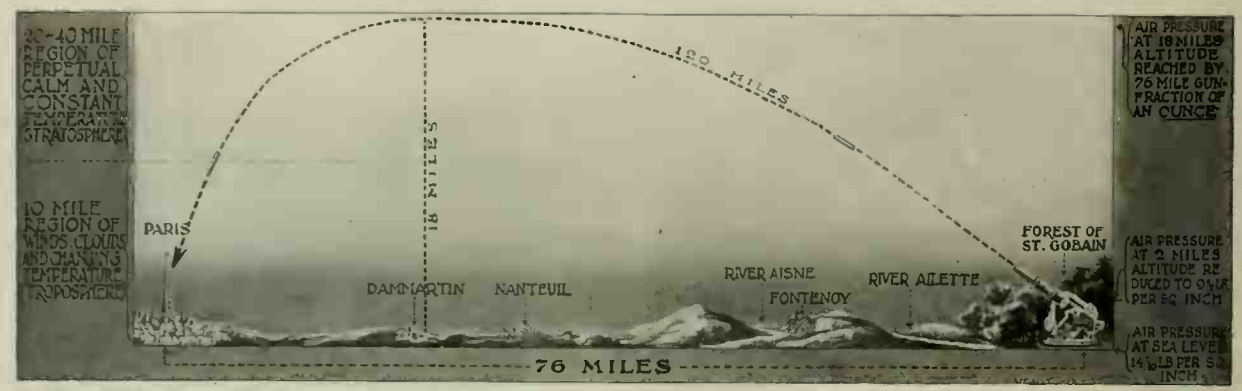
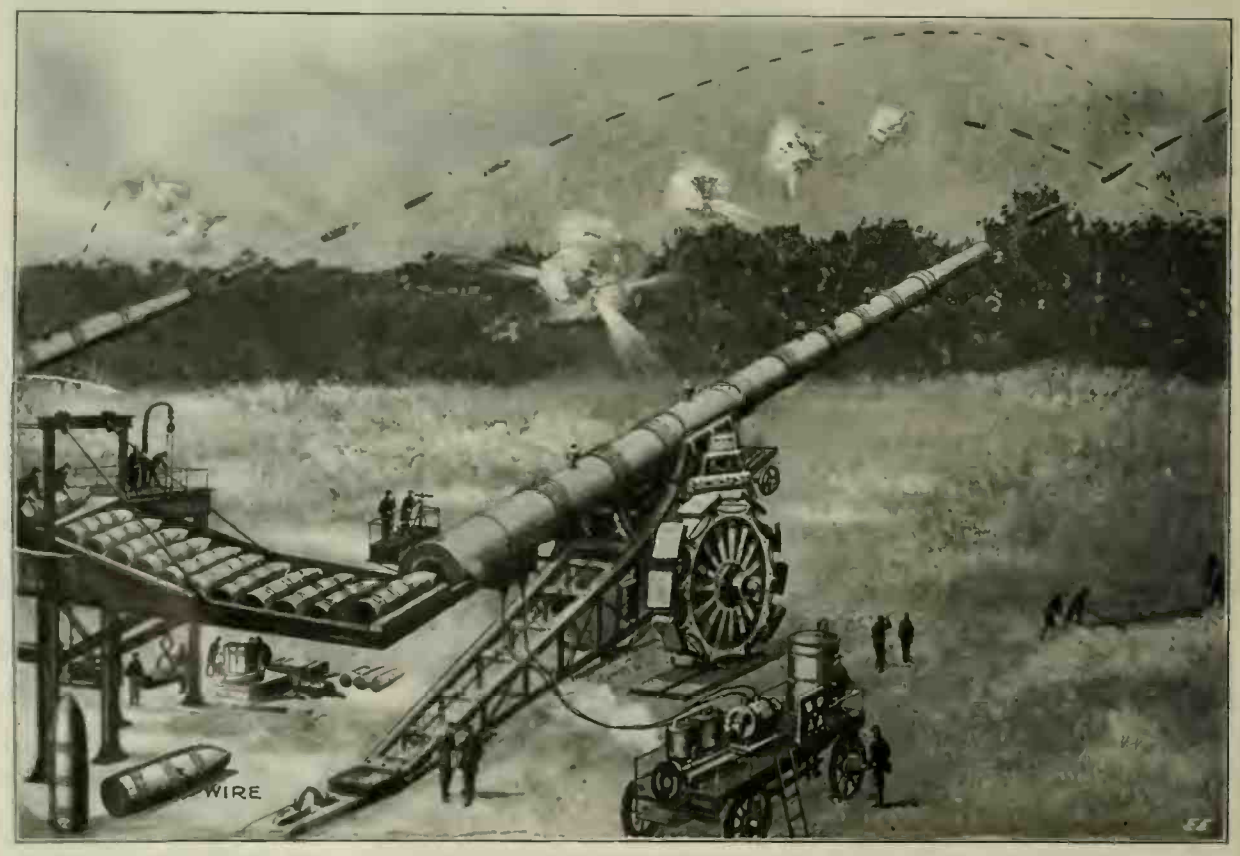
A 100 Mile Electro-Magnetic Gun

GREAT GUNS!!! That's what everyone is talking about these days, when the Teutons have succeeded in hurling nine-inch explosive shells into the heart of Paris from a monster cannon located at a distance of seventy-six miles away, safe within the German lines. The bombardment of Paris was started with two of these super-cannon, which were presently spotted by Allied aircraft observers as being situated in the Forest of St. Gobain, west of Laon. The first shells landed at intervals of about twenty minutes and did considerable damage to buildings, but caused relatively few casualties. At first it was thought that possibly enemy "bombing planes" were being utilized, flying at very high altitudes of say 25,000 to 30,000 feet, which, when properly camouflaged, would defy detection from the ground. When the Allied air scouts located the gigantic guns, however, it became evident that the wily Germans had conceived and executed another psychological grand-stand play in the form of a cannon that could actually bombard Paris from within their lines. The longest range attained hitherto with the standard 16 and 18 inch naval and coast defense guns has been in the vicinity of 25 miles. Ordnance experts have shown, however, that were it possible to build a successful 16-inch gun carriage that would support and absorb the recoil of such a standard gun at 43½ degrees elevation, then we could hurl its shells a distance of 50 *to* 60 *miles!* To fire the 76 mile gun bombarding Paris costs about $5,000 for each shot, it is calculated.



This Illustration Shows Vividly the Great Altitude Attained By a 76 Mile Shell, Viz., 18 miles. The Shell Encounters But a Small Fraction of the Air Resistance in the Rarefied Upper Strata That Short Range Shells Do in the Lower, Denser Air Strata.



The Illustration Herewith Shows a Mighty 90-Foot Electro-Magnetic Gun, Capable of Hurling a Torrent of 19-Inch Shells, Each Containing a Charge of High Explosives. It Would Be Noiseless and Smokeless, Besides Being Mobile Enough to Permit Its Transportation From Place to Place At Short Notice. There Would Be No Wear and Tear On This Gun As Is the Case Now With the Cannon Using Explosive Charges to Expel the Projectile From the Barrel. First Described In This Journal For November, 1915.

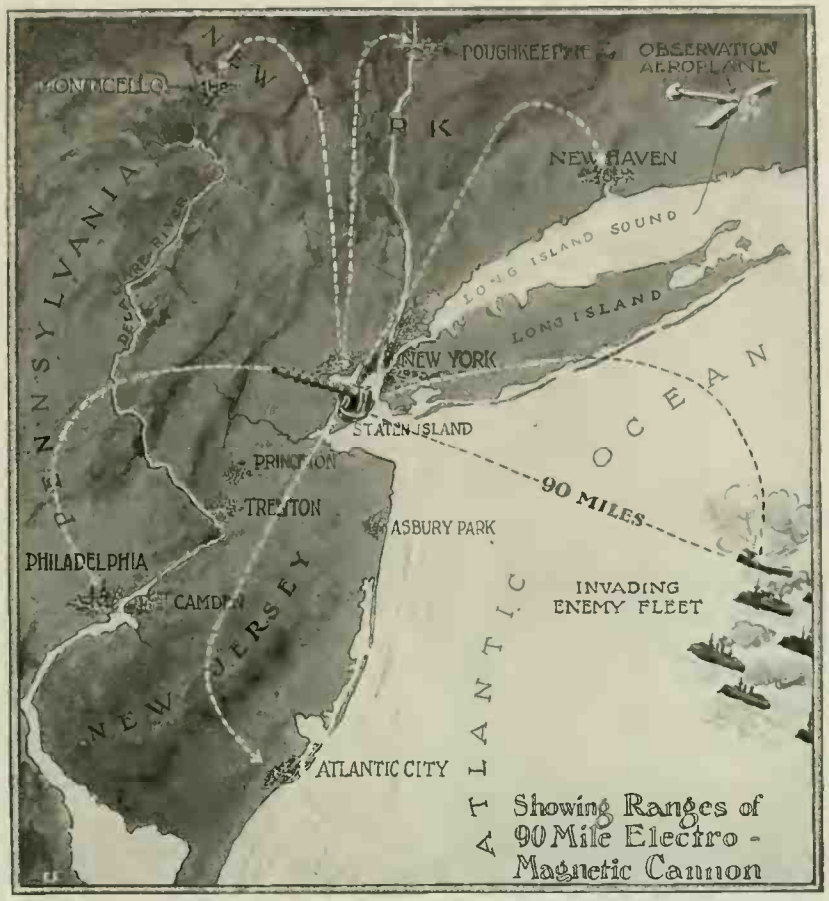
A report from Geneva, Switzerland, contains the statement that Lieut. Gen. von Rohne, a German authority on ordnance and inspector of artillery, gives in a magazine of which he is editor additional details in regard to the long-distance German guns with which Paris is being bombarded. He says they are 20 meters (65½ feet) long. The empty shell weighs 150 kilograme (330 pounds). The projectile attains a *height of 30 kilometers* (18.6 *miles*) and descends from the sky like a meteor on its target. Refer to the accompanying illustration showing the trajectory of the projectile and how it passes thru the highly rarefied air encountered at such altitudes, the air pressure at this height varying from a *fraction of an ounce* to several ounces *per square inch*, this greatly reducing the air resistance offered the projectile in its flight thru the air, which posseses a very much greater density at low levels, the air pressure at sea level being 14.7 lb. per square inch. Even ordinary, long-range heavy ordnance fire as used today has to waste a great part of the energy given to the projectile in overcoming air resistance, the average shell traveling at say 2 miles highest altitude, for example. Now, at 2 miles the air pressure is still quite high, being 9.8 lbs. per square inch.*

Gen. von Rohne further says it requires about three minutes for the shell to reach its destination. The greatest difficulty in the way of increasing the range was overcome by sending the projectile high enough to reach the rarefied air.

The whole secret of such long range cannon fire lies in the elimination or suppression of atmospheric resistance, and hence it will pay us to study this subject of rarefied air in the upper atmospheric strata. The illustration showing the trajectory of the 76 mile shell also gives a clear idea of the make-up of the atmosphere surrounding the earth. The thickness of this atmospheric envelope has been variously estimated at from 30 to 50 miles. Modern researches have indicated that the earth's atmosphere may be broadly divided into two portions,—a lower portion or *troposphere* as illustrated, in which the chemical percentage composition remains tolerably uniform, since the mechanical mixture of its gases is maintained by winds and convection currents; but the pressure and temperature, however, fall as we rise upwards; and a second or higher region, the *stratosphere* beginning at a height of about 10 miles, when temperature ceases to fall and becomes nearly constant for an unknown further height. The lower region or *troposphere* is the locus of clouds and water vapor. Above the 10 mile line, in the *stratosphere*, the atmosphere is in a state of perpetual calm, the gases composing it actually sorting themselves out in order of density. The highest upper regions are composed entirely of the lighter gases such as hydrogen and helium. Above 45 miles the air becomes so rarefied it has no appreciable weight. Hence the struggle of heavy ordnance designers to build a gun that could be fired at the angle giving the maximum range or 43½ degrees, and thus project the shell rapidly into the highly rarefied strata of the upper atmosphere.

There have been a number of designs for powerful *electro-magnetic guns* brought forth by various inventors in the past 15 years. One of these electro-magnetic cannon, here pictured, was described in detail in our *November*, 1915, issue. It

(*Continued on page* 132)



This Map Illustrates Graphically What Damage a 90-Mile Electro-Magnetic Gun, Such As Here Described, Could Wreak From a Given Point of Action Such As "Staten Island"—the Center of Fire Here Chosen.

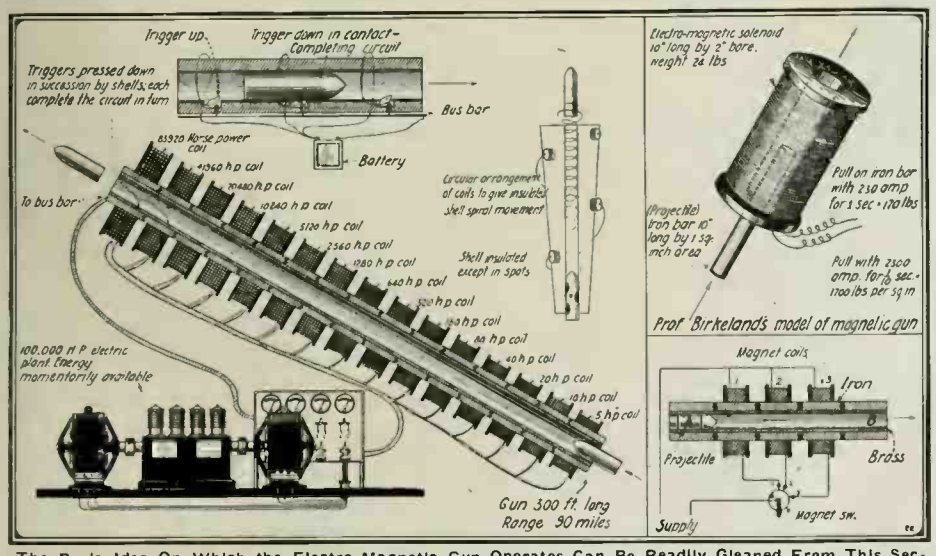
*See paper by Prof. A. E. Kennelly, Proceedings of the Institute of Radio Engineers, Vol. 1, Part 3, Page 42.

Also "Principles of Electric Wave Telegraphy and Telephony," by Dr. J. A. Fleming, Page 843, Third Edition.

Kent's "Mechanical Engineer's Pocket-Book," Page 607, 1916 Edition.

A. L. Rotch—"The Conquest of the Air," New York, 1909.

W. J. Humphreys—"On the Physics of the Atmosphere," Journal, Franklin Institute, Phila., Pa., March, 1913.



The Basic Idea On Which the Electro-Magnetic Gun Operates Can Be Readily Gleaned From This Sectional View of Such a Monster. Magnet Coils Suck the Shell Forward At Ever Increasing Velocity.

attorney for search in the Patent Office for patents of this class. A search of this kind can be made for a few dollars by any reputable patent attorney.

GAS GUN.

(233) H. W. Seeley, Bridgeport, Conn., claims that he has experimented for some time with what he terms a "Gas Gun." The cannon is supposed to be built of brass or steel and is to be fired with gas. Certain other information is given as to how to operate the gun, as well as other various details. He also claims that with such a gun he has hurled objects with considerable force for fairly long distances, but he admits that of necessity he used a very small gun. Our advice is asked.

A. In view of the fact that late advices from Germany thru Swiss sources mention that the famous 74-mile gun which the Germans used in shelling Paris are supposed to be using gas, our correspondent's idea seems feasible. How practical such a device is, is not known to us. Until the German came along no one ever spoke of gas guns, but there is a good chance that there might be something in an idea of this kind. We would advise our correspondent to proceed cautiously, and have a thoro patent search made before applying for patent.

AUDION.

(234) E. F. Johnson, Waseca, Minn., thinks he can use an A. C. current step-down transformer in connection with an Audion. He shows several schemes to be used in connection with the idea.

A. We think it is impossible to use A. C. current in connection with such a sensitive device as an Audion, as we are almost certain that a loud hum will result in the telephone receivers, and we doubt if the same can be overcome entirely to make the operation of the instrument suitable. Furthermore, no matter what arrangement is used in connection with the transformer, the constantly changing potential of the line is certain to interfere with the operation of the Audion. Everytime somebody down the line turns on a number of lights there is a disturbance along the entire circuit, which will certainly manifest itself in the Audion.

AN ELECTRIC AEROPLANE SHOOTING GALLERY.

(*Continued from page 77*)

pathway, the target being preferably in the form of a miniature aeroplane as here illustrated.

In the front portion of the gallery there is arranged a shooter's stand and in the rear are traveling targets adapted to be shot at by the shooters or gunmen standing on the stand. The shooter's stand is preferably in the form of an aeroplane suspended in mid-air and adapted to rock from side to side. The lower wing of the stand forms a floor for the shooters to stand on and a set of steps lead to the end portions of this floor so that the shooters can board the "aeroplane" readily.

Various mechanical means may be employed for suspending the shooter's stand and for imparting a rocking thereto, for instance, as shown in the drawings, the floor on which the marksmen stand is hung at its ends on upwardly extending rods, connected at their upper ends with the cranks attached to crank shafts journaled in suitable bearings arranged on brackets and attached to an overhead beam extending along the ceiling of the gallery. The crank shafts are provided with bevel gear wheels meshing with a second set of bevel gear wheels secured on a shaft driven by an electric motor. When the motor is running then a rotary motion is transmitted by the gearing described to the shaft and cranks, whereby a rotary motion is given the links and imparting a sidewise rocking motion to the shooter's stand, as will be readily understood by reference to the illustration.

The rear of the suspended stand is provided with propellers driven by a sprocket wheel and sprocket chain mechanism from an electric motor mounted on the floor, and the propellers are preferably inclosed in a wire netting protector. When the motor is running a rotary motion is thus given to the propellers, whereby an air current is induced in a lengthwise direction, producing a very realistic aeroplane effect to the shooters standing on the floor as well as to the onlookers in front of the shooting gallery.

Each of the miniature aeroplane targets is provided on top with an eye detachably engaging the return bent end of a holder, in the form of a rod provided with a flanged wheel, traveling in an endless slot formed in the target background extending across the gallery in the rear of the targets. The rear end of each holder is attached to an endless traveling sprocket chain passing around a series of sprocket wheels located in such a position as to guide the sprocket chain along the slot as is readily understood. A suitable electric driving motor is connected with one of the sprocket chain shafts to impart a traveling motion to the chain and targets.

As the marksmen hit the aeroplane targets they can thus be easily replaced by an attendant located at one side of the target rack, as they are only hooked on any of the slowly moving shafts.

To give a truly realistic effect to the whole affair the inventor mentions that a moving cloud panorama can be flashed on the target board, so that the resemblance to the "real thing" will be greatly heightened thereby. Also it is not necessary to have the shooting gallery in the open; it can be very effectively placed in an enclosure so that a moving earth panorama can be projected on the floor between the plane and the target.

A 100-MILE ELECTRO-MAGNETIC GUN.

(*Continued from page 81*)

has a possible range of 90 to 100 miles when properly designed and elevated to a maximum range angle of 45 degrees. The principle of the electro-magnetic gun is best understood by reference to the line drawing here shown. Prof. Kristian Birkeland, inventor of the gigantic solenoid gun mentioned, his patent being dated *March* 15, 1914, tried out a simple experiment to prove that his design was feasible and practical. This experiment was made with a single magnetic solenoid or coil weighing about 24 lbs., and having the dimensions given in sketch. Here is what he found: With a current of 230 amperes sent thru the solenoid, the iron rod was sucked in and propelled with a magnetic pull of 170 lbs. The heat generated in the coil at the end of *one second* was not so great but that the solenoid would have safely withstood *ten times* as heavy a current for *one-tenth second*, in which event the force acting upon the rod would be about 1700 lbs. per square inch. If instead of an iron rod a body made up of coils thru which a current is past is made use of, the magnetic suction of the solenoid may be vastly increased, points out Prof. Birkeland.

As an introductory explanation reference may be made in this connection to one of

(*Continued on page 134*)

A 100-MILE ELECTRO-MAGNETIC GUN.

(*Continued from page* 132)

the small line drawings herewith, showing a simple three coil electro-magnetic gun, and undoubtedly the reader will then be able to grasp, with the aid of the following explanatory remarks, about how the various inventors of the electro-magnetic guns intend hurling their projectiles at the enemy with astonishing rapidity and accuracy.

For the sake of simplicity, we may consider that but three electro-magnetic coils are in use as at 1, 2 and 3 along the gun barrel. It may be said that invariably such a gun barrel should have an inner lining of brass or bronze, so that the projectile which is usually made of a magnetic material (such as iron or steel), will not bind within the barrel. The barrel proper can be made of iron properly divided, but an all-brass barrel is common. Now consider that the three magnet coils, 1, 2 and 3, are connected up to a switch as shown. If, then, an iron projectile is placed in the position A, and the current caused to flow thru the coil 1, the electro-magnetic field of force set up within the gun barrel will tend to pull the projectile forward in the direction of the arrow. It should be mentioned before going further that the iron barrel (if used) of the cannon or gun is divided up into several distinct sections so as to localize and intensify the magnetic pull on the projectile at each new impulse.

When the projectile has reached the position of coil 1 the control switch is moved so as to cut out coil 1 and to connect coil 2 into circuit. If this is done quickly the projectile will have been *sucked forward* on a line with coil 2. The operation is again repeated and the switch is moved so that coil 3 will be put into the circuit and coils 1 and 2 opened. Thus the projectile will again be pulled forward to section 3, and at the instant it reaches the center of the *final coil* the current is cut off and the momentum acquired by the projectile is relied upon to carry it on and out of the muzzle of the gun at B.

In one of the illustrations there is shown a probable development of a large electro-magnetic field gun mounted on a massive iron frame-work fitted with large caterpillar wheels, as observed, so that it is mobile enough to be quickly hauled from one place to another on the battlefield or for siege purposes. When used for portable requirements it will invariably be necessary, if such guns are ever adopted, to provide a complete portable electric, generating plant as is shown in the picture. This would comprise a powerful gasoline engine direct connected to a suitable electric dynamo.

Some idea of the probable size of such guns may be obtained when it is stated that one of the best designs ever worked out on this principle, and due to Prof. Birkeland, has a barrel 90 *feet in length*. The projectiles used in this gun would be about 9 *feet long* and have a *diameter of* 19 *inches*. Also to gain the maximum magnetic pull by this arrangement it is recommended that the projectile be wound with coils of wire so as to be electro-magnetically reactive in conjunction with the regular magnetic disc coils placed along the barrel of the gun as perceived. It is estimated that the shells would have to leave the gun barrel with a velocity of 4,000 ft. per second. In order to facilitate the passage of the projectile thru the barrel of the gun with the least friction we strongly suggest that suitable lubrication be provided by means of grease or oil cups placed along the barrel at intervals; these may be observed in our illustration.

It must be remembered that these guns would not heat to any appreciable extent and not at all compared to the heat produced in the modern high powered guns using explosive charges of powder. Due to this and other obvious reasons such a gun as this can fire a great number of larger caliber shells per minute, possibly

fifty to seventy-five shells in one minute. It will be seen from the foregoing that such a discharge of 19-inch two-ton shells, each of which contains a 1,000 lb. high explosive powder charge, would serve to quickly rout the enemy, no matter how well he might be entrenched or ensconced behind fortified embankments. A rain of such monster shells would batter down almost any fortification whether natural or built by man.

A method is suggested in the illustration of this electro-magnetic gun whereby a constant supply of shells for rapid firing can be always maintained before the open breach of the gun. The shells might be hoisted by means of a gasoline engine and run on the platform at the left and then allowed to slide by gravity down the inclined chute. As fast as one of the shells is sucked into the breach of the gun barrel it is followed by another one right after it successively. It is easily possible to have means of firing the shells as far apart, in respect to time, as is deemed advisable, of course. The electric current supplied thru the coils along the gun barrel can be controlled thru a suitable switch by the man aiming the gun and who may be located alongside of the breach of the monster as indicated in our illustration.

The second large electromagnetic gun illustrated in the line drawing is a design suggested by Mr. Paul T. Kenny, a New York electrical engineer. This basic design principle is similar to Prof. Birkeland's, namely, to apply a very large electric current to the magnet coils surrounding the gun barrel for a fraction of a second, or in other words to create an enormous magnetic suction to act on the projectile before the magnet coils have had time to heat up, *time* being one of the factors governing the heating effect in any case. The shorter the time the current is on, the less the amount of heat produced. Thus does it become possible to overload the coils on the magnetic gun 10 to 12 times their normal current carrying capacity, and as pointed out before to thus realize a corresponding increase in the strength of magnetic field produced.

Mr. Kenny says that he offered it to the United States Government in 1908, and proposed to throw a shell *ninety miles*, from New York to Philadelphia, to prove what it could do, but his offer was refused, on the ground of "no appropriation." Subsequently Mr. Kenny went to Berlin, where he was associated with Ambassador Gerard, and in 1913 he submitted his invention to the German military authorities. The latter acknowledged its practicability and asked him to supervise the construction of one of the war terrors at the Krupp works in Essen. Pressing business interfered and Mr. Kenny, leaving the secret of his terrible weapon behind, returned to the United States. He is confident that the Teutons may be preparing or have already used an electro-magnetic cannon of giant size built on the design he suggested at that time.

Mr. Kenny gives the following description of his invention:

"The gun itself is a huge telescope shaped funnel of steel from 200 to 300 feet in length, open at both ends and supported by struts of steel in bridgework construction so that the broader end, which is the muzzle of the gun, is elevated and movable. This funnel is nowhere near the weight of a sixteen-inch gun, for there is no strain on any part of it during 'firing' except that of its own weight.

"This gun is wrapt from the breech to the muzzle with coils of wire, thru which electric current from a dynamo may pass. The coils at the breech are of very fine wire capable of producing an electro-magnetic force of five horse power. The next set of coils are of heavier wire to carry heavier current, and so by progression the strength of the coils increases until at the muzzle the fifteenth coil would possess a throwing force of 83,920 *horsepower!*

"The shell, which is constructed so that the action of the magnetic force upon it will cause it to revolve without the necessity or rifling the bore of the gun, is introduced into the breech. The operation of the current in the first coil throws it forward, and the shell itself closes connection by a tripper or trigger set in the bore. It passes under the influence of the next coil, with the momentum already gained—and so on until the last and greatest thrust forward comes from the coil possessing 83,920 horsepower. With terrific muzzle velocity the shell then soars on its high trajectory toward the object to be destroyed."

The map illustration shows the frightful range of one of these 90 to 100 miles electro-magnetic cannon. It could, if located on Staten Island, in New York harbor, bombard Atlantic City, Philadelphia, Camden, Poughkeepsie, New Haven, and hundreds of interlying cities, such as Trenton, New Brunswick, Elizabeth, etc. The day of the 100 mile electro-magnetic gun may not only be near, but actually present. The Teutons keep their secrets well.