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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.

AIR RESISTANCE OF ELECTRIC CARS.

Among the valuable scientific results of the St. Louis Exposition, few rank higher than those which were obtained by the various commissions appointed for the carrying out of engineering tests. We have already referred in these columns to the excellent work of the locomotive testing plant established and operated by the Pennsylvania Railroad Company, the results of which have been tabulated and published in book form. An equally valuable work was that carried on by the Electric Railway Test Commission, whose work covered very broadly the field of electric traction. Among other tests was a series which was carried out on a straight stretch of track belonging to the Indiana Union Traction Company; and among these was included a series of experiments on atmospheric and train resistance, which were conducted with an air-pressure dynamometer car, designed by members of the commission especially for this purpose.

The resistance due to the pressure of the air on the front of the vestibule and car body was registered for speeds which varied from 25 to 70 miles an hour. Care was taken in these measurements to separate the resistance of the car due to the atmosphere from the total resistance, which latter includes that due to internal friction and to the rolling friction of the wheels on the track. In order to obtain a separate record of air resistance, the car body was so suspended above the trucks that the pressure on the car could be measured separately by suitable dynamometers. Furthermore, the vestibule was suspended separately from the body of the car, and the head-on pressure was registered independently of the other resistances encountered. In order to determine what form of vestibule front presented the least resistance to the atmosphere, four different forms were used in the experiment: First, a vestibule with a plain, flat front; second, the standard curved vestibule as ordinarily used on interurban cars, the radius of the curved front being 5 feet 6 inches; third, a parabolic vestibule with a length of 6 feet 3 inches; and fourth, a vestibule having a wedge-shaped extension of the parabola 2 feet beyond its end. The wisdom of suspending the vestibule so that the pressure upon it could be measured separately from that upon the rest of the car body was shown by the discovery of the fact that an unexpectedly large proportion of the power is expended in overcoming head resistance, and that this resistance is greatly reduced when tapered ends are substituted for flat ends.

The great effect which the shape of the front end has in determining the head-on atmospheric resistance was shown early in the experiments, when it was found to be impossible to drive the test car at a higher speed than 50 miles an hour when it was carrying the flat front end, although when a parabolic wedge front was substituted, the same motor and the same current were easily able to drive the car at a speed of 75 miles an hour. It was proved in the tests that the atmospheric resistance on the rear vestibule of the car was due to a suction, the effect of which was, of course, to retard the car. With a vestibule of the standard shape at the rear, the power absorbed by the suction of the air was found to amount to 16 horse-power at a speed of 60 miles an hour.

The general results obtained by the commission proved that at all speeds the pressure per square foot on the parabolic wedge vestibule is only about one-fourth of that on the flat vestibule, and that for all shapes tested, the unit pressure at 80 miles per hour is about ten times as great as that at 20 miles an hour. At 60 miles an hour the unit pressure on the wedge-shaped vestibule is 2.10 pounds, and on the flat vestibule 8.20 pounds. At 20 miles per hour the flat vestibule recorded a unit pressure of 1.4 pounds; whereas at 80 miles per hour the corresponding pressure worked out at 14 pounds. On the other hand, on wedge-shaped vestibules the pressure was 0.4 pound at 20 miles an hour and 4 pounds at 80 miles an hour.

These experiments would seem to demonstrate conclusively the advantage of the pointed front and rear, not merely for electric cars but for all swiftly-moving vehicles. In this it is in agreement with the celebrated Berlin high-speed tests, which clearly demonstrated the value of the tapered front. The Bavarian state railways have built their recent express locomotives with tapered casings on the various parts of the engine that are exposed to head-on air resistance, and our readers will have in mind our recent illustration of the Union Pacific motor car No. 7, whose shape at front and rear would seem to have been modeled in agreement with the findings of the St. Louis test commission.

GROWTH OF THE HUDSON RIVER STEAMBOAT.

There were several facts that conspired to make the recent maiden trip of the new steamer "Hendrick Hudson" memorable in the annals of steamboat history on the famous Hudson River. Apart from the fact that she is the largest and swiftest of a long line of famous boats, her maiden trip was completed on the ninety-ninth anniversary of the ever-memorable journey of Robert Fulton's "Clermont" from New York city to Albany and back. It was on August 17, 1807, that Robert Fulton's epoch-making trip began, and the little craft returned successfully on the 21st of August. The "Hendrick Hudson" started on the 20th and, returning next day, made her landings, in New York city, exactly on the ninety-ninth anniversary of the completion of the "Clermont's" voyage. The steady growth in size of Hudson River steamers is shown in a study of typical vessels that have navigated the waters of this river.

The "Clermont" of 1807 was 133 feet in length only, or but one foot longer than the America's cup-defending yacht "Columbia." The "Chancellor Livingston," built in 1816, was 154 feet in length; and the "Erie," constructed sixteen years later, had an over-all length of 180 feet. The "Rochester," which measured 209 feet from stem to stern, may be taken as a typical vessel of the year 1836. Twenty-four years later, at about the time of the outbreak of the civil war, that famous old craft, the "Daniel Drew," was placed in service, a vessel which will be familiar even to many of the younger readers of this journal. In this steamer the over-all dimensions had risen to 251 feet. The most marked advance in size and comfort was undoubtedly made when the two sister ships "Albany" and "New York" were placed in service. Each of these was 325 feet in length and they had no difficulty in maintaining an average speed of over 20 miles an hour. The "Albany" was placed in service in 1881, and the "New York" six years later. The last-named vessel, after running successfully for over a decade, was taken to the Erie Basin, Brooklyn, cut in half and lengthened to 350 feet. In the "Hendrick Hudson" the over-all length of the Hudson River steamer has been carried for the first time up to 400 feet, with a corresponding increase in the other dimensions, the boat measuring 82 feet over the guards with 14 feet 4 inches depth of hold and a draft of 7 feet 6 inches.

In the broad field of engineering there are few products that bear such strong individuality as the American river steamboat. There is nothing like it to be found in any other country in the world. With its shallow draft, broad beam, and towering superstructure, with its long lines of amply-lighted staterooms and wide expanse of promenade decks, the typical river steamboat possesses a dignity and grace which combine to render it one of the most picturesque creations of the naval architect. This is particularly true of the boats that ply upon the Hudson River. In the earlier history of steamboat development, iron was scarce and good shipbuilding timber plentiful. But it was soon found that as the length and weight of the boats increased, it was necessary, on account of the great shallowness of the hull, to provide some method of trussing by which the boats could be held to their true sheer line and prevented from "hogging," or the sagging of the bow and the stern. Hence those remarkable trusses extending parallel with the keel of the boat, and the elaborate system of tie-rods leading from the hull to a row of central posts erected upon the keel of the ship. Another characteristic and decidedly picturesque feature was the curious walking-beam engine, whose low speed of revolution necessitated the construction of paddle wheels truly gigantic in size. In the earlier boats, moreover, the boilers were carried upon the guards and outside of the hull of the vessel; indeed, several fine old boats of this description, notable among which is that swift and graceful craft, the "Mary Powell," are still doing good service, and seem likely to for many years to come.

It was only a question of time, however, before huge stiffening trusses, multitudinous hog chains, cumbersome walking beam engines and ponderous paddle boxes would have to give way to more modern and scientific methods of construction—indeed, it is surprising that these makeshift methods, rendered necessary by the conditions of a long bygone day, should have survived in one or two notable vessels which have been built for night service on the Hudson River within the last few years. In the "Hendrick Hudson," however, steel has taken the place of wood in the construction of the hull; low-pressure boilers and cumbersome walking-beam engines have disappeared, and their place has been taken by compact, high-pressure boilers, and inclined direct-acting engines placed below the main deck of the steamer. The result of these changes is that practically the whole of the ship above the main deck is devoted to passenger accommodation and the decks are no longer obstructed by the capacious well which formerly housed in the A-frame, connecting rod, piston, and the gear of the old walking-beam type. The result, looking at the ship from the broadside, is a decided gain in smartness and general symmetry of appearance. The addition of another deck, bringing the total decks up to five, has increased the capacity, until it is estimated that 5,000 day passengers could be carried. On the maiden trip some 4,000 were accommodated without any discomfort from crowding. The speed of the vessel on the trial trip was 23.7 land miles per hour, and it is probable that when the engines, which are of the triple-expansion three-cylinder type, have worn to their bearings, the boat will be good for a maximum speed of 24 miles an hour.

CEMENT BASES FOR WOODEN TELEGRAPH POLES.

Up to date, wooden telegraph poles remain in most countries the cheapest in first cost and in many respects as desirable as any. The question of durability, however, has been a sore point to those in charge of equipment and maintenance. All sorts of preservative solutions and all kinds of treatment therewith—pressure, vacuum, a combination of the two, etc., have been tried, but the wooden mast still remains more perishable than the iron, and its renewal means an expensive piece of work, outside of the cost of the pole itself. Happily, however, a new idea has been evolved from the depths of some one's moral consciousness or the heights of his inventive faculties, and according to which not only new wooden poles may be made more durable, but those which are already rotten at the base may be utilized to advantage and given a longer second life than the first. What is particularly gratifying to telegraph and telephone companies is the fact that this process is not patented, and from the point of view of first cost not too burdensome.

The process consists in mounting the pole in a socket of cement beton, with which, however, it does not come in direct contact. When we say "in a socket" we err in the matter of technical accuracy; for in the later forms of mounting there is a space between the foot of the wooden pole and the top of the cement base. The pole is attached to the base by four iron splice-plates or fish-plates. The cement base stands 8 to 10 inches above the ground level, and is a prism of the same diameter as the pole which it has to carry. On account of the severe leverage tending to break it off, it is strengthened with iron in the well-known manner of Monier or Coignet. The attachment of a wooden pole to such a foot takes only about twenty minutes; and the same is true in the matter of replacing one pole by another. To put a cement base on an old pole with a rotten foot the latter is sawed off about 8 to 10 inches above the ground and without removing the wires lifted a couple of feet away and leaned to one side; the old rotten foot is then removed, the hole somewhat enlarged, the ready-prepared cement stump or base is set in the hole and well rammed in and the old pole then attached to the cement base by the fish-plates, leaving say two inches between the two. The life of a pole thus mounted is reckoned at sixteen years. As regards the resistance of the cement base to breakages—that has been settled beyond question by the simple means of attaching a rope to the top of several poles and pulling horizontally thereon until something gave way. That "something" was in every case the wooden pole, and the break took place in every instance just where it was expected, namely, right above the cement base, or rather the fish-plate.

The bases are molded in a plain prismatic box, well rammed in, and left two or three days in the mold to set; they are then firm enough to handle without danger of injury. The bases are left to dry another week after removing them from the mold.

The first application of the multiple-unit system of railway motor operation and electrical control to motors of the alternating-current commutator type will be made soon on the suburban extensions of the Milwaukee Electric Railway and Light Company, one of which is 20 miles and the other 16 miles long. According to Power, the motors will be the "combination" type for operation on either alternating or direct current. Each car will be equipped with four 75-horse-power motors. The electro-motive force on the alternating-current overhead lines will be 3,300 volts, and transformers on the cars will reduce this to the proper voltage for the motors.

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

If we look directly upward early on a clear September evening, we will see the heavens just as they are shown on our map. Right above us is the fine constellation of the Swan—a great cross of stars in the Milky Way. West of it, and near to it, is the Lyre, with one very bright star, Vega (marked with the letter α on the map).

Following down the Milky Way to the southwest, we come to the Eagle (Aquila), whose brightest star, Altair, is nearly equal to Vega. Below this is the brightest and finest part of the Milky Way, which is almost startlingly brilliant on a thoroughly clear night. Even an opera glass shows that it is full of groups and clusters of stars, and those who have telescopes, of whatever size, will find it a happy hunting ground, full of magnificent fields. It extends far down to the southwest, where the constellations of the Scorpion and the Archer are beginning to set.

In the western and southwestern sky are the Serpent Holder (Ophiucus) and the Serpent, which, like Hercules to the north of them, can be studied better from the map than from any description. Below Hercules is the Northern Crown, and beneath this the Herdsman, with the great red star Arcturus. The Dragon and the Little Bear are to the left of the Pole, and the Great Bear is below them, so that the Dipper lies along the northwestern horizon. Cepheus and Cassiopeia are on the right of the pole and above it, toward Cygnus.

East of the Milky Way stretches a row of fine constellations. Due east, and about half-way up to the zenith, is Pegasus, which can be known at once by the "great square," whose four stars are all of the second magnitude. The northeastern one belongs not to Pegasus, but to Andromeda, which extends far to the northward and eastward. Still further on in the same direction we reach Perseus and then Auriga, the Charioteer, whose brightest star, Capella, is just rising.

The most interesting object in Andromeda is the great nebula, which is marked on our map, a few degrees northwest of β Andromeda. It is visible to the naked eye, and conspicuous in a field glass, but the marvelous concentric spirals which form its outer portions are revealed only by photography.

Below Andromeda is the small group of the Triangle, and the smaller but brighter one which marks the head of Aries, the Ram.

The Zodiacal constellations of the Fishes (Pisces), the Water Bearer (Aquarius), and the Sea Goat (Capricornus), which lie in the southeastern sky, contain no bright stars. The planet Saturn is now in Aquarius, and is much brighter than any star near it. It lies almost on the line of the western edge of the great square of Pegasus, extended southward. Farther down, in this same line, is a solitary bright star, Fomalhaut, in the Southern Fish.

THE PLANETS.

Mercury is morning star at the beginning of the month, rising at about 4:30 A. M. On the 4th he is in conjunction with Mars, passing him at a distance equal to one-third of the moon's apparent diameter. Both planets are near the bright star Regulus and soon pass north of it at a distance of less than a degree.

During the latter part of the month Mercury is invisible and on the 24th he passes behind the sun and becomes an evening star.

Venus is evening star in Virgo, and is very bright. On the 20th she is at her greatest elongation—that is, her apparent distance from the sun is greatest. She is, however, far south of the Sun, and is not nearly as conspicuous as at a spring elongation, but sets at about 8 P. M.

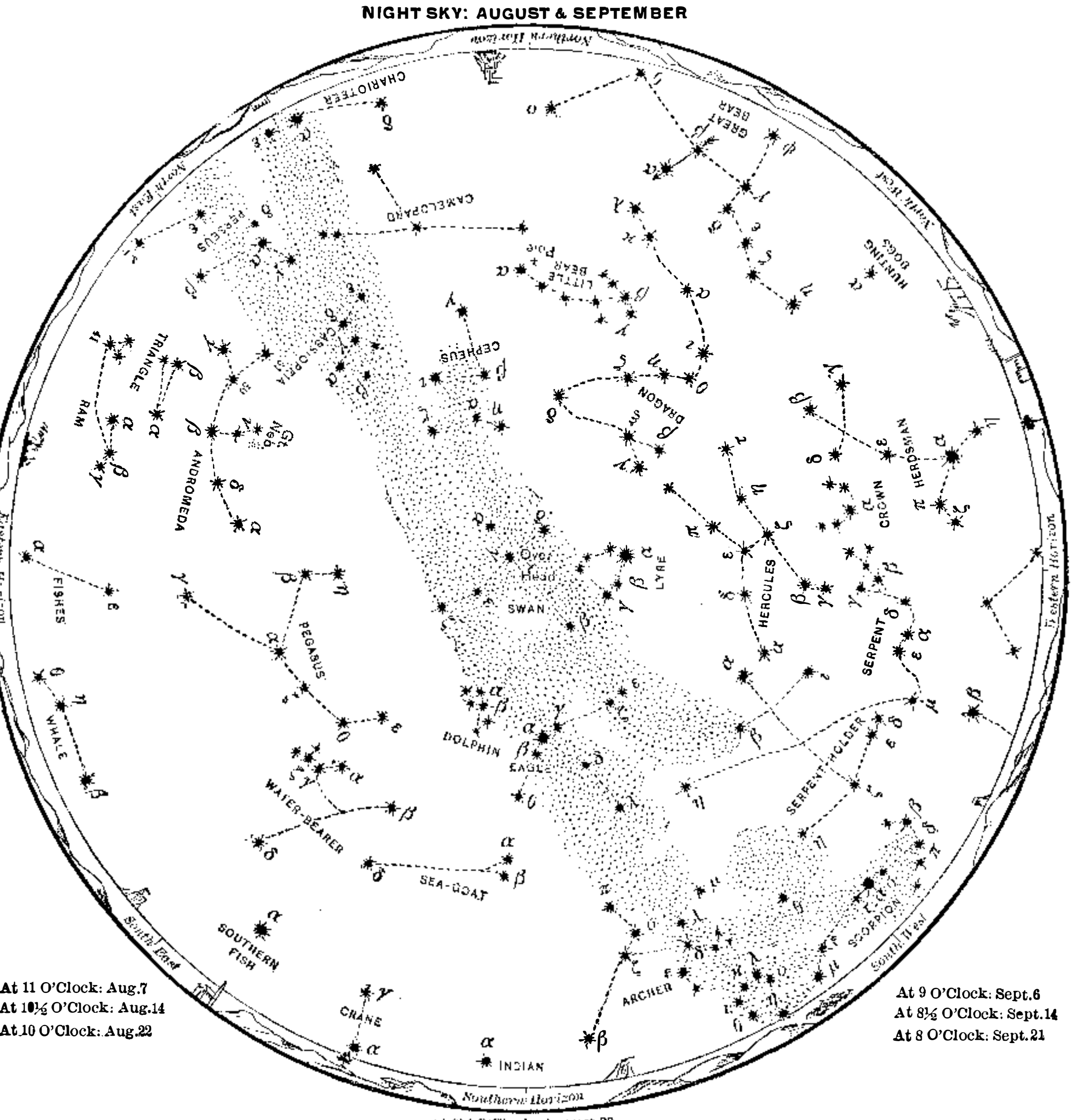
Mars is morning star in Leo, rising about 4:30 A. M. Jupiter is in Gemini, and rises near midnight in the middle of the month.

Saturn is in Aquarius, and comes to opposition on the 4th. He is now in a better position for observation than for several years past, and will well repay any one who turns a telescope upon him. The Earth is getting near the plane of his rings, so that we see them much more nearly edgewise than last year. A few years ago they appeared as an oval about half as wide as it was long. Now the length of the ellipse is ten times its breadth, and the rings seem to stick out on each side of the ball of the planet like handles. In another year we will see them edgewise, and they will then disappear entirely, except in very powerful telescopes, to broaden out again in the year following, when we see their opposite side.

The brightest of Saturn's nine satellites, Titan, may be easily seen with a small telescope. It is west of the planet on the 5th and 21st, and east of it on the 13th and 29th (its period being sixteen days). When it is north or south of the planet it now seems so close to it (less than the planet's diameter) that it will be hard to see it with a small instrument.

Uranus is in Sagittarius and is in quadrature on the 28th, coming to the meridian at 6 P. M. Neptune is in Gemini and can be observed before sunrise.

NIGHT SKY: AUGUST & SEPTEMBER



At 11 O'Clock: Aug. 7
At 10½ O'Clock: Aug. 14
At 10 O'Clock: Aug. 22

At 9 O'Clock: Sept. 6
At 8½ O'Clock: Sept. 14
At 8 O'Clock: Sept. 21

At 9¼ O'Clock: August 29

In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE MOON.

Full moon occurs at 6 P. M. on September 2, last quarter at 4 P. M. on the 10th, new moon at 7 A. M. on the 18th, and first quarter at 1 A. M. on the 25th. The moon is nearest us on the 21st, and farthest off on the 9th. She is in conjunction with Saturn on the 2d, Jupiter and Neptune on the 12th, Mars on the 16th, Mercury on the 17th, Venus on the 21st, Uranus on the 24th, and Saturn again on the 30th.

The conjunctions with Saturn are close, and occultations are visible in the southern hemisphere.

At 6 P. M. on the 23d the sun crosses the celestial equator and enters the sign of Capricorn, and in the old expression of the almanac, "autumn commences."

THE USE OF CLAY CONES IN STEEL HEATING.

The days of estimating the heat of a work-piece by the color have gone by—at least in establishments where any weight is laid on uniformity of product. In the first place, no two men will agree as to the color of a piece in any one fire or bath; in the second, the same temperature will be differently estimated in different parts of the shop or at different times of the year—or even day; and in the third place (what is of equal importance), no two steels will show the same color for the same temperature. Something more exact must take the place of the eye. There are some good pyrometers, but they are generally expensive and delicate, and inconvenient to apply. But there is a means of measuring—not estimating—temperature, which manufacturers of fine porcelain use, which should be of great value to steel workers in enabling them to ascertain with certainty just what the temperature in a furnace really is, instead of guessing at it. And here we may add what we should have given as fourthly above—that the eye grows tired and less sensitive to color; so that the same temperature will be estimated lower, after ten minutes' watching red or white hot metal or combustible.

The method to which we refer consists in the use of porcelain—or rather clay—cones of various melting or softening points; there are about sixty different grades, each stamped with a number corresponding to a definite temperature at which slumping down takes place. The range of temperature is between 590 deg. and 1,940 deg. C., or say 1,094 to 3,524 deg. F.

In order to find out which cones to use, where the right temperature is not known in degrees, the first test is made with several cones, and that one is chosen as the standard which at the desired temperature curls over and nearly or quite touches the floor of the furnace. It is best to use two cones of the proper number, one for the hottest and the other for the coolest part of the furnace; their curling over is to be watched through the usual peep-holes, preferably covered with mica. The cones should be protected from direct flame, just as much as the work-pieces are. A good way is to fence them around with two bricks on the side and one on top, the cone also standing on a brick. Another way is to use open-sided clayware hoods provided for the purpose, and which melt at a higher point than any of the cones. There are also small muffles which serve the same purpose, as well as capsules with lids; these latter, of course, must be drawn from the furnace in order to observe the cones.

Just why the cones now used are not marked with the melting temperatures instead of numbers ("022," "09," "29," etc.), "deponent saith not, not knowing"; perhaps some wire-gage manufacturer can give the reason.

"GALVANIZING" WITH ZINC-ALUMINIUM ALLOY.

In order to get a "galvanizing" bath that shall be quite liquid and yield a brighter surface than is attainable by the use of zinc alone, Gührs uses an alloy composed of about one-half of one per cent of aluminium, and one-fifth per cent of bismuth with the zinc. In order to get this alloy in proper state of diffusion it is necessary to melt the aluminium at the same time with the zinc; the bismuth can be melted in at the same time if desired. It is claimed that simultaneous melting of the zinc and the aluminium prevents the formation of oxide and of hard dross. In order to effect this desirable simultaneous melting of these two metals, it is best to prepare beforehand an alloy of zinc and aluminium, or of these with bismuth, in stronger proportions of aluminium than is desired in the bath—for instance, 20 parts of aluminium and the same of zinc, with 5 of bismuth, well stirred while melting. This "mix" is to be melted with the rest of the zinc, in such proportions as will give to the resulting melted mass the requisite proportions for the bath.

A higher percentage of aluminium can be used than one-half (one two-hundredths of the entire weight), but it effects no improvement above that brought about by the use of the smaller quantity. The bismuth may be used in even smaller quantities than the above-quoted one-fifth of one per cent.

An American patent has been granted for making pens of tantalum or its alloys.