clearer, let us employ, not only as a mere analogue, but as a similar proposition, the fact that electric oscillations emit electric waves, just as an electrically charged vibrating atom sends forth waves which are likewise of electromagnetic origin formed by the polarization of the ether. Even alternating currents of comparatively low frequency of a few thousand per second will emit long electrical waves in space, as Guarini has shown in his experiments in wireless transmission between Antwerp and Brussels. The length of the waves depends on the periodicity of the oscillations, the oscillations on the inductance, capacity and resistance of the circuit, and these in turn on the constants of the ether.

The constants of the ether are its elasticity and its density. The elasticity of the ether is not known absolutely, but is measured by its reciprocal or dielectric constant, which is the ether modified by its relations with gross matter, and is called its specific inductive capacity. Ether, when in close proximity with gross matter, apparently assumes a greater density than in vacuo or free air, however paradoxical it may seem; it is now well known that it is not the conductor or wire joining an electrical circuit which conducts the electricity, but the tube of ether including the wire. The atoms of which the earth is composed are likewise permeated with the ether to a much greater extent than the atoms of gases forming the air. To this condition Tesla has given the name of *bound* ether. Similarly as mediums of greater densities transmit sound waves to greater distances than mediums of lesser densities, so the bound ether of the earth will propagate electric waves of proper length to greater distances than those of the ether-bound air. As an illustration, in the case of sound waves, if a bell is struck in free air it can be heard at a distance of a mile, it could be heard at a distance of twelve miles if struck under water, for water has a density twelve times that of air; now, when a rapidly alternating current of high potential is discharged into the earth and there allowed to restore the equilibrium, electric waves are emitted and propagated through the earth; the length of the waves is determined by the frequency of alternation and the distance of propagation will depend upon the density of the medium.

These waves are, of course, normally radiated in every direction, but it has been found possible to reflect them and so make them unidirectional within certain limits. Fig. 1 shows photographically the wireless telephone transmitter the author devised for field work. Fig. 2 is a diagrammatic drawing of the system which has been patented in the United States and Great Britain. In the patent specifications a telegraph key is substituted for a telephone transmitter, as the system is interchangeable and may be used either for wireless telephony or telegraphy with some minor changes and additions.

Referring to Fig. 2, *A* is a transmitter and *B* the receiver. The primary coil is shown at 1 and is in series with the battery, 2, and the key, 3. One terminal of the secondary winding, 4, is connected with a special form of transmitter, 6, and this to a large capacity, 7. The opposite terminal of the induction coil is earthed at 8, and bridged across the terminals of the secondary is the condenser, 9; 10 is a "variator," which will be again referred to. The receiver is quite simple and consists essentially of a transformer coil, 1, a telephone receiver, 2, and a battery, 3; the condenser, 4, of large and equal capacity to that employed in the transmitter, and 5 the earthed terminal.

The action of the instruments is as follows: When the key, 3, closes the primary circuit the current is automatically varied by a special device, 10, which takes the place of the ordinary interrupter; this produces alternations in the secondary coil, 4, giving rise to high potentials at the terminals, 7 and 8. This potential difference is, however, modified by the transmitter, 6. The surging of the alternating currents through the circuit formed by 7 and 8, emits waves principally at 8, and these traveling with the speed of all other electromagnetic waves reach the earth plate, 4, and, finding an ether path of greater density surrounding the circuit, 4 and 5, it traverses that circuit in preference to passing onward through the earth, since the former offers the least resistance. This sets up alternating currents in the transformer coil, 1, and these are impressed on the telephone receiver, 2. The capacity areas, 4 and 7, should be large and of special construction to secure the best effects. The capacities, 4 and 7, are not elevated, and the larger the capacities the greater the distance over which articulate speech may be carried without wires.

Both the transmitter and receiver are mounted on tripods providing the operators with testing apparatus almost as portable as a camera. The tests, from the incipiency of the idea of wireless telephony, have been made at Narberth, Pa., where the conditions were all that could be desired. In 1899, speech was transmitted by this system a distance of 200 feet; in 1900 a mile was covered, when with the equipment shown in the engravings articulate speech was transmitted across the Delaware River at Philadelphia, and in 1902 with the instruments placed on hills separated by a railroad, valleys, wooded lands and numerous streams a distance of three miles was attained. The results have shown the possible commercial value of this system of wireless telephony, which is soon to be perfected for actual use.

## THROUGH THE SUEZ CANAL ON A MAN-OF-WAR.

BY H. H. BYRNE, U. S. N.

About noon, August 14, 1901, the U. S. gunboat "Castine," then returning from the Philippine Islands, dropped her anchor at Port Tewfik, once called Port Abraham, the southern terminus of the Suez Canal. It is not the city of Suez that is located here, as is generally supposed, for that city lies about three miles to the northwest of this place.

The city of Port Tewfik is an exceptionally small place, the inhabitants hardly exceeding a few hundred, in fact the only evidence of life is a few wandering Arabs along the quay, and an occasional donkey or camel. You cannot form your opinion from these observations, however, for at the noon hour very nearly all of the inhabitants are taking their daily siesta, an essential requisite for anyone desiring average health in Egypt. If you wish to see Port Tewfik, go ashore at sunset, then you will see on the water front roadway the inhabitants taking their daily walk or drive; for all are more or less interested in the ships just arrived from the Red Sea and Port Said.

About sunset the pilot came aboard and announced everything ready for our trip "across the desert," which we were to make during the night, an immense searchlight having been rigged over the bow for the purpose. After a few moments' delay, caused principally by the natives remaining on board until the very last second in their efforts to make just "one more sale," we "up anchored" and started on our journey.

### THE GREAT SUEZ.

The plans for the construction of the Suez Canal were by no means originated by De Lesseps, for as early as the year 1640 similar ideas were entertained but not matured because of an existing superstition. The Red Sea was thought to be above the level of the Mediterranean and any connection of the two would only result in the disastrous flooding of that entire part of Egypt. De Lesseps, however, deserves the distinction of bringing the possibility of his plans before the eyes of the world sufficiently well enough to warrant its commencement and of directing its construction to complete success. A company was formed and after obtaining the consent of Egypt, Turkey, Russia, France and Austria, but not of Great Britain, work was actually begun under the immediate supervision of Daniel Lange in the year 1858, just six years after its idea had originated with De Lesseps. In its first stages forced labor was universally used; this was, however, objected to by Egypt and was stopped soon after; in 1862 the waters of the Mediterranean were connected with Lake Temsah by means of an artificial channel independent of the canal. The existence of this and other lakes in the immediate vicinity and by reason of evidence found in the canal's construction, serve only to corroborate the sayings of geologists that the Mediterranean and Red Sea were at one time one body of water. In the early part of 1869, that part of the canal between the lakes and the Mediterranean was opened to traffic. While this section was in progress, there was at the same time a connection being made with the Nile and the lakes and from this vein a connection with the Red Sea via Suez; in 1869 a complete passage from sea to sea was announced and in the same year this passage was made by Clarence Paget, an English lord, the itinerary of the trip being from the Mediterranean to Lake Temsah by the smaller or independent route, then through the main canal to Bitter Lake and then by the fresh water route into the Red Sea. In addition to irrigating the land in its vicinity, this water-way served as a reservoir to the cities of Port Tewfik and Suez, a decided necessity at those places, for previous to that time, a great portion of the inhabitants used water imported from so great a distance as Cairo and Alexandria. In November of the year 1869 the main canal opened for traffic in the presence of the Emperor of Austria, Empress of the French and Viceroy of Egypt. Thus in eleven years the greatest feat ever attempted in engineering was successfully performed in spite of the incessant predictions to the contrary by some of the leading engineers of that time. I will quote here an article taken from the Edinburgh Review concerning the possibility of constructing a breakwater at the Mediterranean entrance. It says:

"Any construction attempted so as to form an entrance for the canal will be swallowed up. Every block, every stone will be swallowed up, and we shall not see a single one above the water."

Although in 1869 a passage was made by direct route from England to Australia in about two-thirds the time formerly required, it should be remembered that several years before that time it could be done also, only by a more complicated passage, for as early as 1863 ships leaving Liverpool and Marseilles traversed the Mediterranean bound for the Suez Canal where their cargoes were discharged into lighters of light draught and towed by tugs to Port Tewfik where they were again discharged into large steamers in waiting bound for India, China and Australia. This seems to have been a complicated mode of transportation, but when the only other routes are considered, those of Cape Horn and the Straits of Magellan with their danger to shipping as well as the increase in distance, it is easily proved that the Suez route was the better of the three. The advantages of this passage were three-fold, in addition to the facilities gained in shipping, the voyage was made under circumstances more agreeable and in much shorter time to the East, and last but not the least important, it yielded a revenue to the Canal Company much needed at that time, for in view of the adverse predictions as to the canal's success, funds were not freely appropriated by the French government, who were then fostering the enterprise.

By 1870 the canal's traffic doubled that of the year previous; in 1875 that number was quadrupled; during the year 1880, 2026 vessels passed through, or between five and six a day; in 1882 this increased to eight a day; during the year 1890, 3389 passed through, between nine and ten a day; over 74 per cent of which were British; the total receipts for this year were about $12,500,000, at an average cost of between three and four thousand dollars' toll for each ship, and of this amount $5,000,000 was spent in the maintenance of the canal, thereby giving a net profit of $7,500,000 to its owners.

In 1873 the charges for toll were doubled; this action caused the British shipowners to ask for a national conference which was held at Constantinople in December of the same year; this was followed by a protest from De Lesseps; his agent, Mr. Lange, informed those at the conference that unless back dues were paid the canal would be closed to their traffic. After much discussion the matter was compromised to the satisfaction of both parties. In May, 1883, trouble again occurred between England and the Canal Company, whereupon the former determined to build a second canal; for this purpose a syndicate was appointed and met in November of that year, but before any action was definitely agreed upon De Lesseps compromised by agreeing to reduce the rates and to widen the canal. This practically ended trouble of any serious nature between these parties and since that time England has purchased Egypt's shares, whereby she now owns an extensive controlling interest in its administration.

In view of the construction of our own canal, about to be begun, a few remarks here on the construction of the Suez will give a faint idea of the labor necessary. When the forced labor was finally prohibited by Egypt the company was confronted by very grave obstacles. Necessity, however, soon invented a steam dredge which after many experiments worked successfully; tracks were built on either side of the route on which these dredges mounted on cars traveled; by means of an arm, an endless chain with scoops attached was so arranged as to drag from the middle of the ditch inward; this dirt was carried away by hand labor, horses, mules and camels. Among the laborers were immigrants from most of the countries of southern Europe; the officials arranged matters so that these helpers would be assorted into gangs of their own nationality thereby averting any race trouble likely to occur. They were paid in money for the amount of work performed, making from one to two and a half shillings a day. The amount of work done was determined usually by the cubic contents of earth removed. In the construction of the canal before it was finally widened the total excavation reached 80,000,000 cubic yards; this, however, has since been greatly increased, as the latest statistics give a total length of 100 miles (20 miles of which is lake) depth 31.2 feet, bottom width 108.2 feet and surface width 420 feet; these dimensions will allow the passage of any ship drawing not more than 25 feet of water. The British cruiser "Powerful" on her passage from England to China was obliged to go by way of Cape Horn because her draught was above the standard.

The rules governing ships while making the passage are many; a few of the more important are that every vessel is required to have a pilot; the captain of each ship is required to furnish, before entering, a complete list of passengers on board, for each of which a toll of $2.50 is charged; in cases of merchant vessels and men-of-war a copy of the muster roll is required; all life boats must be rigged inboard, a cutter shall be towed astern carrying the end of a hawser, to be used in mooring the boat aside to allow the passage of another steamer. Ships having made over half the passage are allowed the right of way, and mail steamers are allowed the right of way at all times.

# SCIENTIFIC AMERICAN

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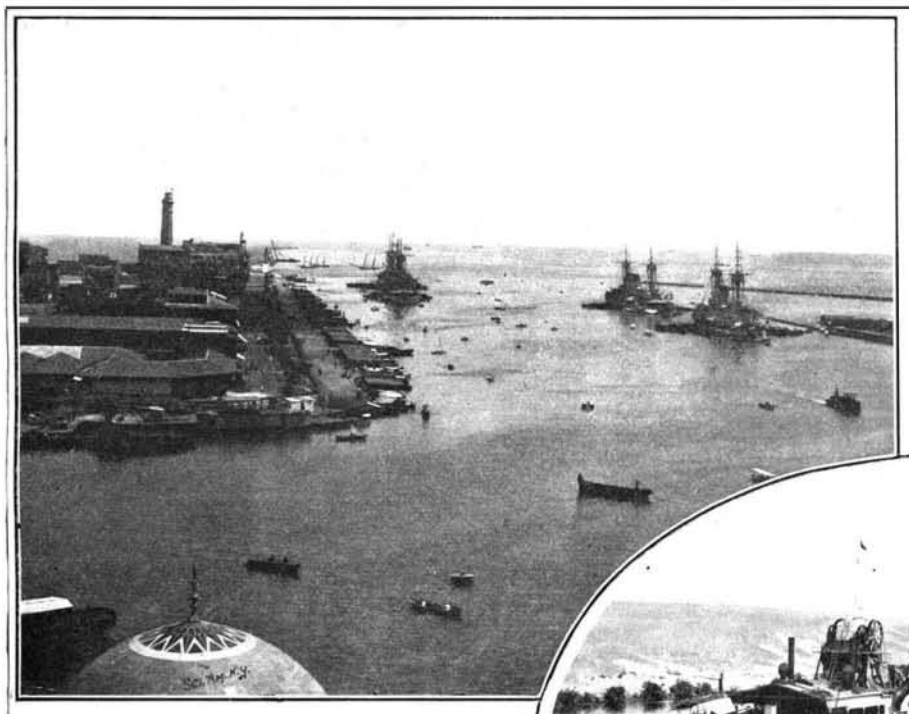
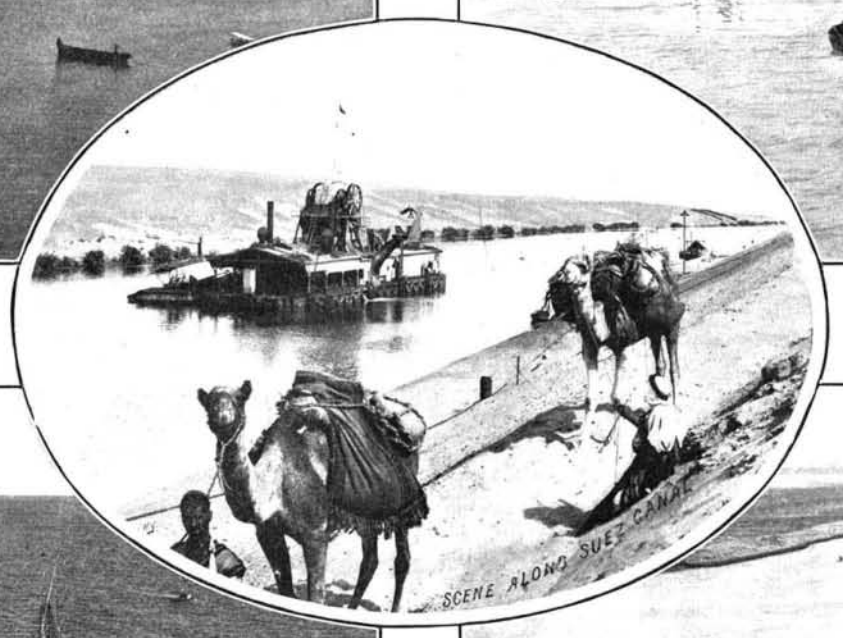
Vol. LXXXVII.—No. 3.
ESTABLISHED 1845.

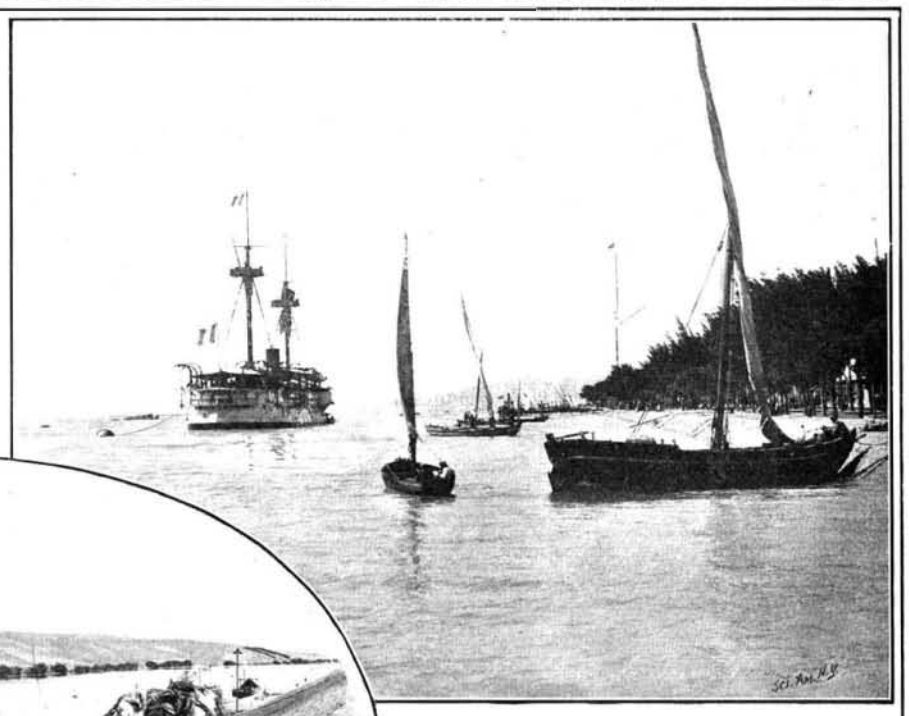
NEW YORK, JULY 19, 1902.

$3.00 A YEAR.
8 CENTS A COPY

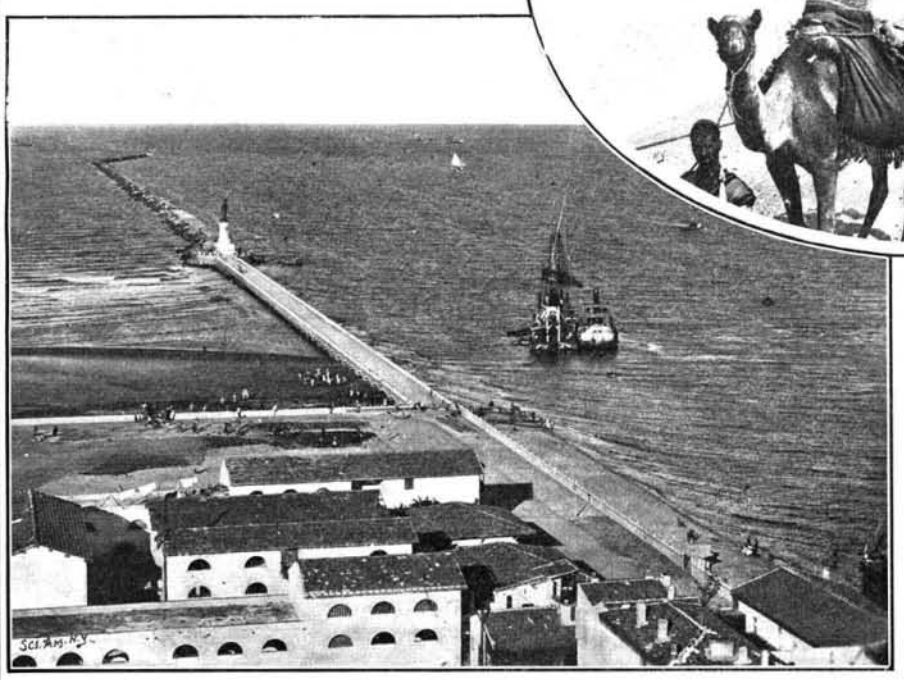



Port Said.

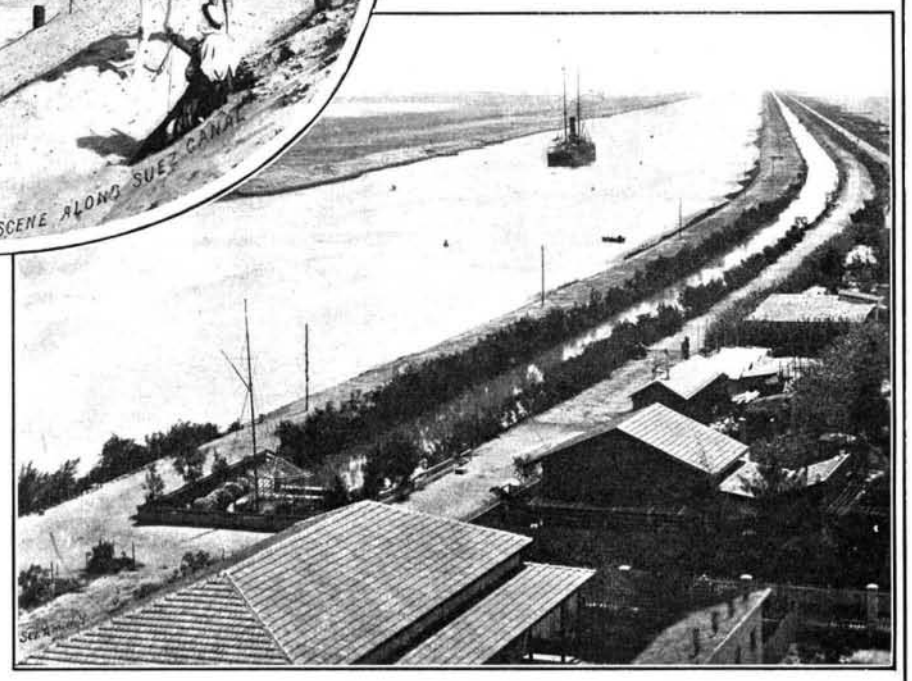


Entrance to the Red Sea.



The Mediterranean Sea from Lighthouse.



The Suez Canal with the Fresh-Water Canal Adjoining.


The West Breakwater with Statue of De Lesseps.

**THROUGH THE SUEZ CANAL ON A UNITED STATES WARSHIP.**—[See page 38.]

The total cost of the canal when completed was $102,750,000.

The next place of interest is the city of Ismailia, situated on Lake Temsah; this is the central point of the canal and is a comparatively large town, its inhabitants numbering about 5000 (mostly French). The homes of the pilots are situated here; there are also hotels, shops, cafés, a theater and a central railway station. The remainder of the trip is of little interest aside from camels and their masters who can be seen bound for different parts of the desert.

On arrival at Port Said we completed our journey in fourteen hours. The first thing to take the eye at this place is the activity of the port; here are assembled ships of every nation, some coaling or discharging cargo, while from seven to eight are probably awaiting their turn to enter the canal. The city of Port Said is, in comparison to cities in that part of the world, a modern place; previous to 1860 it was not in existence, but since the building of the canal, it has developed from a camping center into the "half-way house" of the East and West. At the latest census it had a population of 10,000, consisting more or less of a mixture, representing every nationality on the face of the earth. The streets are wide and very clean, and as for places of amusement, it has its share of music halls, their incomes being principally derived from travelers stopping at the place on their way through the canal. One of the principal points of interest is the light-house, a structure 180 feet high, and for many miles at sea it determines the entrance of the canal.

It was in the making of this entrance that De Lesseps found his greatest opposition; his opponents predicted that the constant supply of mud and sand brought from the interior of Africa by the Nile would block any plan devised for the canal's entrance at this place. He persisted, however, and constructed two breakwaters, one on either side of the canal to converge toward the sea entrance; these walls were made of stone carried from a great distance and at enormous cost. When partly finished, artificial stone was made on the spot and was used in its completion.

On the western breakwater about a mile from shore is situated the statue of Ferdinand de Lesseps, with his right arm raised and his hand pointing to the south; you almost imagine you can hear him say "My canal."

### The Boston-New York Motor Bicycle Endurance Test.

The first long-distance endurance test of motor bicycles that has ever been held was that which took place on July 4 and 5 over the 254 miles of road leading from Boston to New York. The course was divided into ten controls, and each contestant was allowed a certain minimum and maximum time to cover a control. A perfect run through every control gave the contestant 1000 points, and unlike what has heretofore been the rule in other endurance tests, if he failed to make a control within the maximum time limit, he was not out of the test altogether, but, upon reaching it, was given a certain number of points.

Out of thirty-one starters, seventeen succeeded in reaching Hartford, Conn., the halfway point. Most of the machines that failed to reach this point gave out before traveling seventy-five miles of the journey. The following day, out of the seventeen survivors at Hartford, thirteen succeeded in reaching New York. This was a remarkably good showing, considering the state of the roads, which were rutty and very muddy. The test was a most severe one to riders as well as machines, and many tumbles were reported on account of the slippery roadbed. One of the contestants was so badly hurt from a fall that he had to be carried to a hospital.

The performance of the machines of several of the first motor bicycle manufacturers in the country shows that those earliest in the field have profited from their experience and are now producing perfectly practical motor bicycles, which on good roads are capable of carrying a rider at fast speeds with safety and without breakdowns. The winning of the contest by one of these manufacturers, who had entered but a single machine, speaks well for the reliability of his motor and the general construction of the bicycle.

Clothed with the authority of the Naval Appropriation Bill, Secretary Moody has given orders for the construction, at Brooklyn, by the government, of a 16,000-ton battleship. The Department will begin working out the detail plans immediately; and it is hoped that the keel-plates for the vessel will be laid in about eight months.

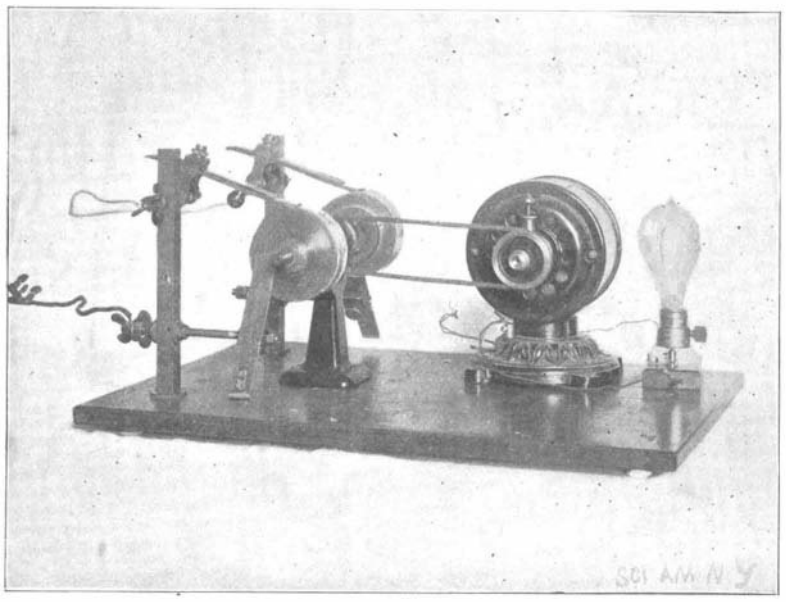
In order to determine the condition of New York city's air, Street Cleaning Commissioner Woodbury is exposing gelatine plates to collect germs.

## Correspondence.

### THE GRISSON CONTINUOUS-ALTERNATING CURRENT TRANSFORMER.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 28, 1902, an illustrated description of the Grisson continuous-alternating current transformer, by Mr. A. F. Collins, occurs on page 452. Possibly some of your readers who are occupied with wireless telegraphy may care to hear further details regarding the practical working of an identically similar apparatus, independently devised by myself over four years ago to actuate an induction coil containing a primary with two circuits, so that the secondary discharge would be alternating in character. Although the apparatus was consigned long ago to the junk shelf, it happens to be still in my possession; and, as can be seen from the accompanying photograph, its plan is identical to that figured by Mr. Collins. At the time I attempted to satisfactorily employ this form of double rotary current distributer for the above-mentioned purpose, it was used in conjunction with both core transformers and induction coils in which the primary circuits were doubled, as figured by Mr. Collins. With neither type of apparatus, however, were satisfactory secondary discharges obtained, while considerable pyrotechnics always occurred at the brushes unless the current transmitted was kept below two or three amperes and two separate condensers were connected across the brushes of each wheel. With an induction coil giving normally a spark of eight inches, a spark of only one inch could be had without condensers, and one of two and a half inches when suitable condensers were used. When shunted by the condensers, the contact maker would usually run for a few moments with very slight sparking at the brushes, but frequently either at one or both brushes a prodigious flaming would occur, accompanied by a sudden increase in the primary current from three to forty or fifty amperes, when the 115-volt continuous current formed the source of supply. Hence the discharge was extremely irregular, and the wear and tear upon the mica insertions of the wheels so great that after very brief runs truing was required. By employing in the above-mentioned induction coil a primary wound with four layers along its whole length, which were connected so as to use the inner and outer layers in series for one circuit and the two middle layers in series for the other, thus approximately equalizing the inductances of the two circuits, the length of the spark obtainable from the secondary was increased to three and a half inches, although the behavior of the contact wheels as regards the constant tendency to flame was unimproved. When core transformers were used instead of induction coils, the results were equally as unsatisfactory. When several cells of storage battery supplied the current, the sparking at the brushes, as would be expected, was much diminished, but the performance of the induction coil was nothing like as good as when the usual spring vibrator was used to interrupt the current.



ALTERNATING CURRENT TRANSFORMER.

From the preceding experiences it appears that this method of directing the current first through one winding of the primary, and then leading it suddenly in the reverse direction through the other winding, does not cause a variation of the primary current at all suited to induction coils. If, however, the current through either primary winding is suddenly interrupted when at its maximum value, and suitable condensers are connected as usual across the break, the spark length of the secondary alternating discharge fully equals that obtained from the same induction coil as if it were actuated in the orthodox fashion. Although the employment of this high-potential alternating discharge is found to be necessary for actuating a special form of X-ray tube used in my form of the stereo-radioscopic apparatus, it seems to me that nothing is to be gained by using it for wireless telegraphy, unless the complex method necessary to produce such a discharge absolutely eliminates all the various disturbing factors which arise when other well-known devices are used to interrupt the primary current.

R. H. CUNNINGHAM.

### Galileo Ferraris Prize for Inventors.

The committee for the "Galileo Ferraris Award," instituted in 1898, have decided to open an international competition for the award of said prize on the occasion of the unveiling of the monument to Ferraris, in Turin, in the latter half of the month of September next. The award is 15,000 lires ($3000), together with the compound interest accumulated since the year 1899 up to the day of the award. The prize will be granted to the inventor of some practical application of electricity likely to lead to noteworthy progress. Competitors may submit either pamphlets, projects and drawings or machines, apparatus and appliances relating to their invention. The jury has full power to cause practical experiments to be made with the inventions entered for competition, and upon the corresponding apparatus. Competitors are to file their applications and deliver their credentials appertaining to their invention not later than 6 o'clock P. M. on the 15th of September, 1902, at the office of the secretary of the committee, care of the Administrative Committee on the First International Exhibition of Modern Decorative Art in the buildings of the Chamber of Commerce and Art, 28 Via Ospedale, Turin, Italy.

### Proposed Steel Automobile Road.

The Steel Roads Committee of the Automobile Club of America is making rapid progress in its work, and through its energy, together with the liberality of the United States Steel Corporation and the hearty co-operation of the city authorities, a thorough demonstration will very soon be made in this city of the merits of the steel highway system under various conditions of service. The chief difficulty was to get the special shape of steel rolled; none of the outside mills were willing to furnish it, or even to take an order for regular sizes requiring prompt delivery, but when Chairman Seligman of the committee met President Schwab he found him in full sympathy with the movement, and ready not only to furnish the special forms and deliver them promptly, but to contribute the steel for a mile of road as a gift. General Stone, the designer of the proposed road, has already conferred with the steel corporation's experts on the details of construction and the material will be delivered in six weeks. President Cantor has shown a warm interest in the affair, and by his direction Chief Engineer Olney is to recommend suitable locations for sections of the road. It is intended to place one in the heavy trucking region down town, another in a street of general travel, and a third on a suburban earth road. The track plates will be 12 inches wide and will be laid on special foundations of broken stones. An English engineer, who recently inspected the steel road at Valencia in Spain, reports in the highest praise of it in every particular. This road has been in use for ten years.

### The Current Supplement.

The current SUPPLEMENT is one of the most important which has appeared in some time. The first article is an interesting illustrated description by E. C. Rost of the methods of cultivating coffee in Brazil and in the Philippines. Antarctic exploration just now is occupying the attention of many geographers. For that reason Edwin S. Balch's discussion of the subject is rather timely. A new census machine is described and illustrated. Frank C. Perkins writes entertainingly of vertical direct and alternating generators used in Switzerland. Capt. John Stephen Sewell discusses the important subject of electricity in its application to submarine mines. A very complete paper on blue-print and black-print photographic papers and their preparation, from the pen of Mr Alfred I. Cohn, is of rare value. The new model filter plant of the city of Middletown, N. Y., is described in a handsomely illustrated article. Prof. Henry S. Jacoby read before the last meeting of the American Association for the Advancement of Science a most valuable paper on the recent progress in American bridge construction. That paper is published in full. Two technological articles, one on the "Making of India Ink" and the other on the "Recovery of Rubber," are of exceptional value. The usual Consular Notes and Selected Formulæ will be found in their accustomed places.