WIRELESS TELEPHONY FOR THE UNITED STATES NAVY.

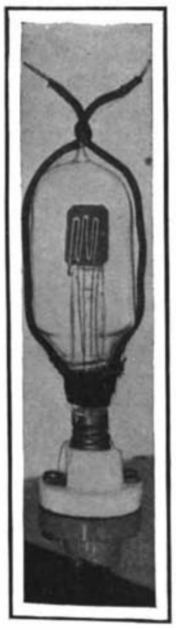
HERBERT T. WADE.

A most essential condition of modern warfare is to maintain unbroken and complete communication along the entire line, from the commander-in-chief and the board of strategy to "the man behind the gun." Every device in the way of a signal or telegraph that accomplishes this purpose must be employed, and new inventions are warmly welcomed, especially in the naval service, where to secure the best results a fleet must move at the direction of one man, and often as a single unit. Accordingly, when it was announced recently that wireless telephony had been developed to a practical state, it was but natural that the United States navy should wish early to test its claims, with a view to its extensive adoption for intership communication, as well as for talking between sea and shore or between temporary or isolated stations, as on islands. For such tests apparatus has recently been installed on the U. S. battleships "Connecticut" and "Virginia" by the Radio Telephone Company under the direction of Dr. Lee De Forest, who for several years has been devoting himself to the transmission of articulate sounds by electrical waves, and has developed his apparatus so that the practicability of wireless telephony on a commercial scale seems assured. If the report of the naval officers supervising these tests is satisfactory, it is quite probable that the new Pacific fleet, at least, will be completely equipped with apparatus for wireless telephony.

The present application and tests involve the installation of transmitting and receiving apparatus in the wheel house or on the bridge of the battleships, working in connection with, yet quite independent of the ship's ordinary wireless telegraph equipment. This enables the admiral or captain to converse with any ship within five miles, the contract limits of the present installation. The apparatus as now constructed is the result of an exhaustive series of laboratory experiments by Dr. De Forest, combined with practical tests made last July on Lake Erie, when wireless telephony was used in reporting a yacht race to communicate between a small yacht in motion and the shore. On this occasion it was shown publicly that for distances up to four miles, satisfactory telephonic communication without wires is perfectly feasible, and it is with an improved form of this apparatus that tests are being made by the navy. Just previous to shipment to Provincetown for installation on the battleships, and while undergoing the final laboratory testing, the instruments were specially photographed for the Scientific American, and are shown in the accompanying illustrations.

In explaining the construction and operation of the De Forest system, it may be desirable to say a few words as to the underlying theory. Wireless telephony, as also wireless telegraphy, depends upon the production of electric waves that pass through the atmosphere, and also solid substances, with a velocity equaling that of light—186,000 miles per second.

In order to transmit either telegraphic signals or vibrations corresponding to those of the voice, it is necessary to interrupt or vary these waves at intervals depending on the signals or character of the sound. The production and transmission of the waves is essentially the same in wireless telephony as in wireless telegraphy, but their interruption is an entirely different matter. The vibrations corresponding to the human voice have an average rate of about 500 per second, for a man's voice, extending up to 20,000 per second for the overtones, while in wireless telegraphy, manually operated, it is possible to work at a rate of about five interruptions per second, the telegraph signals of course corresponding to the familiar Morse alphabet. In wireless telegraphy the receiving of the waves is accomplished by any one of a number of devices, such as the coherer, the magnetic detector, electrolytic responder, etc., but in wireless telephony there is need of a specially sensitive device, and this is realized in the Audion, which, devised by Dr. De Forest and adapted for both space telegraphy and telephony, has been found a specially valuable element in the latter. This instrument, shown in the illustration, appears at first glance to be simply a small incandescent lamp, but there will be noticed a plate and a grid of platinum sealed into the bulb and connected with the exterior by platinum wires. The filament is of tantalum or other metal and is made to glow by a current from a small storage battery shown in the illustration on page 222. The action will be explained below more fully in connection with the rest of the apparatus whose connections and arrangement are indicated on the accompanying diagrams.

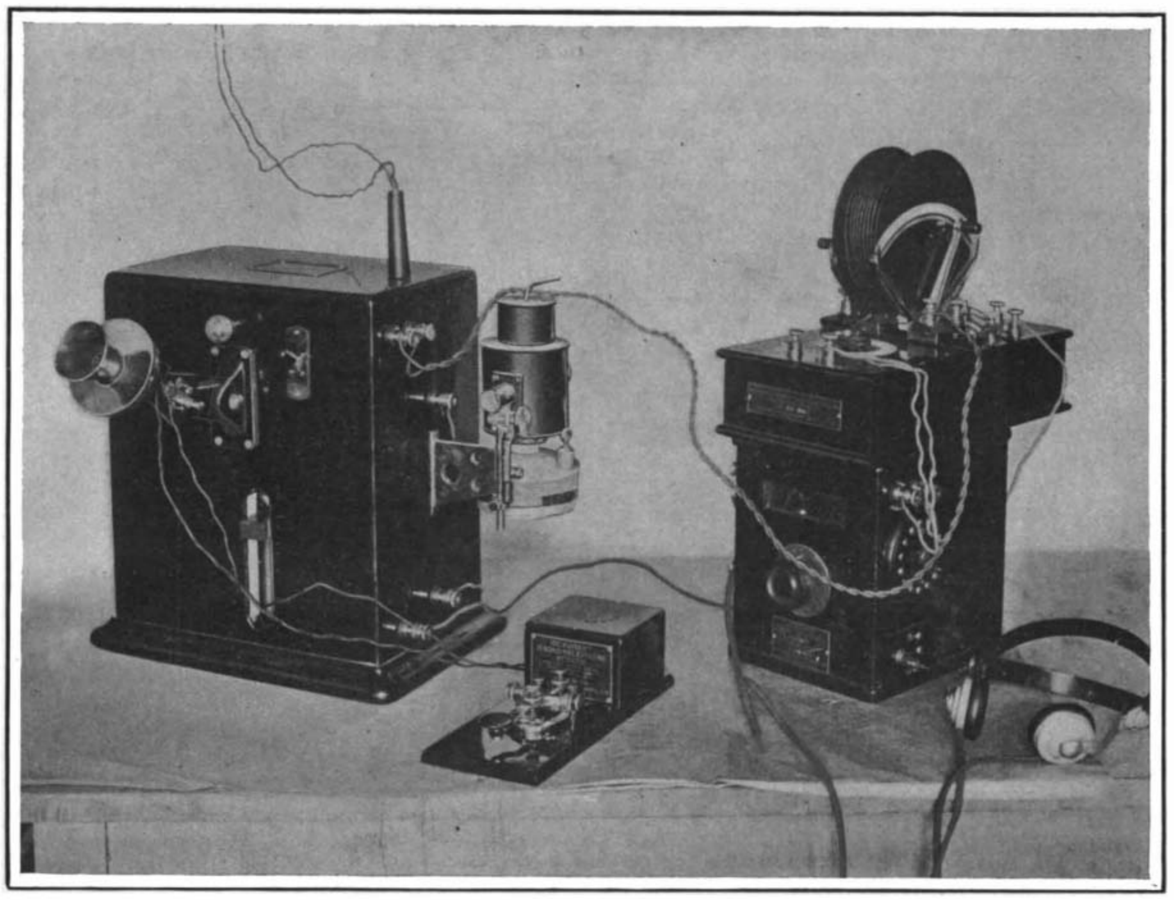


The Audion.

The Radio-Telephone Transmitter.

At the transmitting instrument current is supplied at 220 volts from the ship's lighting mains or other supply such as a small dynamo driven by an oil engine or a dynamotor using current at a different voltage. This direct current flows through choke coils which prevent the high-frequency alternating current from passing, and then goes to the oscillator, which consists of an arc maintained in the flame of a small alcohol lamp. The production of high-frequency alternations from an arc was first discovered by Duddell in England and has been investigated by several physicists and experimenters, so that it was comparatively easy for Dr. De Forest to adapt the principle to his transmitting apparatus, although the actual application and the construction of a practical device required most elaborate and careful experiment. These currents with a frequency of about 40,000 per second pass through the primary of the transformer as indicated, a condenser being interposed in the circuit. The secondary of the transformer is connected with the antenna or aerial wire of the usual type used in wireless telegraphy, and to the ground through the microphone of an ordinary telephone transmitter. By adjusting properly the two circuits it is possible to produce in the aerial wire oscillations that will cause waves of the desired frequency to be sent out into the air. Now the vibrations of the voice acting on the microphone cause the resistance of the carbon granules to vary, consequently the resistance of the aerial wire circuit varies, and this correspondingly affects the amplitude or intensity of the waves emitted from the antenna, not cutting them off absolutely as in wireless telegraphy. Examining now the diagram for the receiving instrument, a similar aerial wire will be seen connected to the earth through one coil of a transformer, while the circuit of the secondary includes two condensers, the audion with its storage battery, and the telephone with its cells. The electric waves impinging on the aerial wire set up a series of oscillations, which in turn are reproduced in the corresponding circuit of the transformer and affect the audion, causing the resistance of the gas ionized by the heat of the glowing filament to vary in proportion to the amplitude of the oscillations in the aerial wire, and the diaphragm of an ordinary telephone receiver is made to vibrate in the usual manner, reproducing the sound spoken into the transmitter.

The conditions outlined above and explained by the diagrams are realized in the instruments themselves, shown in the illustrations. Here everything is brought together and the adjustments reduced to a minimum, so that by observing a few simple rules there is no need for a trained operator. The illustration shows the complete apparatus for a single station, with the appropriate connections and all adjuncts except the batteries and aerial wires. It will be noticed that the apparatus is simple and compact, occupying little more space than the familiar wall set of the ordinary telephone. The transmitting instrument on the left will be recognized from the familiar microphone transmitter, while the instrument is shown again by itself somewhat enlarged. The conductor leading to the aerial wire passes out at the top of the case and the source of current is connected with binding posts at the rear. At the side of the box is the oscillator or arc inclosed in its nickeled casing with the alcohol lamp beneath. This lamp is lighted and the transformer coils contained in the case are adjusted so that oscillations of the proper frequency are produced and waves of the desired length are emitted from the aerial wire. The action of the arc is indicated by the small incandescent "pilot" lamp shown at the top of the box, which is acted on inductively by the current in the primary of the transformer and glows when the oscillation takes place. The tuning of the transmitting circuit is accomplished with the small handle moving in the slot at the side of the box, while a listening key is provided to enable the operator to connect at will the aerial wire to either transmitting or receiving instrument. There is also a telegraph key and a device resembling the ordinary buzzer which is termed a "chopper" by Dr. De Forest, shown in the foreground of the illustration, which by simply cutting out the microphone with a switch in front of its case, enables the apparatus to be used for wireless telegraphy, sending the ordinary Morse signals. In telephoning, the method is to send a few such signals to attract attention and then to switch onto the microphone or talking circuit. The receiving instrument is contained in the two boxes shown at the right of the illustration. On the upper box is the two "pan-cake" syntonizer or



Complete Equipment of Transmitting and Receiving Instruments for One Station.

THE DE FOREST RADIO-TELEPHONE APPARATUS.

tuning device consisting of two coils where the number of turns can be varied at will, and beneath an adjustable condenser and impedance coils, the whole being tuned of course to the sending apparatus.

The lower box, from which leads pass to the telephone receiver, contains the audion, already described and illustrated, which is provided in duplicate in case of possible mishap, together with suitable switches and resistances to enable the current from the storage battery for the lamp circuit and that from the dry cells for the telephone circuit to be regulated and used most effectively. The speaker has merely to put the telephone to his ear, using the listening key, and to talk into the transmitter. The simplicity of the apparatus commends it for naval use, as it enables communication to be maintained not only between the vessels of a fleet but with torpedo boats or dispatch boats on detached service in maneuvers or in action. Furthermore, there is a field for use in communicating with colliers and supply boats, not to mention lightships, lighthouses and shore stations generally. With the improvement and increase in the range of action which is bound to follow now that a practical success has been assured, the usefulness of wireless telephony at sea will be widely extended. As a fog signal and means of communication in thick weather, it promises to increase the safety of ocean travel. Wireless telephony has also important applications on land which are attracting the attention of the inventor, but the apparatus above described is of special interest as being the first to be installed on U. S. naval vessels.

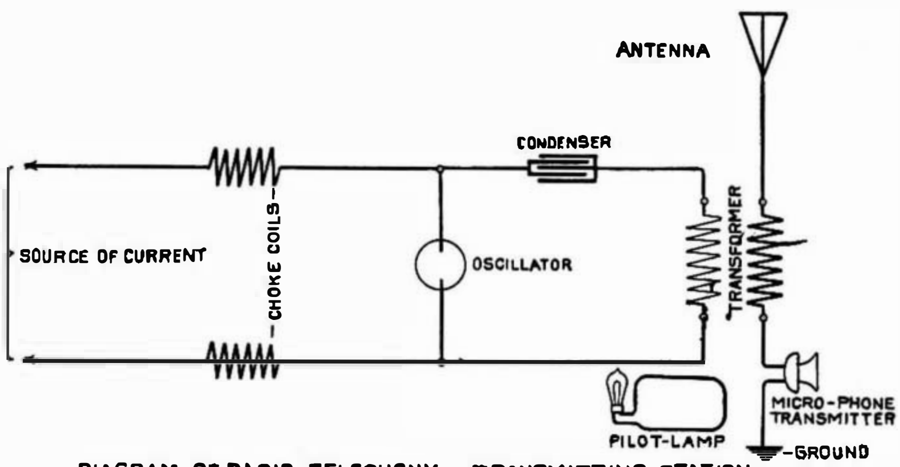


DIAGRAM OF RADIO-TELEPHONY TRANSMITTING STATION

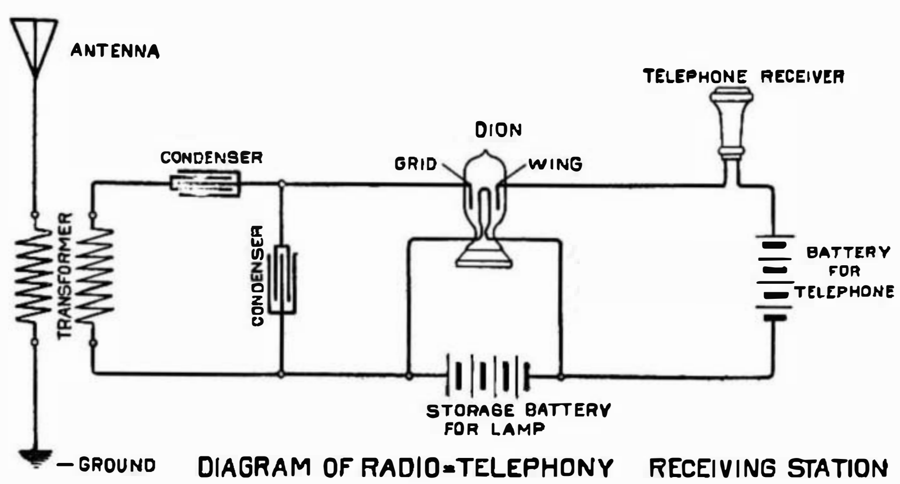


DIAGRAM OF RADIO-TELEPHONY RECEIVING STATION

WIRELESS TELEPHONY FOR THE UNITED STATES NAVY.

Stone Railways.

BY W. B. PALEY.

The real origin of railways is to be found, it has always seemed to the writer, in parallel tracks of stone laid down for wheel traffic, as distinguished from horse traffic, which could go anywhere. The nations of antiquity had, in many cases, got so far as this in the direction of railway making. How much further they would have got, had they not been swamped by the rising tide of barbarism, it is useless now to inquire. It is certain that there are plenty of examples of stone railways of great antiquity in Greece, Sicily, and the south of Italy. In 1842 a Mr. William Mure published in London "The Journal of a Tour in Greece and the Ionian Islands," undertaken four years previously. He seems to have been much struck by the many evidences that stone tracks were well known in that country in ancient times, and speaks of "the frequent occurrences of wheel ruts in every part, often in the remotest and least frequented mountain passes." These, he says, "are not to be understood in the sense of a hole or inequality worn by long use and neglect in a level road, but of a groove or channel, purposely scooped out at distances adapted to the ordinary span of a carriage, for the purpose of directing and steadying the course of the wheels. Some of these tracts of stone railway—for such they may in fact be called—are in a good state of preservation, chiefly where executed in strata of solid rock." Mr. Mure further argues that "the extensive use of chariots in ancient Greece, so conclusively proved by poetical tradition, could hardly have been possible without the aid of such roads." The famous ancient road through the Vale of Tempé, in Greece, is frequently seen ten, fifteen, and twenty feet above the present modern road. The ancient one is mostly in the solid rock, the worn sections being about twelve inches wide. This was a military road, but also over it were taken the blocks of marble from the Verde Antico quarries at Casambola, which were rediscovered some years ago and are now in full work. Near them is a raised road through the marsh, made about the time of Justinian (A. D. 483-565), which also has grooves in it. Here the grooves are due to wear of the longitudinal blocks, in the other case probably surfaces were dressed for the wheels on the rockbed itself, as may be seen, for example, on the Acropolis at Athens, where similar traces remain, with a transverse notching between to give foothold to the horses. A friend of the present writer, well acquainted with Greece, considers that the Greeks never made such good roads as the Romans, and that the best of the ancient roads in that country were probably laid by the Romans themselves during their domination in the early part of the Christian era.

There seems no reason to suppose the Romans used long slabs of stone in parallel rows on any of the hundreds of miles of road they built in Britain. The amount of wheeled traffic was probably far too small to justify the time and trouble getting, bringing, and placing them would have involved. In the medieval period, too, there was next to no wheeled traffic, in fact the roads were not good enough for it. But about the middle of the eighteenth century the improvement of internal communication began to be taken up in earnest; turnpike roads, canals, and tramroads were made in all directions, and in about fifty years the country passed from being one of the worst to the best provided in Europe. Many of the canal acts authorized the construction of "tramroads or stone roads," the former meaning railways with cast-iron plates having an inner flange to keep the wheels in place, the latter trackways formed of dressed-stone blocks placed end to end. These were laid in several important instances in the years immediately preceding the introduction of steam railways. The making of the great road from London to Holyhead by Thomas Telford was perhaps the largest public work undertaken till then. In several cases where an easier gradient than 1 in 20 could not be had without great cost, a stone track was laid, at less than half the cost, while the tractive force required on the latter, for the same weight, was not half what was needed on the unpaved portion. In fact, so successful were stone trams deemed, that when steam road traction began to show its powers, it was seriously discussed whether an extension of this system might not advantageously be laid down, at any rate between London and Birmingham.

A very fine stone railway or tram was laid along the Commercial Road, in the east of London, during 1828-30. This was expressly for the use of the heaviest traffic to and from the East and West India docks, and had granite blocks 16 inches wide, 12 deep, and 5 or 6 feet long, the intermediate space being paved with small sets. The reduction of friction was so great that it was estimated two horses could do the work that required three upon an ordinary macadamized road. The loaded wagons worked over this tramway weighed about five tons (11,200 pounds). It continued in use for many years, although the route is nearly level, and no special reason, except the heavy nature of the traffic, existed for its maintenance.

About the same time stone tracks were laid on the high-road between Coventry and Nuneaton, two busy towns in Warwickshire. In this case the blocks were only 12 inches wide, 9 deep, and 3½ feet in length, the intermediate space not being paved. There was a great deal of coal traffic by carts, a sort of work which cuts up ordinary roads badly. The distance from Coventry to Nuneaton is about eight miles, and the cost of laying such trams slightly exceeded £1,500 per mile. This, of course, would mainly depend upon the nearness of the quarry.

Such tracks, however, have seldom been laid for any considerable distance along British country roads. In almost every town, nevertheless, there are lengths of stone track, both in streets and backyards, that would probably amount to a considerable total if carefully reckoned up. In London there must be scores of miles of them. Almost every riverside wharf has one, and at the towns bordering on the Thames the same applies. At Brentford, in particular, there are a great many of them. Their age is uncertain, but many of the alleys through which they go contain houses fully two hundred years old. So lately as 1890, the bridge over the Thames at Battersea, London, was constructed with a stone track on each left-hand side, as far as the center. The blocks are 4 feet apart, 1 foot wide, and 4 or 5 long. The gradient is 1 in 31 on both sides. On the other hand, Southwark bridge, which is much steeper than that on the city side, has no track, and in consequence has always been more or less useless.

Some very massive stone tracks may be seen at Liverpool, in North John Street, and Exchange Street East, for example. The blocks are as much as 2 feet wide, 6 feet apart center to center, but the rise in both streets is so slight that they are not much wanted. The curious old goods yard of the London and Northwestern Railway at Edge Hill, Liverpool, has a fine stone track running up to the street level at Smithdown Lane. It appears to be part of the original Liverpool and Manchester Railway of 1830. An interesting bit of stone track runs from the Edgeware Road, London, down to the coal-yard at Kilburn Station, London and Northwestern Railway. It is made of the stone blocks used as sleepers when that line (then called the London and Birmingham) was opened in 1837, placed close together. A remarkable form of stone railway may still be seen in Devonshire, although a good deal of it has been wantonly destroyed within the last ten years. It ran from the head of the Stover Canal, near Newton Abbot in South Devon, by a circuitous and steeply rising course up to the Heytor Rocks on Dartmoor. These rocks are of the granite formation common about there, and rise in a very singular and rugged shape on the top of the down. They are visible, rising to 1,491 feet above the sea, for miles around in all directions. The railway was made by a Mr. George Templer, of Stover, for the purpose of bringing down stone to the canal, which is a small, shallow one made by his father in 1792-4. Blocks of granite, generally about 15 inches square but varying in length from about 4 to 8 feet, laid end to end, have a step or rebate cut on the outer edge, to form a wheel track. This step is about 4 inches wide usually, but probably has worn inward somewhat by the grinding action of the wheels. No means of preserving the gage are adopted, nor are the blocks attached to each other in any way. Except a certain tendency, especially of the shorter blocks, to sink at the ends when the ground was soft after rain, the line seems to have preserved its gage and level remarkably well, though no very high standard of either was required. Some two miles of it at the lower end disappeared about 1862, the course being taken for the Moreton-Hampstead branch of the South Devon (now Great Western) Railway; but after getting clear of the pottery works near Bovey Tracey, the tram will be found crossing the road on the level and following a lane for a considerable distance. It renders this lane quite useless for any but pedestrian traffic. A narrow brook is crossed by four huge blocks laid side by side, the center ones having each a groove for the wheels; the wagoners probably used the outside ones for a footpath. A wide moor succeeds, where the tram is so densely overgrown as to be hard to find, then it runs through the estate called Yarner, and out onto the bleak top of Dartmoor. Here it is very perfect and readily visible, the wind blowing so continuously up there that nothing grows except fine grass, which leaves the stones bare. There are several branches to different faces where the stone used to be won, at about 1,200 feet above sea, but some 300 feet below the actual summit of Heytor Rocks. Except that the iron tongues or points that guided the wheels at the junctions are gone, the line is practically as good at the top as it ever was. It was opened for traffic on September 16, 1820, the quarries being worked by the Heytor Granite Company. For some years they did a large trade in London, landing the stone at Grosvenor Wharf, Westminster. The west face of London Bridge (opened 1831) is of Heytor granite, also the columns of the General Post Office (1829), and the Waithman obelisk at Ludgate Circus (1833). The stone is a fine-grained porphyritic rock, which can be got in blocks of almost any size, but from the tie of the jointing is costly to quarry. This fact, and the competition of quarries nearer the sea, ruined the Dartmoor granite industry, and Heytor has been disused nearly fifty years.

The gage of the tramway was apparently 4 feet between the faces of the ledges or rebates which guided the wheels; but some blocks have tilted outward a little from the load not coming in the center line. The fall from the quarries to the canal must be at least 1,000 feet, so that loaded wagons ran alone a large part of the distance. They were very small and low, on four cast iron wheels nearly 3 inches broad and 2 feet in diameter. The leading vehicle was fitted with removable shafts for a horse. Other horses were, no doubt, sometimes used in tandem fashion. The absence of cross sleepers was, of course, very advantageous in horse traction, for which they are greatly in the way. Quite five miles of the course of the line are readily traceable, over the greater part of which the blocks were still down two or three years ago. Although it is a single line, there was not more than one passing place in that distance. A walk of about three miles from Bovey Station brings you to Heytor, where the most perfect part of the line remains, and the view from the top of the rocks, above it, is extremely fine on a clear day.

Some 16 miles southwest from Heytor are the remains of another derelict railway, formed by an Act of Parliament of 1819 for bringing down stone from Dartmoor to Plymouth. This was mainly laid with cast iron fish-bellied rails, but some of the sidings or passing places have short pieces of granite rail. In this case, the wheels having flanges in the usual way, the top of the blocks is dressed to a surface along the inner edge. The greater part of this line was opened in 1823; a small portion near Plymouth is still in use, and the company owning it, the Plymouth and Dartmoor, can boast of being the oldest railway company in the world.

In the American Cyclopædia, 1875, article Railroad, it is stated that on the Quincy Railroad in Massachusetts, opened in 1827, there were stone rails at the level crossings, the line being a short one for quarry purposes, like those just mentioned. There can be little doubt that good stone, in sufficiently large pieces, would be a stronger material for railway construction than the very light iron rails then used, where heavy weights and horse traction were used in combination.

Aeronautical Notes.

On Tuesday, the 10th instant, the first new military dirigible balloon to be constructed in England for the British War Department made its trial trip near Farnborough. Two trials of the airship were made on this date. In the first one, after a flight of about two miles had been made around Farnborough and Cove Common, the engines stopped, and the balloon settled down near some trees. The aeronauts threw out all the ballast (800 pounds) without being able to get the airship to rise. In this test the new dirigible stemmed a wind of fifteen miles an hour, navigating against it without difficulty, and traveling over the ground at about five miles an hour.

In the second trial the airship performed different evolutions, and completed a three-mile circle at a height of about half a mile. It afterward descended successfully near its shed.

This new dirigible is said to consist of a sausage-shaped balloon about one hundred feet long by thirty feet in diameter, which gives it a lifting capacity of about two tons. The balloon is provided with a framework of aluminium covered with canvas, on which are carried the engines and other apparatus. An arrangement is provided for keeping the balloon distended by means of ballonets, which are inflated in the usual way by blowers operated by the engines. Three men can be readily carried by this new airship.

M. Bleriot made a successful flight with his new aeroplane above the drill grounds at Issy, France, on the 17th instant. After running along the ground for a distance of about 75 yards, the machine rose to a height of some 50 feet, and flew a distance of 598 feet. The motor stopped working, and the aeroplane settled down rather abruptly, which damaged it somewhat and cut the daring aviator about his head. The distance covered in this flight is the nearest approach to Santos Dumont's record of 689 feet.

Thirty-four balloons ascended in clear air and, carried by a light wind, drifted southward over the field of Waterloo in an international balloon race that was started from Brussels, Belgium, on the 15th instant. This race was conducted by the Belgian Aeronautic Club, the prize being a silver cup donated by the club. The German balloon "Pommern," piloted by Herr Erbslob, won the race by descending at Bayonne, France, 621 miles from Brussels. A Swiss balloon was second, landing at the foot of the Pyrenees after covering a distance of 565 miles. Prof. Huntington, of England, was third, with a distance of 553 miles to his credit, while Mr. Rolls with another English balloon, the "Britannia," was fourth with 534 miles, the balloon landing at Sanguinet. An Italian balloon piloted by Usuelli covered 515 miles, and Herr von Abercron's German balloon came down at Carcans, 481 miles from Brussels. The contest was an extremely interesting one in view of the large number of balloons that competed.

The United States Army Signal Corps officers have recently established a balloon corps. This corps will be under the immediate charge of Capt. Charles De F. Chandler, and will also be under the tutelage of Leo Stevens, the well-known aeronaut and balloon constructor. It is planned to make ascensions from Washington in one of the new army balloons. It is also expected that within the next few months systematic ascensions and test flights will be made at Omaha, Neb., where the Signal Corps has a station, and where special arrangements have been made for the manufacture of compressed gas to be used in the balloons. The new corps will endeavor to learn in a practical way the advantages of the balloon for scouting purposes. In time, no doubt, this branch of the army will experiment with dirigible balloons and with aeroplanes, in the same manner as is being done by the leading foreign governments to-day.

Correspondence.

Apprenticeship System on the Pennsylvania Railroad.

To the Editor of the SCIENTIFIC AMERICAN:

I am in receipt of a letter signed W. S. Vanover, written from Lexington, Va., inclosing a letter from you to him under date of September 6, 1907, in which you advise him to enter the railroad university conducted by the Pennsylvania Railroad Company at Altoona.

There seems to be a pretty general misunderstanding as to what the Pennsylvania Railroad Company is doing in this respect at Altoona; and I thought it advisable, therefore, to let you know exactly what we are doing. Your letter referred to is certainly misleading. We do not conduct a railroad university at Altoona, in the ordinary acceptation of that term. What we do is as follows:

Young men, graduates of technical schools, either in the mechanical or engineering departments, are taken into our service in the mechanical departments as special apprentices, serving a period of four years in the different shops, offices, and laboratories of the company, thus fitting them for positions of responsibility with the railroad company.

In the engineering department these young men are employed as rodmen, from which position they are promoted according to seniority and ability to transitmen, assistant supervisor, and so on up into positions of importance and responsibility with the company. The maintenance-of-way men do not serve any fixed time in any of the positions referred to, but they are advanced accordingly as the vacancies occur and their abilities fit them for.

It will be observed from the above that we do not maintain a university or a school, in the ordinary acceptation of the term.

At Altoona, however, in connection with the public school system there is a manual training school, the higher branches of which are conducted in connection with the Altoona High School; and it is proposed to have this manual training course include a post-graduate course of approximately two years, thus giving special training to graduates of the high school in mechanical work, so as to make them better fitted for mechanical positions, not only with our company, but with any company with which they desire to become connected. The Pennsylvania Railroad Company is interested in this manual training school only to the extent that it increases the available material for them to draw upon for a higher class of mechanics; and for this reason the Pennsylvania Railroad Company donated a sufficient sum of money to properly equip the manual training school in the high school building.

G. W. CREIGHTON,
General Superintendent.

Test of Wellman's Airship in the Arctic Regions.

The following account, by Mr. Walter Wellman, of the first flight of his airship "America" in the Arctic regions may be of interest to our readers, in view of the fact that this test was the culmination of two winters spent in preparing the airship and two summers spent at Dane's Island with it in an effort to get it ready to start for the pole. The start was finally made on the 2d instant, and the following is a dispatch to the Lokal Anzeiger of Berlin, sent by Mr. Wellman from Tromsoe, Norway:

"After the steamer 'Express' cast off the cable, the balloon 'America' did excellently, but an increasing wind soon gave us a hard struggle, and the storm drove us toward some high, jagged mountains near the coast, where the airship would have been destroyed if she struck.

"There then ensued a hard fight between the storm and the motor. The latter triumphed, and we slowly rounded the north end of Foul Island in the teeth of the wind. Our confidence in the 'America' had so increased in the meanwhile that I gave the order to start for the north pole.

"The wind, however, increased to twelve miles an hour, and the snow fell so thickly that we could not see a quarter of a mile. Just then the compass failed to act owing to defective construction. We were completely lost in a snowstorm above the Polar Sea and threatened with destruction. After a brief deliberation we decided to try and get back to the 'Express' to rectify our compass and start again.

"It was impossible, however, to keep in one direction, and we were again carried into dangerous proximity to the mountains. Vaniman, the engineer, then started the motor at top speed, and the 'America' moved a second time against the wind, which probably was blowing fifteen miles an hour.

"She circled three times in the teeth of the wind. We saw the 'Express' for a moment, but immediately lost her again. We would have returned to the 'Express' if we could have seen where to steer, but under the circumstances the only thing possible was to try to land. With this idea we stopped the motor and let the 'America' drift over the glacier.

"At the end of Foul Bay we used a trailer filled with provisions and a brake rope. Both acted well and dragged over an ice wall 100 feet high without damaging the provisions.

"After crossing the glacier we opened the valve, and landed on the upper glacier, half a mile inshore. The landing was effected so successfully that material weighing nine tons descended three hundred feet and touched the ice with no shock or damage whatever excepting several bent tubes and broken wires. The numerous delicate instruments were not injured. The self-registering barographs, meteorographs, and manometers continued running after the landing. The mantle of the balloon can easily be repaired.

"The 'America' was in the air for three hours and fifteen minutes, and covered about fifteen miles with her own machinery. She made three loops against the wind, proving her power and capability of being steered. The ascent was successful in every respect. The 'America' is from every standpoint the strongest airship and the most durable for a long journey that ever was built. She held the gas splendidly.

"Later in the same day the 'Express' found us, and fetched the steamer 'Frithjoff,' with men and sledges from the camp. The crew of the 'America' lived for three days comfortably in the gondola while the work of rescuing the balloon was in progress. They could have lived there for nine months had it been necessary. The entire airship, including even a part of the gasoline, was returned to the camp in three days.

"The balloon and the entire outfit have been made ready for the winter, and three men have been left on guard.

"After this successful attempt we were all convinced that the 'America,' in normal summer weather, can make her way to the pole. We all regard this plan as rational, practicable, and feasible. The thing can be done, and what can be done shall be done."

The Current Supplement.

Advances in the construction of telescopes and other astronomical instruments have enabled scientists to make new discoveries far surpassing those made even a few years ago. "Recent Progress in Astronomy" is interestingly written about and fully illustrated in a lengthy article in the current SUPPLEMENT, No. 1656. The efforts made to obtain turpentine and other products from waste wood are described by J. E. Teeple, Ph.D., and J. S. Miller writes on asbestos, a useful mineral, of which the supply is insufficient. Few toolmakers know how to test with any precision the grade of a bar of steel. In an article on "The Spark Method of Grading Steel," Albert F. Shore, M.E., describes a method of testing steel with an air blast. The first of a series of practical articles on the "Elements of Electrical Engineering" is written by Prof. A. E. Watson, and an illustrated note on "Automatic Speed Control for Magnets" will also be of interest to electricians. The Cape to Cairo railway, dreamed of for years by Cecil Rhodes, is gradually becoming fact; from its southern end it now stretches through northwestern Rhodesia toward the Congo Free State frontier. Our English correspondent describes and illustrates one of the features of this length of line—the building of the longest bridge in Africa. The fifth of J. H. Morrison's articles on "The Development of Armored War Vessels" brings us to the verge of modern construction. Dr. A. Gradenwitz contributes a valuable note on the "Cause of Vitiation of Confined Air." We have several times lately referred to archæological research in northern Africa; much of this work has been done by European investigators. In the current SUPPLEMENT the Egyptian work undertaken by the New York Metropolitan Museum is described.