more or less experimental condition, no uniform practice having as yet been adopted throughout the country. The remarks on this subject are particularly timely just now, because of the attention that has been directed to our signaling system by the many and fatal collisions that have occurred, either through faulty signaling, or through disregard of correct signals. Moreover, as the Board of Trade has oversight of all matters relating to the safety of the traveling public, and has the authority to investigate and report on all railway accidents, the opinion of its expert necessarily will carry very great weight. His severest criticism is of the fast-and-loose method by which the interpretation of block signals is in many cases left to the judgment of the engineer; by which more than one train is frequently allowed to be in the same block section at the same time; and by which trains are permitted, under special conditions, to run against the traffic, that is to say, a down train is permitted to run on an up line, and *vice versa*.

On the question of automatic signaling, the report considers that it does not necessarily produce greater safety of operation, that it is after all merely a labor-saving device, and that while it gets rid of errors due to the human element, it opens the way for other errors due to inaccurate operation or breakdown of the mechanism, which may be equally disastrous. It is pointed out that since the chief object of such a system is to increase the density of the traffic by enabling trains to be run under shorter headway, this very density must of itself increase the chances of accident. We must confess that we can hardly see the force of this argument. It is evidently desirable that as many trains as are consistent with safety should be run over any given stretch of track. Automatic signaling increases the number, and if the apparatus be properly made and carefully maintained, this increased traffic can be worked with the same immunity from disaster as a less frequent traffic under a non-automatic system. The fault is not in the automatic system, but in the human element that operates and takes care of it. The system being good in itself, the obvious thing to do is to teach signalmen and maintenance-of-way engineers to exercise redoubled care and vigilance in keeping the automatic plant at all times in first-class condition. Automatic signaling has come to stay. With increased experience in its use, and with a more rigid observance of the first principles which underlie its successful operation, our railroads will learn to operate their trains without incurring the frightful loss of life that has occurred during the past few months.

ELECTRIFICATION OF THE LONDON "UNDERGROUND" RAILWAY.

BY OUR LONDON CORRESPONDENT.

By permission of Mr. James R. Chapman, general manager and chief engineer of the "Underground Electric Railway Company of London, Ltd.," the writer was enabled a few days ago to inspect the two new electric trains for the District Railway which have just arrived at the carsheds at South Harrow, and to make a trip in one of these over the new electrified line between Ealing and South Harrow, which will shortly be open for public service.

Each of the new trains is made up of seven cars, three of which are motor cars and four trailer cars.

They are to be regarded at present as experimental only, and on their working will depend the nature of the cars, not only for the electrified Metropolitan District Railway, but also for the three tube railways controlled by the Underground Electric Railway Company via the Baker Street and Waterloo, Charing Cross, Euston and Hampstead, and Great Northern, Brompton, and Piccadilly Circus lines.

In a few weeks' time electric trains will be running on the new line which the Metropolitan District Railway Company has constructed from Ealing to South Harrow, a distance of six miles. This line has been finished for more than eighteen months, but it has not as yet been opened for traffic. It has been chosen as the first section to be operated by electricity, and a temporary power station has been installed at Alperton which supplies current to the rails at 550 volts direct.

The new Ealing-South Harrow Railway, which con-

sists of six miles of double track, is completely in the open. During the past few months the work of electrifying this portion has been steadily pushed forward, and the Brush Electrical Engineering Company have just delivered the two "sample" trains referred to. The system which has been adopted may be described as the "third-rail multiple unit."

As a matter of fact, two new conductor rails, one the positive and the other the negative conductor, have been laid; there are therefore four rails in all. This system differs from that found on the Central London Railway, where only one conductor rail is laid, and also from the British Thomson-Houston system to be adopted on the North-Eastern Railway, where the third-rail will be used on the positive side of the circuit. All the existing track rails will be bonded for the entire current.

It is quite true that on the Ealing-South Harrow line the track rails are bonded also, but this is done for the purpose of carrying the small currents necessary for working the electric signaling system to be employed. The conductor rails weigh 100 pounds per yard and are very soft and of high conducting power, their electrical resistance being only from six and one-half to seven times that of pure copper, whereas the resistance of the ordinary steel rail is about twelve times that of copper.

These conductors have been supplied by the Rheinische Works, Germany, and another German firm has since obtained the contract for 3,000 tons more of these conductor rails.

The two sample trains are very similar to those employed on the Boston Elevated Railway. Each train will be made up of seven cars, of which three will be "motor cars" and four "trailers." One of the motor-cars will be at the front, another at the rear, and the third at the center. The total length of the train will be 352 feet, and the seating capacity, 330; each motor-car will seat 38, and each trailer 52 persons. Each car is 12 feet 4 inches high, 8 feet 4 inches wide, and 50 feet long. The two end motor-coaches have a luggage compartment as well as longitudinal seats; the other coaches have part longitudinal and part transverse seating, except the middle motor-car, which has only longitudinal seats. Each train, therefore, contains three different types of cars. The Brush Company are also supplying the bogie trucks, which are of two types, motor-trucks and trailer trucks; they are made entirely of cast steel. Each motor-car will be fitted with two motors mounted on one of the four-wheel trucks, the truck at the other end of the car being free; the motors are each of 175 horse power and will be geared by single-reduction gear to the two axles of the truck. This will give 350 horse power per motor car, or 1,050 horse power per train. The driving wheels of the motor cars are 36 inches in diameter, while the carrying wheels, as well as those of the trailers, are 30 inches in diameter. One train is to be fitted with electrical apparatus manufactured by the British Thomson-Houston Company, and the other with apparatus made by the British Westinghouse Electric and Manufacturing Company. Each firm will apply its own particular system of train control.

The framework of the cars is of the best English oak and ash. The paneling is of whitewood run in two courses, the inside being horizontal and outside vertical. The exterior woodwork will be entirely in wainscot oak, with natural wood finish. The seats will be of rattan on spring frames. There will be no upholstering in the interiors of the cars; all the wood has been treated to render it uninflammable, so that there is but little danger of cars catching fire.

A motorman's cab is provided at each end of the train, and at either end of the center motor-car is a similar cab, which is capable of being folded up when not in use. It is practically settled that there will be no distinction of class on the Electrified Underground, and a uniform fare of probably 2½d. will be instituted for any distance. The rumor that as a concession to British custom some cars will be labeled "reserved," and that for these an extra fare will be charged, is generally believed to be incorrect.

The motors will be capable of very high powers of acceleration. A speed of twenty miles an hour will be attained in less than half a minute, and midway between stations as high a speed as sixty miles an hour will probably be reached. The stop at each station will not be more than 20 seconds.

Until the great new power house in Lots Road, Chelsea, is ready to supply the current, the temporary power house at Alperton will be relied upon for the short Ealing-South Harrow section. The Underground Electric Railway Company have purchased the plant which was used for the experiments on the Earl's Court-Kensington High Street section, and have installed it at Alperton.

The Lots Road generating station has been commenced, and it is expected that the steel framework will be erected in June next. It will be the largest electric traction station in the world, and it will be first to employ steam turbines exclusively instead of reciprocating engines for driving the dynamos; the steam turbines to be installed will be the largest ever built. There will be ten turbines, each of 7,500 horse power, giving 75,000 horse power in all. The overload capacity of these machines will, however, allow them to work continuously at 11,000 horse power each, or in all 110,000 horse power, the largest power of any one station in the world. They are to be supplied by the British Westinghouse Company, and will be of the Parsons type with Westinghouse modifications. The speed will be 1,000 revolutions per minute and mounted on the same shafts will be ten three-phase generators of 5,500 kilowatts each. The current will be supplied at a voltage of 11,000, the highest pressure yet employed for traction purposes in this country. Substations will be erected, among other places, at the Mansion House and South Kensington, where the alternating current will be converted into continuous current and transmitted to the rail at 600 volts.

THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

Though the winter constellations have ere now disappeared from our view, and the duller skies of spring taken their place, there is yet much of interest for the star-gazer, even apart from the presence of two of the brightest planets in the evening sky.

We may well choose as one point of departure, for this month's survey of the heavens, the constellation of the Great Bear, more familiarly known as the Great Dipper, which is nearly overhead at nine in the evening. Prolonging the curve of the dipper-handle southward for rather more than its own length, we come upon Arcturus, the brightest star of Bootes, which includes also most of the stars we have passed on our way. Below Bootes, and to the right, lies Virgo, marked by one bright star, Spica, and, for the present, by the brighter presence of Mars.

Farther to the right, and a little higher up, is Leo. It requires but little imagination to see the head and mane of a couchant lion in the curve of the "sickle," while Regulus marks his fore-paws, and the triangle of stars some distance to the left forms his hind-quarters.

Cancer, which comes next along the ecliptic, is distinguished only by the little nebulous group of the Præsepe—a star cluster whose components can be seen with any field-glass. Gemini is still lower in the west, and is the last zodiacal constellation in sight. Rather lower than the twin stars, Castor and Pollux, and more to the southward, is Procyon, while Capella, with the rest of Auriga, is low in the northwest.

The long irregular line of stars below Leo and Virgo forms the constellation Hydra Its head is marked by a little group below Cancer, while its tail extends far beyond Spica. The little group of brightest stars below and to the left of the latter is known as Corvus, the Raven, who appears to be perched on Hydra's back. From the extreme southern portions of the United States, south of latitude 27 deg., the Southern Cross is visible at this season, directly below Corvus, its brightest star, at the foot of the Cross, almost touching the horizon.

A line of three second-magnitude stars in the southeast, followed by a brighter red one, shows that Scorpio is reappearing. The large and formless group of Ophiuchus and Serpens lies to the left and above. Farther on in this direction is Hercules, with the pretty circlet of the Northern Crown between it and Arcturus and with Lyra below in the northeast.

The Little Bear is on the right of the pole—east of it by ordinary reckoning, but south in the astronomical sense; for "south" in astronomical parlance always means away from the pole-star, or, more accurately, from the invisible pole which lies near it. Between the Great and Little Bears, separating them completely, is the long line of Draco.

By far the most interesting piece of astronomical news at the present writing is the discovery of a new star in Gemini, just announced by Prof. Turner, of Oxford.

The new object is faint—only of the eighth magnitude—and it seems improbable that it will become visible to the naked eye. With the telescope—as seen by the writer at Cambridge, England, March 28—it is conspicuous by reason of its strong orange color, which is strikingly like that of Nova Persei just after its maximum—and its peculiar spectrum, which, like that of other novæ, is full of bright lines, some of which are probably due to hydrogen.

THE PLANETS.

Mercury is evening star throughout May, and is visible under remarkably favorable circumstances. On the 10th he is at his greatest elongation, 21½ degs. east of the sun, and as he is also very far north, he does not set until the unusually late hour of 8:30 P. M. He is in Taurus, north of Aldebaran, at about one-quarter the distance of Capella, and moves rapidly eastward. As he is about as bright as Capella, he should be easy to see, at least during the first half of the month. After the 20th he approaches the sun and rapidly becomes invisible.

Venus is likewise evening star, and is exceedingly conspicuous in the west. She moves eastward through Taurus and Gemini during the month, and increases in brightness and remains in sight till nearly 10 o'clock each evening. The only difficulty about seeing her in broad daylight is that it is hard to find out just where to look for her. On the 29th she is in conjunction with the moon, but she is so far from the latter—7½ degs. north of her—that the conjunction will not be much help in finding the planet.

Mars is conspicuous in the evening sky. He is in Virgo, about two-fifths of the way from Spica toward Regulus, and is still very bright, though he loses half his light during the month, as he recedes from us. His apparent motion among the stars is westward until the 10th, when he begins to retrace his path.

Jupiter is in Aquarius, and Saturn in Capricornus. The latter rises at midnight in the middle of the month, and the former about 2 A. M.

Uranus is in Ophiuchus, and is approaching his opposition, which occurs next month. Neptune is in Gemini, and is getting too near the sun to be observed.

THE MOON.

First quarter occurs at 2 A. M. on the 4th, full moon at 8 A. M. on the 11th, last quarter at 10 A. M. on the 19th, and new moon at 5 P. M. on the 26th. The moon is nearest us on the 28th, and farthest away on the 16th. She is in conjunction with Neptune on the 1st, Mars on the 7th, Uranus on the 14th, Saturn on the 18th, Jupiter on the 21st, Mercury on the 27th, Neptune on the 28th, and Venus on the 29th. None of these conjunctions is at all close.

London, England.

SCIENCE NOTES.

In the course of a lecture at the Conference of Musicians in Dublin, Ireland, some interesting particulars and some astonishing statistics were given relatively to the amount of work accomplished by the brain and nerves in piano playing. A pianist in view of the present state of piano-forte playing has to cultivate the eye to see about 1,500 signs in one minute, the fingers to make about 2,000 movements, and the brain to receive and understand separately the 1,500 signs while it issues 2,000 orders. In playing Weber's "Moto perpetuo," a pianist has to read 4,541 notes in a little under four minutes. This is about 19 per second; but the eye can receive only about ten consecutive impressions per second, so that it is evident that in very rapid music a player does not see every note singly, but in groups, probably a bar or more at one vision. In Chopin's "Etude in E Minor" (in the second set) the speed of reading is still greater, since it is necessary to read 3,950 signs in two minutes and a half, which is equivalent to about 26 notes per second.

The manufacture of pure artificial camphor upon a commercial basis has been discovered by Mr. E. Callenberg, of Germany, technically known as chlorhydrate of terebinth. This substance possesses many peculiar properties, which will render it of great value for many commercial purposes, the most important of which is that it is soluble in nitro-glycerine; and as it reduces the maximum temperature of this dangerous substance during explosion, it is considered that it will do much to render considerably more safe the manufacture of high explosives such as nitro-glycerine. Not only does it reduce the temperature of explosion, but it lowers the freezing point of the substance to a very marked extent as well. Pure nitro-glycerine freezes at +8 deg. Centigrade, but when a 3 to 5 per cent solution of the chlorhydrate of terebinth is added, the freezing point drops from —10 deg. to —15 deg. Cent. Furthermore, guncotton and many other soluble explosives can be easily dissolved at a cold temperature in a solution of chlorhydrate of terebinth and nitro-glycerine, the resulting substance being a highly improved quality of gelatine-dynamite.

It has been reported to the Academy of Sciences by Henri Dufour that a comparison of the solar observations made with the Crova actinometer during the first three months of the present year with the results of preceding years, shows a distinct falling off in the sun's radiation in the lower layers of atmosphere. The suggestion that the solar radiation is perceptibly absorbed by the volcanic dust now diffused through much of the earth's atmosphere is to say the least plausible. But so far as international reports of the season indicate, the earth's loss of solar heat has not recently been traceable in the meteorological observations. March was, on the contrary, marked by abnormally high temperatures in portions of Europe and America, and few records for excessively intense cold have been reported this year. If the dust from the volcanoes of tropical America has now been spread through the upper atmosphere within the middle latitudes of America and Europe, it will be conducive in some slight degree to the formation of rain clouds in unusual quantities for several months. But the precipitation of summer will mainly depend on much more influential causes.