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.