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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.


## SCHEDULE VERSUS SAFETY.

The greatest credit is due to the Interurban Company for the admirable manner in which they have operated the new Subway during the two months of its active service. Systems as large as this have usually grown from small beginnings, and developed gradually to the full magnitude of their traffic; but in this case, the turnstiles were opened and the full flood of a great city's traffic was allowed to flow into the Subway, as though the opening day were but one in a long series of years of successful operation. Not even the Interurban officials, however, will claim that the operation of the system is so perfect that no further improvements can be made; and, indeed, an incident occurred recently in the early hours of the morning which served to show that in one respect at least the security of the passengers can be very materially increased. We refer to a rear-end collision, which took place between two trains on the local tracks at the Worth Street station, and to the fact, which was brought out by this incident, that although the automatic stop is used on the express tracks, this most excellent device has not as yet been installed on the local tracks. The automatic stop, it will be remembered, is a small lever placed on the tracks, which is raised whenever the adjacent signal is at danger, and when in this raised position serves to shut off the current on a passing train, and set the emergency brakes. This stop is considered, and rightly so, to be an absolute preventive of rear-end collisions.

Now, the action of the stop in the case of a breakdown of any train, is to delay the whole service on that particular line back of the obstruction, every train being held with a clear stretch of track between itself and the train ahead. This, of course, means that the blocking of one train involves the instant blocking of a long stretch of trains behind it. In order to avoid such delay, the management decided not to install the stop on the local tracks; but to adopt a modified operation of the block signal system, under which, when the signals are against him, the motorman is permitted to proceed "under a slow bell" until he brings himself as near to the train ahead as to his judgment may appear to be advisable. By thus playing fast and loose, as it were, with the inexorable demands of the block-signal system, the following trains are kept moving much longer than they otherwise would be, before being brought up by the obstruction. This conduces, of course, to a closer observance of the time schedule; but it is done at a very evident sacrifice of those safeguards which the block-signal system is intended to throw around the passenger.

It is this practice of leaving to the judgment of the engineer as to how far and how fast he may proceed beyond a signal that is set against him, that is answerable for a large percentage of the accidents that are occurring on our steam railroads with such alarming frequency; and it cannot be denied that the adoption of the same method on the local tracks of the Subway has materially lessened the security of travel on that system. It is to be hoped that the officials, prompted by the recent collision, will see the wisdom of applying the automatic stop not merely to express tracks, but to every track on the road.

## THE AMERICAN EXHIBIT OF FOREIGN AUTOMOBILES.

The fact that in this year's annual automobile show it has been necessary to find a separate hall in which to house the foreign exhibits, is striking evidence of the rapid growth of the domestic industry. In previous exhibitions there has been a hint of the separation that has taken place this year, in the fact that for the last two or three years foreign exhibitors have been grouped in a separate room at Madison Square Garden. The demand this year has been so great, that every foot of available space at Madison Square has been required for the exhibition of domestic machines, with the result that, for the first time, the foreign makes are to be found in an entirely separate building. As it is, there is a sufficient number of first-class foreign machines and their accessories to entirely fill an exhibition hall which occupies one complete floor of the largest department store in New York city.

Our succeeding issue, which will be a special number, devoted to the annual Automobile Exhibition as illustrative of the development of the American industry, will include detailed illustrations of some of the leading foreign machines; and it will suffice in the present article, which is devoted to a general survey of the foreign exhibit, to mention some of the more important points of novelty that have been developed during the past twelve months. In the first place, testimony should be borne to the characteristic beauty of design and excellence of finish that distinguish every machine. Although, in general contour and proportions the cars conform to the standard of last year, there have been some modifications produced in the form of the bonnet and the curves and proportions of the body that have added not a little to their handsome appearance. There is a general tendency to abolish the rear door and substitute the side door, which is placed either in the body of the tonneau, or else is formed by an ingenious arrangement, either of a swiveling or a lifting front seat, which makes it possible to enter the automobile directly from the sidewalk, and avoid the old inconvenience of having to step into the street. A machine that attracted much favorable comment was a brougham intended for city use, in which the bonnet is dispensed with, and the motor is placed beneath the driver's seat, which is hinged at the forward end, and can be lifted for inspection of the engine. This arrangement permits a considerable shortening of the wheel base, and provides a brougham that is more easily maneuvered in a crowd of vehicles, particularly in moving to the sidewalk in front of a theater or crowded store. This is a step in the right direction, at least in such cases as are intended more particularly for city use. There has been a considerable development of the inclosed or partly inclosed automobile, of the type that has been so popular during the past season, and some very pleasing designs are exhibited.

We note a tendency to abandon the over-light metallic car bodies, and return to the more substantial wood. This, of course, has the disadvantage of increasing the weight of the machine—a fact that has been noted with some alarm by the French tire makers, one of whom has recently offered a prize for a machine having the lightest car body compatible with reasonable strength.

In the design and construction of the chassis, engines, and running gear, there is no striking novelty to record. The pressed-steel frame has become the standard type, although a few makers exhibit a frame built up of standard shapes. There is a general adoption of the protecting pan, curving across the frame beneath the engine and transmission gear—a device so obviously useful that it is surprising it should not have been incorporated long ago. It is a common practice to equip each engine with two separate methods of ignition, the high-tension magneto and the battery and coil. The former is preferred, and the batteries are held in reserve in case of a breakdown of the magneto. In this connection mention should be made of a magnetic clutch, exhibited on a Belgian car, in which magnets, incased in the flywheel, are energized by current from the magneto or from the batteries. The device has apparently given excellent results, and if so, we may look for its very general adoption. Another promising form of clutch carries a series of springs behind the leather casing, by means of which the power is transmitted so gradually, that the car can be started when the transmission is on the high speed. The performance of these two clutches will be watched with keen interest during the coming season.

Many minor improvements were noted in the direction of providing a more convenient access to the various levers for control of the engine, the transmission gear, and the brakes; the foot-brake levers, in particular, being made longer, and so placed as to be operated with more of a forward and less of a downward thrust than in the earlier machines. In tires, the most notable improvement is the introduction of a non-slipping variety, in which a leather sheath is vulcanized over the tire proper, this sheath carrying a leather strip the full width of the tread, on which are riveted a mass of flat steel plates or studs, which serve the double purpose of giving improved adhesion and at the same time protecting the rubber tires from wear and puncture. The exhibit, as a whole, is a demonstration of that excellent workmanship and general beauty of design which have enabled the foreign makers, in spite of the remarkable development of our own industry in this country, to import into the United States, as they did last year, over three million dollars' worth of machines.

## A MONUMENTAL BUILDING.

In planning the truly magnificent station which is to take the place of the present Grand Central Station of the New York Central Railroad, the company have shown a full appreciation of the magnitude of the problem and of the inexorable necessity that is laid upon them of building not merely for to-day, but for the vast increase of travel of the far future. When the present structure was built, back in the seventies, it was the wonder of the day; and because of its magnitude, its great arch of glass and iron, its many parallel tracks, its long stretch of office buildings, and other features of greatness, the Grand Central Station was, for many years, an object of much civic pride in New York city. It was built with a strict eye to the future; nevertheless, but two decades had passed when the company began to realize that so rapid was the increase in traffic, that their great station was great no longer, and that before long they must begin to pull down and build on a far more generous scale. The question of enlargement was receiving serious consideration, when the enormous inconvenience, not to say danger, attending the running of steam-operated trains through the tunnel approach to the station became so acute, that legislative powers were sought to enable the company to dispense with steam locomotives altogether, and operate the terminal yard and the suburban traffic by electrical traction. The opportunity presented by this change of motive power enabled the company at the same time to greatly enlarge and entirely reconstruct the station yard and the terminal buildings.

The magnificent structure, of which we present illustrations on another page, is the outcome of a continuous study of the problem by the architects, Messrs. Warren & Wetmore, associated with Messrs. Reed & Stem, and by the engineering staff of the New York Central Company. Every possible arrangement of tracks and type of building was considered, and no less than two hundred different sets of plans are now on file in the architects' office, as evidence of the care with which the problem was studied. The present designs were adopted because they conform to certain important principles which were laid down as indispensable to the successful operation of a great terminal station such as this, chief among which were the following:

The station must be considered as a great gateway to the city and, therefore, must be simple and dignified in its architecture, and must provide the broadest possible facilities for the inflow and outflow of traffic. It was this consideration that condemned those plans which contemplated the erection above the station of a vast office building; for such a structure would have congregated several thousand people at the very point where it was desired to provide a broad unobstructed thoroughfare for incoming and outgoing passengers.

The progress of the passengers from the street to the cars and from the cars to the street, must take place as far as possible in two direct and entirely separated channels; the incoming and outgoing crowds never meeting or intermingling with those moving in the opposite direction.

In passing from the street to the cars, the passenger should take the steps incidental to departure in their natural consecutive order, with as little running to and fro as possible; the waiting room, the ticket office, the baggage room, the concourse, and the departing platform presenting themselves successively to him as he moves to his particular train. Similarly, the incoming passenger should find the incoming baggage room, the cab stand, and the means of exit to subway station or to street, presented to him in quick and logical succession.

The express and long-distance passengers, whose progress through the station either in departing or arriving is necessarily retarded by ticket purchasing and the checking of baggage, should be entirely separated from the suburban passengers, who almost invariably pass direct from the street to the car without any delay in the station.

Lastly, in view of the vast increase which must necessarily and rapidly take place in the future, the station must be built on a scale much larger than is absolutely needed by the present volume of travel; and this provision must extend not merely to the area devoted to passengers in waiting rooms, ticket lobbies, and concourse, but to the station yard itself, which must be extended in area to accommodate the larger number of trains that will be required.

Now, it must be admitted, after an impartial study of the plans of this great undertaking, that the above requirements appear to have been fully met and all the provision for the future made that can reasonably be asked.

Architecturally, the station building will present a massive and dignified appearance, worthy of what is probably the most important railroad terminal in America. The architecture of the building is throughout and without exception an expression of the plan; none of the decoration being used merely for architectural effect, but everything serving some useful, struc-

tural purpose. Thus the main piers under the great arched roof of the concourse, and at the intersection of the roof and its transept, are necessary to carry the load of the massive steel work of the roof. This is true even of the two massive piers that flank the main entrance on Forty-second Street, their great mass serving to take the horizontal thrust of the arches. The only possible exception is the pairs of columns between the arches of the Forty-second Street entrance; and these are placed there merely to accentuate the fact that this is the main approach. The proportions of the façade are truly monumental, the main arches being 33 feet in width by 60 feet in height, and the cornice being about 75 feet above the street level. The whole structure will be faced with gray granite, and with its great frontage of 300 feet on Forty-second Street and twice that distance on Vanderbilt Avenue, and with an open width of street of from 130 to 140 feet to afford a fitting point of view, it must long remain one of the most successful of the monumental buildings of New York city.

## THE LIFE OF A BARREL.

BY GEORGE E. WALSH.

The introduction of improved machinery in its manufacture has made the American cooperage business the largest in the world. There are upward of 300,000,000 barrels and circular packages manufactured in this country annually, and the demand increases so that this output must be steadily broadened in order to keep pace with the growth of the business. The largest consumption of barrels is in the cement business, which approximately demands 35,000,000 a year for the trade, while flour comes next, with a demand for 22,500,000; fence staples, bolts, nuts, and nails require 18,000,000, and sugar 15,000,000. Roasted coffee, spices, crockery, and fruits and vegetables use up about 5,000,000 barrels a year each, while the glassware trade, baking powder companies, distilled liquor manufacturers, and candy, tobacco, and cheese packers are big users of barrels, averaging in each trade from 2,000,000 to 3,000,000 barrels. The consumption of barrels for molasses, oil, lard and pork is also enormous, while dry paint, glue, snuff, oatmeal, screws, castings, and general hardware articles annually increase the demand on the cooperage supply.

While the amount of expenditures for barrels can be closely estimated for a given year, it is not possible to say how many barrels are in actual use. The life of a barrel is put down at one year by the trade; but that is far from true. The great majority of barrels have as many lives as a cat. They begin as sugar or flour barrels, and are then sold to the farmer for shipping his produce to market. It may be they are returned to him several times, carrying potatoes or pickles to market in the first trip, and then cabbages or lettuce in the next, each cargo being lighter in weight than the previous one, owing to the weakened condition of the barrel. Finally, the barrel may serve out its life work as a garbage receptacle, and be burned in the end in some tenement home to keep out the winter's chill. Thus it may be said that a barrel serves a more useful career than almost any other manufactured article, and its life is much longer than a season.

The demand for barrels is steadily increasing because modern machinery has made it possible to make them for the trade cheaper than almost any other form of package. That it is the most convenient form of package has long been acknowledged. The ancient cooper's art was a skilled one, and the work of cutting out the staves and then assembling them required long practice and apprenticeship. To-day machinery performs in a fraction of the time what hand labor did so slowly and clumsily.

The modern veneer machines have been instrumental in reducing the cost of barrels. Hand labor is eliminated here to such an extent that the work of feeding the machines constitutes most of the requirements of the operators. The staves are cut to the required thickness by the machines, and then pressed into shape by hydraulic pressure until they are ready for the assembling machine.

A feature of barrel-making in this country is the grading of the circular packages so that all the lumber brought to the factories can be utilized. One class of barrels must be absolutely water-tight, without a flaw of any kind in their staves. Barrels made for the oil, whisky, and paint trade must not only be flawless, but they must have a resistance power equal to a lateral pressure of five hundred pounds. In order to secure this the staves must be put to a rigid test beforehand, and they must be cured so there will be no danger of shrinkage and damage when put into use. Lumber used for this work must be carefully selected, and it must be cured by nature's slow but sure process. Kiln-dried lumber would never do. The condition of kiln-dried wood is such that it would prove too brittle.

The choicest oak, hickory, ash, or other hard wood must be selected for barrels used for such purposes, and their cost is consequently in proportion to the extra labor and cost of the raw product. Out of every dozen trees in an ordinary woods only four or five will be found to pass the most rigid examination and tests.

The second grade of barrels comprises those which have to endure a great lateral strain, but which do not have to be water-tight. To this class belong the sugar barrels, and all those used for packing hardware. The staves must be made of hard wood, but they only require strength and a power to resist three or four hundred pounds lateral pressure. It is possible to use for these barrels most of the lumber rejected for the first class of barrels. There must not be knot holes in the barrels, however, for tightness to some extent is essential. While the sugar and flour barrels have paper lining inside of them, they will spill more or less of the contents if holes and cracks of an unusual size are left in them.

The third grade of barrels includes those used in the hardware trade and for packing tobacco, spices. and coffees. The weight of these articles is no less than sugar or flour, but their sides need not be so tight. The barrels and kegs for the hardware trade must be stout, but lumber can be used that is somewhat defective. Knots are not necessarily a bar to the use of staves. Some of the rough lumber used up in this way is practically of little or no use for the manufacture of any other kinds of circular packages. The cost of the raw material being smaller, the barrels can be sold to the trade from fifty to sixty per cent less than those made for sugar, molasses, oil, whisky, and paints.

The question of hoops for these commercial barrels is fully as important as the staves. The use of wire and flat iron hoops has become quite universal, but where wooden hoops can be used as well, they always receive the preference. The most satisfactory method is to use wooden hoops, reinforced by iron or wire ones. A great many of the barrels used in the trade are thus held together. There is a uniformity of strength existing between staves and hoops which must be carefully computed in the manufacture of barrels for the different trades. To make hoops that would break at a straining point of two hundred pounds for barrels that were built of staves guaranteed to withstand a pressure of five hundred pounds would be a waste of good material. If anything, the hoops must have a resistance more than equal to that of the staves. The hoops are consequently the most important part of the barrel. Stout hoops will hold a barrel together even when the staves are weak, and it is possible to hoop a barrel of 200 pounds resistance so that it will resist a pressure for a time of 500 pounds. The breaking power of either the wooden or wire hoops is carefully computed for each class of barrels, and when properly made and applied they will insure a long life to the circular packages. The life of the barrel is estimated by the life of the hoops, and to prolong it beyond that period new hoops must be supplied.

## DETERMINING A SHIP'S BEARING BY WIRELESS TELEGRAPHY.

A Boston inventor has devised a means for determining the bearings of navigable vessels under all conditions of weather, the object being to provide improved indicating devices for use with a ship's compass and the usual sailing-charts, whereby the bearings of known objects at a distance from the ship may be positively determined at times when owing to fog or storm the landmarks may be invisible.

The invention is based upon the scientific fact that "Hertzian-wave" impulses or signals may be conveyed over long distances without connecting-wires. This principle is utilized to determine the position of the ship with relation to known landmarks, thus rendering navigation safer and avoiding delays in the movement of vessels caused by foggy or stormy weather when the usual sight observations cannot be taken.

The apparatus, carried on the ship, is applied to or connected with the binnacle, which incloses the ship's compass; and it consists, primarily, of a receiving instrument electrically connected with an upright conductor so shielded that it can receive only the wave, impulse, or signal (coming from a transmitting station on shore or from another ship or lightship) through a lateral opening or slot when such exposure is in proper range radially with said ship or shore station. The conductor is surrounded by a rotatable shield, cap, or tube slotted vertically to admit the wave or impulse from a given station at such time only, in its rotation, as the slot or opening is approximately between said station and the inclosed conductor. With this apparatus or its equivalent when used on shipboard a rotatable pointer is employed extending over and close to the compass, always in the same radial vertical plane as the slot or exposure, to indicate on the face of the compass the bearing of the station from which emanates the signal or impulse reaching the receiving instrument through such slot or exposure.

With this system of taking bearings each lighthouse and prominent landmark will have a distinctive name or number by which it is known and designated on sailing-charts, and each will be provided with a transmitting instrument adapted to continually repeat its name or number or to automatically transmit such impulse, wave, or signal as shall make the identity of the station certain. Then when a ship appears off the coast provided with the receiver and compass attachments, the elevated conductor receives through the slot of its rotating and intermittingly-acting shield the impulse sent seaward from the transmitting stations, and the navigator notes at once on his chart the bearing of the station as denoted on his compass-dial by the indicating pointer. From another shore-station he receives a different signal, and by the cross-bearings thus secured he obtains his reckoning, showing exactly where on the chart his ship should be. A transmitting instrument on the ship will at such times be able to communicate with the shore-station, thus making its presence and its exact location known.

## SCIENCE NOTES.

A telegram has been received at the Harvard College Observatory from Prof. W. W. Campbell at Lick Observatory stating that a sixth satellite of Jupiter, suspected by Perrine in December, was discovered by him January 4, 1905. The position with respect to Jupiter from previous plates taken in January, is as follows: Position angle 269 deg., distance 45. The distance is decreasing 45 sec. daily. The apparent motion is retrograde and the magnitude 14. Derived from observations with the Crossly reflector on December 3, 8, 9, 10, and January 2, 3, 4.

A clock which will run for two thousand years has been invented by Richard Strutt, son of Lord Rayleigh. The motive power is a small piece of gold-leaf which is electrified by means of a very small quantity of radium salt. It bends away from the metal substance and keeps moving under this influence until it touches the side of the containing vessel. At the moment of contact it loses its electrical charge and then springs back and is again electrified, and the process repeated. Sir William Ramsay considers that this may be made into a very reliable time-piece at an expense of about $1,000.

President Roosevelt has become the honorary president of a committee representing the United States, which is to be a portion of an international organization, including the heads of all of the Powers of Europe, to make excavations at Herculaneum, which, together with Pompeii, was destroyed by an eruption of Vesuvius in the year 79 A. D. Prof. Waldstein has secured the consent of the King of Italy to act as the head of the international committee. King Edward will be at the head of the committee in England, Emperor William in Germany, President Loubet in France, and King Oscar in Sweden. The international committee will have headquarters in Rome, over which the King of Italy will preside. Representatives of every nation will be at Herculaneum, and, once started, the work will be pushed rapidly.

E. Demoussy has made a series of experiments to show the growth of plants in an atmosphere charged with carbon dioxide gas. In this case the plants reach an increased development over the plants growing in ordinary air. He used two glass boxes each of over one cubic yard capacity and containing a number of pots. The first was not entirely closed and was used for the plants growing in ordinary air. The air supply was sufficiently renewed to give the average conditions, and a number of tests gave the normal amount of carbonic acid, or 3-10,000ths. In the second box a certain amount of carbonic acid gas was introduced each day so that the proportion reached 18-10,000ths. In the evening this became less, but never fell below 12-10,000ths, so an average of 15 could be admitted, this being five times the amount contained in ordinary air. During the day the plants were protected from the sun's rays by cloth covers, and at night the boxes were opened so that they were well aired. For the experiments he chose four sprouts as nearly alike as possible, placing them in ordinary flower-pots in garden earth, one pair in each box. The observations were made from the end of May to the end of July, at which time the plants were cut and weighed. The following results show the increase in growth due to the carbonic acid. The weights are those of all the part of the plant lying above ground. At the beginning the weights were very small, as the plants had just sprouted; only the geranium, mint, and fuchsia came from buds. The first figure gives the weight in ordinary air and the second in the air charged with gas. Coleus, 34 grammes; 50 grammes. Lettuce, 21; 36. Geranium, 45; 118. Castor, 26; 45. Mint, 28; 36. Red tobacco, 30; 54. White tobacco, 51; 101. Poppy, 21; 30. Fuchsia, 30; 29. All but one, the fuchsia, show a great increase, with an average of 60 per cent. The appearance of the plants is the same in both cases, but the dimensions are somewhat greater in the latter case. For many of the plants the flowering is more rapid and abundant in the charged air. The fuchsia alone does not show any difference, but this may be due to the fact that the plants were but little developed in either case, as the conditions of high temperature and moisture were probably unfavorable for its growth.