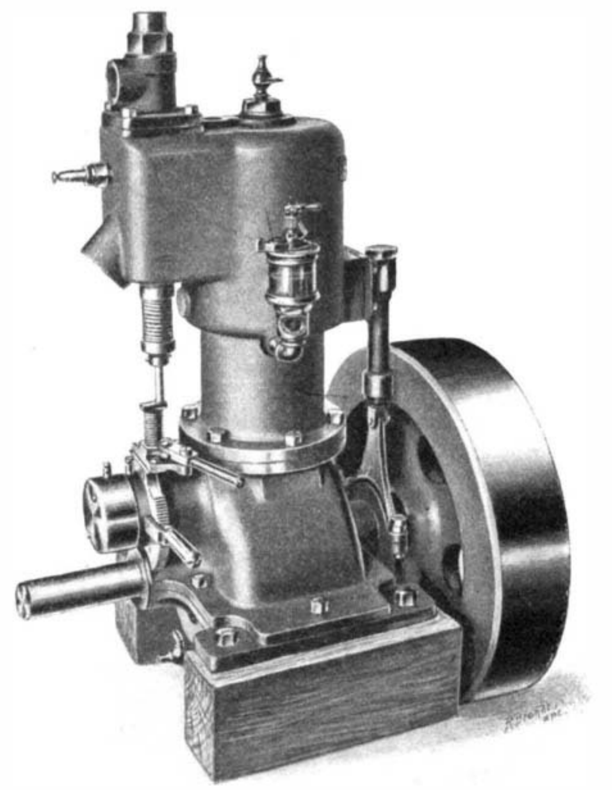
A SINGLE-CYLINDER, REVERSIBLE, FOUR-CYCLE GASOLINE ENGINE.

The engine shown in the accompanying cut is the invention of Mr. A. F. Law, of Bridgeport, Conn., and is manufactured by the Royal Equipment Company, of that city. It is of the usual four-cycle type, having a 4-inch bore by 5-inch stroke, and is adapted especially for marine purposes, where its use makes a reversible-blade propeller or other reversing gear unnecessary, except in cases where the boat must always be instantly reversible. The marine motor is rated at 3 horse-power at 600 R. P. M., and it can be made to develop 5 horse-power by running it at a higher speed. Its weight complete is 235 pounds. The plunger water pump seen beside the cylinder, in front, is driven by an eccentric beside the flywheel. Variable jump-spark ignition is used, the spark being advanced or retarded by moving vertically over its notched segment the lower of the two levers seen beside the base. The upper lever, which moves in a horizontal direction, shifts the small plunger that operates the exhaust valve, from the regular cam on the secondary, or half-speed, shaft to another cam beside it, which is set so as to open and close the valve at the proper time when the engine is running backward. To reverse, it is only necessary to cut off the ignition current when the motor is running with the spark advanced, throw over the reversing lever as soon as the motor slows down, and cut in the ignition current again. The spark, being advanced for running forward, will of course be retarded for running backward, and as soon as the motor starts to turn in the latter direction, the spark must be advanced in order to secure full power.

The motor can generally be reversed without stopping it, but, in the event that it does stop while being reversed, it can of course be at once started again by hand in the reverse direction. In other words, this four-cycle engine comprises all the advantages of engines of this type, with the reversible feature of the two-cycle engine added. The engine is well constructed throughout, has a hand-hole in the base for adjusting bearings, and is built up to a four-cylinder size, which, for automobile use, is rated at 20 horse-power.

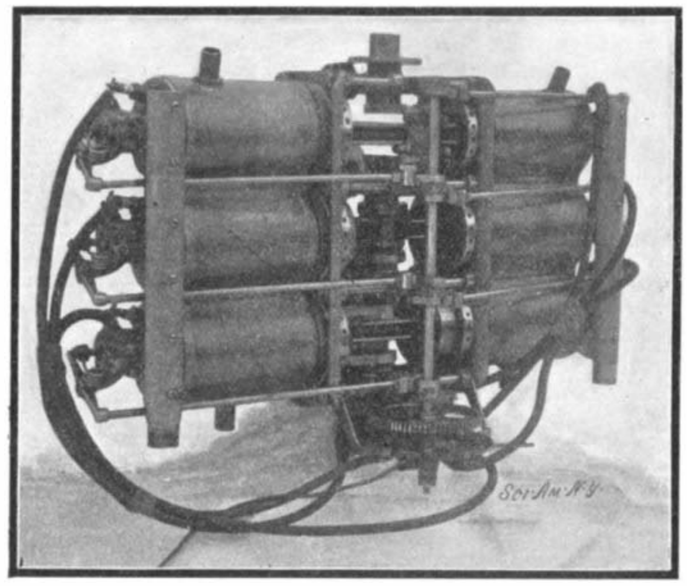


A NOVEL, FOUR-CYCLE, REVERSIBLE, GASOLINE MOTOR.

As stated in a paper recently read before the Russian Physico-Chemical Society, Mr. N. Awerkieff observed that in connection with the action of hydrochloric acid on metallic gold in the presence of formaldehyde, trioximethyl, methyl, ethyl, and amyl alcohol, as well as in that of phenol, chloroform, and several other organic bodies, a dissolution of the gold would take place. The solutions obtained in this way, on being vaporized, dried, and heated, would leave a residuum of metallic gold.

A NEW GASOLINE MOTOR FOR AIRSHIPS.

The six-cylinder motor shown herewith was designed and built by Mr. Charles E. Duryea, of the Duryea Power Company, Reading, Pa., for use on an airship. The cylinders have a 4½-inch bore and the pistons a 5½-inch stroke, and when turning at 900 R. P. M. the motor developed 40½ horse-power. Its weight stripped, as shown, but with complete equipment of two carbureters, battery, spark coil, water, and gasoline tanks, with a gallon of the respective liquids in each, was 232 pounds, or less than 5¾ pounds per horse-power. The three-throw crank shaft of 1⅝-inch diameter is hand forged and has a ¾-inch hole bored in it to carry oil to the crank pins. These are 1¼-inch in diameter and are provided with a ¼-inch central hole for oiling. The wrist pins of the pistons are hollow and are plugged so as to prevent the oil going out at the bottom. Instead of setscrews to hold them in place, oil cups screw into the lug on the inside of the piston wall. These oil cups have an opening on the upper side for filling, and they can be filled when the piston is at the end of its stroke. The reciprocating motion causes the oil to feed properly. The cylinders of the motor are of cast iron, machined inside and outside. They are fitted with copper water jackets. At the base of each cylinder there is a slightly conical space on which the copper water jacket fits with a steel ring around it, which, when it is driven up on the cone, clamps the jacket to it, making a tight joint. The motor is a particularly light and compact one, and should fulfill well the purpose for which it was designed.



A 40½-H. P., WATER-COOLED, GASOLINE MOTOR FOR AN AIRSHIP.

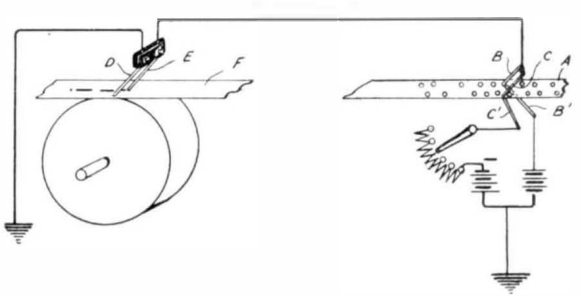
A NEW SYSTEM OF RAPID TELEGRAPHY.

The difficulties which have hitherto blocked the path to the invention of a successful high-speed telegraph system are of an electrical, rather than a mechanical nature. Many transmitters and receivers have been devised, which are mechanically capable of operating at a high rate of speed; but which have utterly failed when used on any but short telegraph lines, because, owing to static capacity of the line, they are too rapid for the electric impulses. A telegraph line presents features and effects similar to those of a Leyden jar. Though these effects are too small to be noticeable in a short line, in a distance of several hundred miles they become so great as to seriously interfere with high-speed transmission of telegraphic signals. Dots and dashes, instead of being sharply defined, are prolonged until they are run together by the sluggishly flowing current, rendering the message unintelligible.

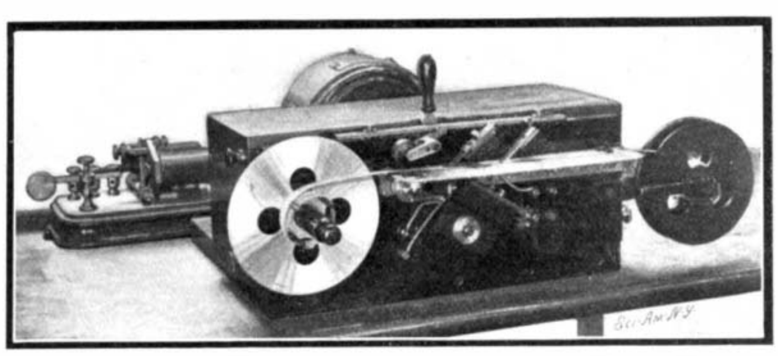
A system recently invented by Mr. Patrick B. Delany, of South Orange, N. J., is not in the least hindered by the static capacity of the line; but on the contrary utilizes the "static discharge" and is inoperative without it, so that, when used on short lines whose capacity is small, it is necessary to bring these lines up to the requisite capacity by the use of condensers.

The system is designed to transmit and receive messages at the rate of one thousand words a minute over distances of one thousand miles, though a speed of eight thousand words a minute has been attained on a short experimental line. In the accompanying illustrations we show the three machines which are used in the operation of this system, namely, the perforator, the transmitter, and the recorder. Messages are sent by means of a perforated tape, which is prepared in the perforating machine. The tape is drawn at any desired speed through the perforating machine under a pair of steel punches. Each of these punches is operated by a magnet. The magnets are controlled by a Morse transmitting key, shown at the right in our illustration. A downward stroke of the key causes one of the punches to operate, and on release of the key the other punch operates. Thus each operation of a key, whether for a dot or a dash, serves to make two perforations, one near the upper edge, and the other near the lower edge of the tape. As shown in our illustration of the perforated tape, the primary and secondary perforations have an angular relation to each other, which is due to the fact that the tape is constantly running, and which varies with the interval of time between the downward stroke and release of the key. When a message has been perforated in the tape, the latter is passed through the transmitting machine. Here the primary perforations co-operate with suitable mechanism to send positive electric impulses through the line, while the secondary perforations permit the passage of negative electric impulses.

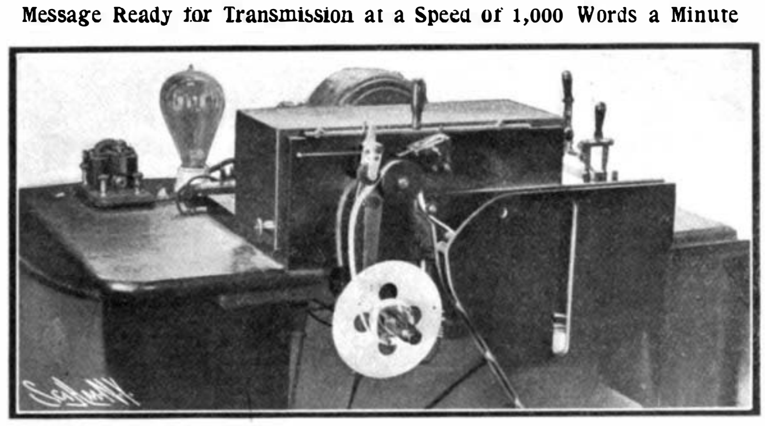
The accompanying diagram clearly shows the method of sending and receiving the message. The perforated tape, A, at the transmitting end passes between two primary contact fingers, B and B', and two secondary contact fingers, C and C'. B' is connected with the positive pole of a battery whose



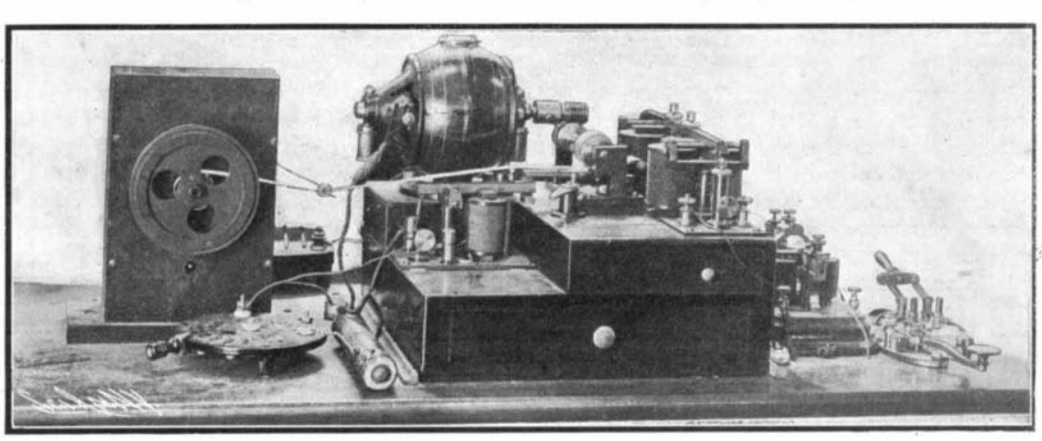
The Transmitter and the Receiver.



Message Ready for Transmission at a Speed of 1,000 Words a Minute



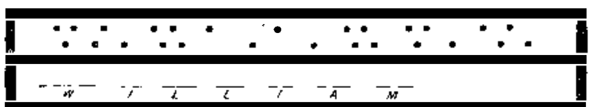
Recording the Message Electrolytically on a Chemically-Prepared Tape.



Machine for Perforating the Transmitting Tape.

A NEW SYSTEM OF RAPID TELEGRAPHY.

negative pole is earthed, and C' is connected with the negative pole of a battery whose positive pole is earthed. When the fingers, B and B', make a contact through a perforation in the tape, they send a positive impulse over the line. This impulse is followed at the proper interval by a negative impulse by contact of fingers C and C' through the secondary perforation. The signal is electrolytically recorded at the receiving end on a chemically-prepared tape, F, by means of an iron electrode, E, connected to the line and a platinum electrode, D, connected to earth. The current in passing through the moistened chemical tape from the iron to the platinum electrode forms a blue mark on the tape, at the contact point of the iron finger. When the current is reversed, no such mark is formed. A momentary positive impulse sent by contact fingers B and B' causes such a mark to be



The Same Word as Perforated on the Transmitting Tape and Electrolytically Produced on the Recording Tape.

produced on the moving tape at E, and this mark is protracted by the slow outflowing current, which is retarded by the inductive capacity of the line, until a negative impulse produced on contact of fingers C and C' abruptly stops this after-flow by reversing the current. Thus it will be seen that the impulses, whether for a dot or a dash, are all of equal duration, and it is the interval between the positive and negative impulses that determines the length of the mark on the paper.

The practical advantages of this system will be readily comprehended. A number of perforating machines can be used in connection with a single transmitter, so that a large number of messages can be prepared simultaneously, and then passed through the transmitter at speeds of 1,000 or more words a minute. Furthermore, Mr. Delany has invented a perforating machine, which is operated from a keyboard similar to that of a typewriter. This can be operated by any typewritist at twice the speed at which the Morse keys are ordinarily operated, and if desired can be used in any business office to perforate messages on the tape. The tape can then be sent to the telegraph station, and run at a high speed through the transmitting machine. At the receiving end the record may be transcribed before being sent out, or the original may be sent to its destination, where any typewritist who has had a few days' instruction can reproduce the message in typewritten form, and in this way absolute secrecy in transmitting the message can be maintained.

Commercial Korea.

"Commercial Korea in 1904" is the title of a monograph just issued by the Department of Commerce and Labor through its Bureau of Statistics. It discusses commercial and other conditions in Korea, showing area, population, transportation facilities, railways, telegraphs, postal service, and foreign commerce, including imports and the countries from which they are drawn, and exports and the countries to which they are sent. The population of Korea the monograph in question puts at about 15 millions in round numbers, the area at about equal to that of the State of Kansas, and the foreign commerce at about $12,000,000, of which imports form about $7,500,000. A part of the Chinese Empire prior to the Christian era, Korea remained under the control of that country until about the end of the sixteenth century, when the Japanese sent a large invading army to Korea for the purpose of driving out the Chinese and taking possession. The Japanese rule, however, was comparatively brief, and in 1627 the people of Manchuria placed the country under vassalage, and until 1894 Korea recognized the control of China by sending tribute-bearing missions annually to Peking.

In 1894 an insurrection led the country to ask aid from China, and Chinese troops were sent. This action, being looked upon by the Japanese as a step toward the complete control of Korea by China, precipitated a war between China and Japan in 1894, which resulted favorably to Japan and was followed by a renunciation of Chinese sovereignty by the Korean king, the substitution of Japanese for Chinese influence, and the introduction of many important reforms under Japanese advisers. These reforms included adjustment of taxation, abolition of slavery, establishment of educational institutions, introduction of a postal system, membership in the International Postal Union, and a reform of the judiciary.

Commercially the development of Korea begins with 1876, when two ports, Gensan and Fusan, were, upon the insistence of Japan, opened to trade with that country only. In 1882 Admiral Shufeldt, of the United States navy, visited Korea and secured a treaty of friendship between the United States and Korea by which American vessels were given access to its treaty ports and the safety of American vessels and citizens assured. This was followed by treaties with Germany and Great Britain in 1883, Russia and Italy in 1884, France in 1886, Austria in 1892, and China in 1897. The formation of the treaty between Korea and the United States in 1882 was immediately followed by a visit from a Korean embassy to Washington, sent to exchange ratifications of the treaty. From this time forward Korea was opened to foreign trade and Western civilization, and the Korean government established its legations in the United States and other great commercial nations. With the opening of the treaty ports and the establishment of commerce an official record of Korean imports and exports began. This shows imports in 1884 amounting to about $800,000 and exports amounting to $475,000. By 1890 imports had grown to $3,850,000 and exports to $2,975,000. In 1894 imports and exports fell considerably below those of 1890, but in 1897 again increased, being for that year of imports about $5,000,000 and exports about $500,000. In 1902 the imports at the treaty ports amounted to about $7,000,000 and the exports of merchandise to about $4,200,000. In addition to this, exports of gold amounted to over $2,000,000, while the imports and exports at other than treaty ports are estimated as being sufficient to bring the total commerce of 1902 up to fully $15,000,000, exclusive of gold exports, which, as above indicated, amounted to about $2,000,000.

The most important articles in the export trade are rice, which shows an annual exportation of more than $1,000,000; beans, $500,000; ginseng, nearly $500,000; and hides, about $100,000 in value in the latest available year. Of the importations, cotton goods form the largest item, from $3,000,000 to $3,500,000 per annum; silk piece goods imported from Japan and China amount to $600,000 per annum; kerosene oil, about $300,000; railway materials, about $250,000; mining supplies, about $200,000; and bags and ropes for packing, $150,000. Of the cotton goods imported in 1902, British shirtings formed the largest single item, amounting to $800,000; British and American sheetings, $260,000; Japanese sheetings, $350,000; Japanese piece goods and yarn for use in manufacturing cotton cloths, $800,000. Korea, like China, is now drawing considerable quantities of cotton yarn from Japan, and considerable supplies of cotton manufactures. Great progress is being made by Japan in the manufacture of cotton, and in addition to supplying cotton cloths to China and Korea in large quantities it is now supplying the cotton yarns which are used in household manufacture as well as in certain of the cotton mills which exist, and are proving quite successful.

The foreign commerce is carried on through the treaty ports of Chemulpo, Fusan, Wonsan, Chinampo, Mokpo, Kunsan, Masampo, and Song Chin. Chemulpo, which is located on the western coast of Korea, about midway from its southernmost point to the northern boundary, has by far the largest commerce. Its imports in 1902 were reported at $1,250,000 out of a total of $1,920,000. The exports of Chemulpo, however, are very much less than those of other ports, being $45,000 in 1902 out of a total of $1,830,000. Its pre-eminence over the other treaty ports as a point of importation is due largely to the fact that it is of itself a considerable city with a comparatively large foreign population and is in direct railway communication with the capital of Korea, Seoul, which is only 35 miles distant.

The principal imports in 1902, stated in United States currency, are as follows: Shirtings, gray and white, $860,000; silk piece goods, $480,000; cotton yarn, $490,000; American kerosene, $385,000; Japanese sheetings, $360,000; Japanese piece goods, cotton, $325,000; British and American sheetings, $285,000; grass cloth, $285,000; railway plant and material, $230,000; bags and ropes for packing, $150,000; mining supplies, $230,000; clothing and haberdashery, $100,000; provisions, $95,000; matches, $90,000; saké samshu, $75,000; sugar, $74,000; machinery, $70,000; cotton wadding, $60,000.

The Current Supplement.

The current Supplement, No. 1473, opens with an admirably illustrated article on the canalization of the Elbe and the Moldau. Mr. O. Chanute presents an excellent discussion of aerial navigation from the historical standpoint. Emile Guarini describes the Dick system of lighting trains by electricity. "Coloring of Metals" is the title of a paper by Paul Malherbe on a subject which is of considerable technological importance. A simple explanation of the N-rays is given for the benefit of those readers who have not been able to follow the more technical articles which have thus far appeared. Mr. Foster H. Jenings begins a very thorough treatise on Korean headdress, which is well illustrated by pen-and-ink drawings.

Workmen are installing the wonderful floral clock at the World's Fair. The steel framework, which was made in Milwaukee, Wis., is being placed. The flowers that will conceal the mechanism are in pots in the greenhouses, and will be installed about April 15. The dial of the clock is 112 feet across.

THE NEW VICKERS-MAXIM 9.2-INCH WIRE-WOUND GUN.

The powerful weapon which we illustrate on the front page of this issue is a good representative of the latest improvements which have been introduced into heavy ordnance, with a view to securing at once greater range, increased penetration, and a higher rapidity of fire, without adding materially to the weight of the piece. The theory of design and methods of construction by which these results have been secured are not by any means peculiar to this piece, inasmuch as they have been followed by gun makers for many years; but the significance of this 9.2-inch gun is that in it we see what is, perhaps, the most successful combination of these qualities that has yet been attained. Although this gun weighs only 28 tons, and has a service rapidity of fire of five rounds in a minute and a half, it has a power of penetration at 3,000 yards (the minimum fighting range of to-day) approximately equal to that of the 13½-inch English gun, of more than twice the weight, of a dozen years ago.

The immediate cause of this increase in efficiency is the greater velocities that are secured with modern guns; and the increase in velocity is due to the enlargement of the powder chamber, the use of slow-burning powder, and the lengthening of the bore, so as to enable the products of combustion as they are given off by the burning powder to exert their accelerating effect upon the projectile for a longer period and with a higher average pressure. To such a successful point have these principles been carried, that the latest types of gun, such as the one herewith shown, have fully fifty per cent greater velocity than the guns of ten or fifteen years ago. The gun weighs 28 tons, has a total length of 37.2 feet, a bore of 9.2 inches, and measures 36 inches in external diameter at the breech and 18 inches at the muzzle. It fires a 380-pound projectile with a muzzle velocity of 2,900 feet per second, and a muzzle energy of 22,160 foot-tons. The penetration of wrought iron at the muzzle is 37 inches, and at the minimum fighting range of 3,000 yards its projectile striking squarely would pass through 11 inches of Krupp steel, so that the water-line armor of practically every battleship afloat would be penetrable by this gun.

The piece is built by the wire-wound method. It consists of an inner tube containing the powder chamber and the rifling, over which is shrunk a heavier inclosing tube of gun steel, and upon this is wound, under very high tension, the wire upon which the gun mainly depends for its tangential strength. Over the wire is shrunk on a single heavy jacket, which extends from the breech for nearly two-thirds of the length of the gun, and a chase hoop, or tube, which extends to the muzzle, which latter is slightly swelled to a large diameter, to give the extra reinforcement needed to prevent splitting at this point.

The breech mechanism is shown very clearly in our illustrations. The whole of the breech action, namely, unscrewing the plug, withdrawing it, and swinging it clear of the breech box, is accomplished by the continuous rotation of the hand-wheel shown to the right of the breech. The breech plug is of the same type as that used in our navy. It is threaded in segmental portions on steps of varying radii, an arrangement which enables three-quarters of its circumference to be threaded, and to be available for meeting the longitudinal thrust on the block. The ordinary type of block has only half of its circumference threaded, so that the new type of plug may be made proportionately shorter than the old. This shortness of the plug enables it to be swung clear from the breech as soon as it is unscrewed, thus saving the time occupied in the old type of block in withdrawing the plug in line with the axis of the gun, before swinging it clear of the breech box.

Another element of interest in this gun is found in the fact that it is built upon the same principles and is of the same general efficiency as the Armstrong gun, with which nearly the whole of the Japanese navy is armed; although it should be understood that this particular caliber of gun is not used by the Japanese, whose battleships and cruisers are armed with the 12-inch, 8-inch, 6-inch, and 4.7-inch Armstrong guns. The 9.2-inch gun, however, forms the primary armament of the British cruisers, and the intermediate battery of the latest types of British battleships, just as the 8-inch gun occupies the same place in the respective classes of ships of our own navy. The latest British designs carry eight of these 9.2-inch guns in four barbettes, in addition to the primary armament of four 12-inch guns—an impressive evidence of the vast increase in the offensive power of warships, due to the improvement of ordnance and the increase in displacement.

Underground hospitals and mule stables, methods of ventilating and draining mines, of robbing pillars, and flooding with culm are illustrated in an interesting world's Fair exhibit made by the Pennsylvania commission in the Palace of Mines and Metallurgy at the World's Fair.