ENGINEERING.

The War Department is greatly pleased with the result of the recent practice with heavy coast-defense guns at Fort Monroe. Five 12-inch and two 10-inch rifles were fired at a moving target 30 feet high by 60 feet long, which was towed past the fort at a speed of seven miles an hour. Twenty-four projectiles were fired in 2½ minutes and 18 hits were made. Since a modern battleship is from 400 to 500 feet in length and from 20 to 28 feet in height, it is considered that, had the firing been at a battleship instead of the canvas target, every shot would have found the mark.

The science of aeronautics, in addition to rapid recent developments in practice, is beginning to co-ordinate the results of tests and reduce them to formulæ. A paper by M. D. Drzewiecki in Comptes Rendus gives some rigorous formulæ connecting thrust, carrying power, speed, surface, and incidence. The minimum power per weight carried is obtained when the loss due to friction and the passive resistances is one-third of the resistance due to incidence. The author claims that none of his formulæ are based on unproved hypotheses but upon direct experiments under varying conditions.

The railroads of the United States have ever been famous for the great size and carrying capacity of their rolling stock. Nowhere in the world are such heavy passenger and freight trains hauled as in this country. Not long ago a train 3,000 feet long, containing 85 cars loaded with 4,451 tons of coal, was hauled from Altoona to Enola, Pa. Trial was made to determine what loads could be moved over the middle division, where the maximum grade has recently been cut down to 0.2 per cent. The train was hauled for 124 miles at an average speed of 17 miles per hour by a single freight locomotive.

The loftiest chimney in the world was recently put into service at the large smelting works at Great Falls, Mont., where it will serve to carry off the gases from the greater part of the large plant. The chimney, which is built of brick, is 506 feet in height above the ground. It is 50 feet in diameter at the top, and increases gradually in diameter to the base. The flue includes a dust chamber in which vertically-hung wires serve to take out the dust from the smoke. The dust is removed from the wires by shaking mechanism and falls in hoppers in the floor, from which it is loaded into cars in a pit below.

We note in a recent copy of Peru To-Day that the survey is shortly to be undertaken for a railroad, which will exert a most important influence on the commercial development of Peru. The line will start from the port of Paipa, one of the best harbors on the west coast, and will be carried across the lowest divide to be found in the whole of the Andes range in South America, the summit level being only seven thousand feet above the sea. This is less than one-half the elevation of the summit of the two existing trans-Andean railroads in Peru, one of which is 14,436 and the other 14,765 feet above the sea. When the line is built, east-bound freight from the coast of Peru, which must now make the circuit of South America and often go to Liverpool to reach its destination, will be carried directly across the mountains to Iquitos, the head of navigation on the Amazon River.

Railroad engineers are becoming increasingly alive to the importance of building both track and rolling stock with reference to the heavy centrifugal forces which are brought into play when heavy trains are run at express speed around curves. These stresses are particularly severe in the case of heavy electric locomotives built for use on steam railroads. We have always believed that the wreck at Woodlawn near this city was due to a conjunction of low center of gravity in a heavy electrical locomotive, high speed, and insufficient elevation of the outer rail of the curve on which the accident happened. To prevent "nosing" or side oscillation, the New Haven electric locomotives have been provided with end pony trucks, and the New York Central locomotives with four-wheel trucks. In both cases the improvement in the running has been very marked.

As we recently remarked, it has been claimed on good authority that all boiler corrosion is traceable to galvanic action. A paper recently read by Mr. G. N. Huntley before the Society of Chemical Industry on investigation of the cause of pitting in a stand-by boiler seems to prove that sulphur is an important factor in some cases, which hardly coincides with the electrical theory. An increase in the proportion of caustic soda used had no effect, and blisters were found, especially near the water-line, which, on being pricked, were found to contain liquid with a fine black powder in suspension, consisting of ferrous sulphate with a slight excess of sulphuric acid, while the boiler water was slightly alkaline. It would seem that sulphur in the water is first oxidized to free sulphuric acid which attacks the metal in its neighborhood, the deposited oxides forming a membrane permeable to oxygen but not to alkali, and permitting the curious acid corrosion in alkaline water.

ELECTRICITY.

The city engineer of Toronto, Canada, will shortly call for bids for an electrical pumping plant aggregating 13,000 horse-power.

A long-distance telephone service with four lines is expected to be opened next year between London, Paris, Madrid, Barcelona, and San Sebastian.

According to the Times (London) the Canadian Pacific Railway will grant use of its right-of-way for a special wire forming the connecting link between the Atlantic and Pacific cables of the proposed all-British round-the-world system.

A French inventor, M. Gabet, has recently made successful experiments in the Seine with a torpedo which he can start, stop, and steer electrically by wireless apparatus on land or in a boat. He expects eventually to control the torpedo for a range of eight miles.

Tests are being made at Brant Rock, Mass., of the apparatus to be installed at the 1,000-foot tower to be erected at Washington. The Navy Department specifications require that it shall be sufficiently strong to send messages 3,000 miles and receive them from the same distance.

Electrification of the Grand Trunk Pacific Railway from the St. Lawrence River to Monckton is being considered. A water-power site capable of generating upward of 100,000 horse-power, greatly in excess of the requirements, has been selected at Grand Falls on the St. Johns River, nearly equidistant from the two points between which electrification is proposed.

Among interesting papers read before the Royal Society in London recently was one by C. Russ upon the electrical reactions of certain bacteria as applied to the detection of tubercle bacilli in urine by means of an electric current. Another by Prof. H. A. Wilson described his experiments to determine the effect of a magnetic field surrounding it upon the electrical conductivity of a flame.

A patent recently granted to Mr. A. F. Rietzel is expected to overcome the difficulty often encountered in electric welding due to the arc jumping at the nearest points of two not quite smooth surfaces, and the exact position of the weld not being easily controlled. Raised portions on both sheets to be welded are placed in contact with each other, and the welding temperature reached only at the points desired, with a result similar to riveting, a saving of electrical energy, and elimination of burning of metal resulting.

The Electrical World calls attention to the great superiority of the electric to the gasoline automobile for city use, with especial reference to the anti-noise campaign. The distracting noise of the latter is sufficiently familiar—to an invalid confined to the city, for instance—the occasional startling explosion in the muffler of a charge which has missed fire, the screech of changing gears, not to mention the smell. None of these disadvantages apply to the electric vehicle, which also avoids the opprobrium directed against reckless driving, the electric motor being equally applicable to a light runabout which a woman or child can operate, or to a heavy commercial truck.

The generation of electricity by aermotors, or "wind turbines," as they call them, is making great progress in England, as shown by an exhibit at the seventieth annual show of the Royal Agricultural Society at Gloucester. The exhibit included a 24-foot turbine on a 60-foot steel tower driving a variable-speed generator with considerable excess storage-battery capacity to provide for calms. Current was supplied for an electric grill, kettles, irons, and fans, as well as a butter churn, a cream separator, a circular saw, and a deep-well pump. By division of the storage battery into two parts it is possible to use 50-volt current for driving the machines and 25-volt current for lighting, the latter permitting the use of metallic-filament lamps.

An interesting article by a lady contributor to the London Electrical Review describes the lighting of an eight-room suburban English home at a cost of $18.75 a year, which is further reduced by saving made in other directions over coal and gas for heating and other purposes. The parlor and dining room have two and one 50-candle-power lights respectively, costing 6 cents each for 16 hours' service, as compared with 7½ cents each for incandescent gas burners of lower power for the same time. The life of curtains, draperies, and plants in the rooms is said to have been twice as long as under the previous gas *régime*, a saving of 12 cents a week for cut flowers alone having been made. Painting and papering had to be renewed only once in four years with electric light as compared with every two years with gas, a saving of two dollars per room per year. Electric heaters in the living rooms cost 24 cents per 12 hours each at maximum capacity, which can be reduced when the rooms are warm enough, against 36 cents for gas fires or 19 cents for coal fires, comparing favorably even with the latter when the elimination of cost of cleaning and attendance is considered.

AERONAUTICS.

A new use for balloons is proposed by W. D. Boyce of Chicago, who sailed recently for East Africa in pursuit of natives and big game, which he will hunt not with the rifle but the camera. His idea is to attract wild animals in their native haunts by a light suspended from a balloon, and photograph them in such natural surroundings by flashlight.

Authority has been given by the War Office for the leasing of certain ground near Washington for use as a training ground for officers of the United States army in the use of flying machines. The first officers selected for instruction will be trained by the brothers Wright personally, and they in turn will teach others. A level tract of 163 acres almost free from trees has been chosen, so that the practice of beginners may be made at a height of 20 feet or less from the ground, eliminating as far as possible the danger of serious accident.

On the 6th instant Glenn H. Curtiss, who, since his 52½-minute flight at Mineola, L. I., on July 17th, is the record holder of the Scientific American Trophy, sailed for France with a new and untried biplane similar to that which he sold to the Aeronautic Society. Mr. Curtiss will be America's sole representative in the international aeroplane race for the Bennett trophy at Rheims on August 29th, and he will also compete in several of the other contests to be held during the week of August 22nd above the plains of Betheny in the champagne country.

Messrs. Baldwin and McCurdy, the two Canadian engineers who were formerly associated with Dr. Bell, are carrying on experiments at the Petâwacoa Military Camp, which is about 100 miles from Ottawa, Canada. On August 2nd they tried a new 40-horse-power motor on the "Silver Dart," the last aeroplane of the Aerial Experiment Association. After making several excellent flights of half a mile each with both men on board, the rays of the rising sun dazzled the aviator so that he steered down too soon, struck a knoll, and damaged the machine. This is the first time on record that the "Silver Dart" has carried a passenger. The speed attained is said to have been over 40 miles an hour. The motor has been placed in a new biplane built for the Canadian government and known as "Baddeck No. 1." If the flights with this are successful, it will probably be taken to England and demonstrated for the British War Office. According to the Minister of War, $390,000 will be spent during the next year for aeronautics in the army.

The Aeronautic Society's aeroplane which was badly smashed on the 18th ultimo, when a member, Mr. Alex. Williams, was taking his first lesson, has been repaired again and tried by Mr. Curtiss preliminary to his sailing. Mr. C. F. Willard, who had made one short flight before the machine was damaged, is taking advantage of all quiet mornings and evenings to make practice flights. As soon as he has become proficient, he will make exhibition flights in various parts of the country. At the Society's meeting on August 5th Mr. José De Viñez gave an interesting talk on model aeroplanes. He exhibited and flew several novel toys which he recently brought over from France. He expressed surprise at the slowness of America in catching the aviation craze. In Paris the children are all building and flying models, from which, as he demonstrated from small paper models made on the spot, much can be learned. It was a toy French flyer, it will be remembered, that first aroused interest in the Wright brothers.

The international aeronautical exhibition at Frankfort-on-the-Main, Germany, was opened a month ago, but nothing startling happened until the arrival of the "Zeppelin II." airship on July 31st. The 220-mile trip from Friedrichshafen on Lake Constance was made in about 11 hours. The start was made by moonlight at 3:40 A. M. and the first 56 miles to Ulm were covered in 1 hour and 39 minutes, an average speed of 42½ miles an hour. Then a violent head wind sprang up and 5 hours was consumed in covering the next 58 miles. Near Geislingen no headway was made for 25 minutes. The machinery worked perfectly throughout the trip, and the landing was made on a selected spot amid the plaudits of thousands. On July 28th at Friedrichshafen a severe test was made in which the airship rose to a height of 3,000 feet in a thunderstorm. On August 2nd a trip to Cologne, 110 miles distant, was attempted. When within 30 miles of that city a severe wind and hail storm was encountered, and the airship retraced its course at a faster rate than such a vessel has ever traveled before. A broken propeller the following day put an end to the second attempt immediately. At 4:40 A. M. August 5th, however, another start was made, and at 10:15 the airship appeared at Cologne and circled the spire of the cathedral. The trip took two hours longer than expected on account of fog. A landing was made in the suburb of Bickendorf. The same day the "Gross II." made a round trip from Berlin to Halle (217 miles) in 15 hours and 40 minutes, an average of 13.85 miles an hour.