

er developed, the large magnetic clutch shown requiring but 200 watts for its exciting coils, an amount of energy less than would be consumed by four 16-candle-power incandescent lamps. The efficiency of this clutch as a power-transmitting device is, therefore, 99.99 per cent, that is, the loss is one-hundredth of one per cent, which may properly be considered a negligible quantity.

In the application of the magnetic clutch in the central electric plant of the Imperial Company, of St. Louis, Mo., the clutches are used to connect the generator to the engines in such a way that each dynamo can be reached from more than one engine. The current is carried to the coils by means of collector rings attached to the sides of the clutches, and the electrical connections are simple and easily inspected. The collector rings take their current from insulated brush-holders, which are connected electrically to the source of current through a switch provided with a device for taking care of the inductive discharge when the oil circuit is broken. These switches are placed upon the switchboard, so that in starting or stopping a generator, all of the controlling devices are within the reach of one station attendant. The fact that magnetic clutches can be controlled by one or more push buttons or electric switches, placed at different parts of a room or plant, is one of their marked advantages.

Mr. Bion J. Arnold, a consulting electrical engineer of Chicago, is the designer of this clutch, and he is now making extensive use of specially designed magnetic clutches for various purposes. A number are now being installed in a plant using large synchronous motors for driving heavy machine rolls, the main function of the clutch being to furnish a quick means of releasing the driving motor in case of emergency, thus allowing the rolls to be shut down without overcoming the inertia of the revolving motor armature.

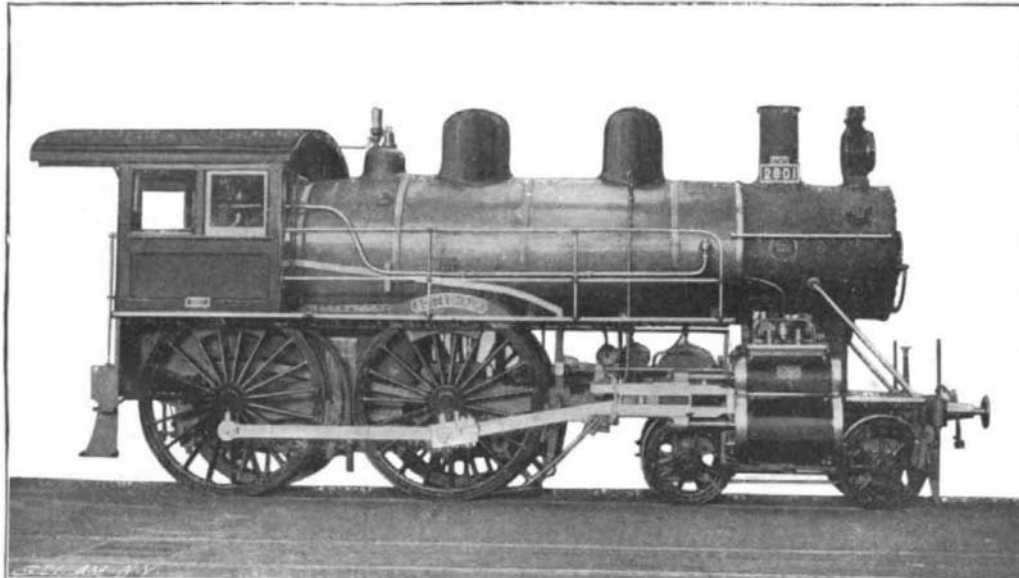
The applications where the use of these clutches is desirable would seem to be limited only by the number of places where it is required to transmit power from one shaft to another. For motor applications to individual machine driving, for shafting transmission, for connecting generators to gas en-

THE FOUR-CYLINDER COMPOUND LOCOMOTIVES OF THE NORTHERN RAILWAY OF FRANCE.

In a recent issue of the SCIENTIFIC AMERICAN, reference was made to the remarkable daily service of express trains run by the Northern Railway of France, which includes no less than forty-five trains, with an average timed running speed, including stops, of from

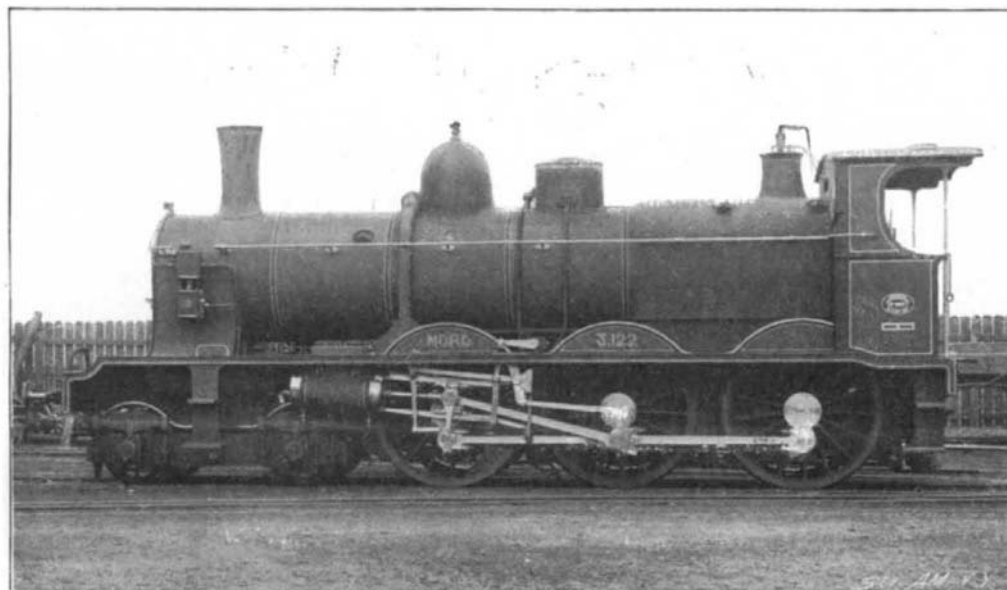
speed of its express trains as has taken place on this French road in less than a decade; for it is a fact that ten years ago, the Northern Railway of France had no express trains on its schedule that were timed to run at a higher speed than 43 miles an hour, including stops.

It was in the year 1885 that La Société Alsacienne de Constructions Mécaniques, under the superintendence of M. de Glehn, designed and built in its workshops at Belfort a four-cylinder compound locomotive for the express service of the Compagnie du Nord. That was, of course, before the era of the present fast express service, and the engine, which was no more powerful than the ordinary locomotives used by the company at that time, was built chiefly to prove that, owing to its economical steaming, the compound locomotive was sensibly more powerful than the ordinary type. When in 1890 it became necessary, on account of the increased weight and high speed of the new express service, to build a special type of locomotive, the excellent results obtained with the compound locomotive of 1885 induced the company to adopt the four-cylinder, compound system for its high-speed trains. An engine considerably more powerful than the compound of 1885 was designed, and with some minor modifications forms the standard express locomotive of to-day on this line. These engines, of which one of the latest type is shown in Fig. 3, conform in many respects to the standard eight-wheeled American engines, the likeness consisting in the fact that it has the truck and four-coupled drivers, and that the tender (a new departure in European practice) is carried upon two four-wheeled trucks. Apart from these broad resemblances, however, these fine engines possess marked characteristics of their own. They are of the four-cylinder, compound type, with the two high-pressure cylinders, 13.4 inches in diameter by 25.2 inches stroke, placed on the outside of the plate frames between the truck and the leading drivers and connected to the rear drivers, and the two low-pressure cylinders, which are 21.6 inches in diameter by 25.2 inches stroke, placed between the frames beneath the smokebox and coupled to the forward pair of drivers. The two pairs of drivers, which are 83.4 inches in diameter, are connected by the usual coupling rods, the arrangement being similar to that of the ordinary high-pressure locomotive of the Atlantic type in this country. The boiler carries a steam pressure of 215 pounds to the square inch. It is provided with Serpentine tubes, the heating surface of which amounts to 1,768 square feet, which with about



1.—EIGHT-WHEEL, COMPOUND, AMERICAN EXPRESS LOCOMOTIVE, FOR THE FRENCH STATE RAILWAYS.

Cylinders, two H. P., 13 × 26 inches; two L. P., 22 × 26 inches. Drivers, 84 1/4 inches. Heating surface, 1,893 square feet. Steam pressure, 215 pounds. Weight of engine alone, 59 tons.



2.—TEN-WHEEL, COMPOUND, LOCOMOTIVE FOR HEAVY EXPRESS AND FREIGHT SERVICE.

Cylinders, two H. P., 13.8 × 25.2 inches; two L. P., 21.6 × 25.2 inches. Drivers, 68 3/4 inches. Heating surface, 1,950 square feet. Steam pressure, 215 pounds. Weight, engine, 65.6 tons; tender, 45 tons.



3.—EIGHT-WHEEL, COMPOUND, FRENCH LOCOMOTIVE, FOR FAST EXPRESS SERVICE.

Cylinders, two H. P., 13.4 × 25.2 inches; two L. P., 21.6 × 25.2 inches. Drivers, 83 1/4 inches. Heating surface, 1,900 square feet. Steam pressure, 215 pounds. Weight, engine, 56.5 tons; tender, 45 tons.

gines, steam engines, or turbines, and for any other purposes, the small amount of space required, the small amount of power needed, and the neat appearance of the magnetic clutch, will readily commend its use to engineers.

FENCES are easily grown in Cuba from pinon twigs, which are planted in rows a few inches apart.

50 to 60 miles an hour. Of these forty-five trains, ten are timed to run at speeds of over 54 miles an hour. The present article will be devoted to a description of the four-cylinder, compound engines, which have been designed especially for this remarkable service. It is certainly difficult to find in the annals of railroading a parallel instance wherein a railroad company has made such a surprising advance in the number and

ward pair of drivers. The two pairs of drivers, which are 83 1/4 inches in diameter, are connected by the usual coupling rods, the arrangement being similar to that of the ordinary high-pressure locomotive of the Atlantic type in this country. The boiler carries a steam pressure of 215 pounds to the square inch. It is provided with Serpentine tubes, the heating surface of which amounts to 1,768 square feet, which with about

132 square feet in the firebox, making a total heating surface of 1,900 square feet. The weight of the engine loaded is 56.5 tons, and of the tender 45 tons, making a total loaded weight of engine and tender 101.5 tons.

The extreme length of the tender is one of the most striking features of these fine engines, the unusual size being evident even to American eyes, which are accustomed to tenders of liberal proportions. It is made of large dimensions to enable the trains to make long distance runs independently of the coal chute and the water tank. The capacity of the tender is 4,000 gallons of water and $5\frac{1}{2}$ tons of coal.

Of the forty-five runs made by these trains, the fastest is that from Paris to Amiens, a distance of 81 $\frac{1}{4}$ miles, which is run in 1 hour and 21 minutes, at the rate of 60.5 miles per hour. The loads behind the tender vary from 150 to as high as 230 tons. In a recent trip from Paris to Amiens, when the load was 230 tons, a speed of 41 miles an hour was reached on an upgrade of 1 in 125, while a 4-mile stretch upgrade of 1 in 135 was climbed at a minimum speed of 50 miles an hour. The last 28 miles of the journey into Amiens was run under reduced steam in order to avoid a premature arrival, the train, as it was, reaching Amiens 2 minutes ahead of schedule time. Other remarkable timings are that of the express from Paris to St. Quentin, 95 $\frac{1}{4}$ miles, at the rate of 57.4 miles an hour; Amiens to Calais Pier, 104 miles, at the rate of 57.2 miles an hour; Longeau to Paris, 79 miles, at the rate of 56.4 miles an hour; and Amiens to Longeau, 31 $\frac{1}{4}$ miles, at the rate of 56.2 miles an hour. During a trip from Paris to Calais in stormy weather, when one of these engines was drawing a load of 19 coaches, weighing 280 tons, a rate of from 61 to 63 miles per hour, we are told, was maintained on the level in a heavy side wind; while on an upgrade of 1 in 125, the speed never fell below 41 miles an hour, and 75 miles an hour was recorded on a light down-grade.

Perhaps the most remarkable feature of the work done by these compound expresses is the capacity to take a fairly heavy load up a grade with a constant acceleration. Reliable testimony as to the performance of the express trains is given by M. Rous-Marten, who has spent much of his time upon the footplates of express engines in Europe. On one occasion when he was present, the load being 128 tons, two miles from the start the speed rose to 60 miles an hour; at three miles it was 70 miles an hour, and at 4 miles from the start the train was running at 71.3 miles per hour. At this point it commenced to climb a 2 $\frac{1}{2}$ -mile grade of 1 in 200 on which the speed averaged for the whole distance 67 miles an hour. The speed was 68 miles an hour and was still rising when the summit was reached. The descent to Creil was made at the maximum speed permitted by law, namely, 77.5 miles an hour, and along the succeeding 50 miles of the road the average speed was 75 miles an hour. In a subsequent ascent of 10 miles, grade 1 in 133, the speed at starting, after a slow-down due to signals, was 40 miles an hour, and from that the acceleration was constant for the whole 10 miles, reaching 70 miles an hour at the summit, when it was still on the increase. Mr. Marten states that this uphill performance is without parallel in his experience. The run from Paris to St. Quentin, 95 $\frac{1}{4}$ miles, was made at the average speed of 67.4 miles an hour.

Our illustration No. 2 represents another type of engine which follows in some respects American practice. It was built from the design of M. de Glehn for the same railroad, and was intended primarily to run local trains, where quick starting and stopping is desirable, and also for hauling fast freight trains. Occasionally, however, these engines are used for the fast expresses, and they are used regularly on the heavier expresses, especially where the trains have to be taken over heavy grades. These engines have six wheels coupled, the outside, high-pressure cylinders being connected to the middle pair of drivers, and the inside, low-pressure cylinders to the forward pair. The high-pressure cylinders are 13.8 inches in diameter and the low-pressure cylinders are 21.6 inches in diameter, the piston stroke in each case being 25.2 inches. The driving wheels are 5 feet 8 $\frac{3}{4}$ inches in diameter. The boilers are particularly large for European engines, having a total of 1,950 square feet of heating surface, with 24.3 square feet of grate area, the boiler pressure being 215 pounds to the square inch. The weight of the engines loaded is 65.9 tons, and the weight of the tenders is 45 tons, the total weight of the engines being 110.6. The performance of the six-coupled engine is fully equal to that of the four-coupled type and indeed, if anything, it is superior. In a run from Paris to Lille a train made up of twenty-four coaches, and weighing altogether 382 tons, the locomotive put the following remarkable records to its credit. After starting 4 minutes and 14 seconds late, a speed of 53 miles an hour was obtained at the end of the third mile; 8 miles out from Paris the train, after being stopped by a signal at the foot of an up-grade of 1 in 200, attained a speed of 40 $\frac{1}{2}$ miles an hour in the first two miles, the speed increasing steadily to 47 miles an hour, which was maintained to the top of the grade. On the down-grade the speed rose to 68 $\frac{1}{2}$ miles per hour. Later, on 14 miles of an up-grade of 1

in 250, the load of 380 tons was hauled at a speed of from 48 to 51 miles an hour. The time of the whole run was 94 minutes and 34 seconds, the net time being 88 minutes and 40 seconds, and the average speed of 53.3 miles per hour for a distance of 78 $\frac{3}{4}$ miles. These performances, especially on the grades, are exceptionally creditable and speak volumes for the steaming qualities of these fine engines.

Our illustration, Fig. 1, will have special interest for our readers, for the reason that it represents the first American-built locomotive to be used on a French road. It has lately been built by the Baldwin Locomotive Works for the French state railways. In all its essential particulars it is of distinctively American type. Like the French engines we have above described, it is a four-cylinder compound, the system in this case being the well-known Vaucrain type, in which the high-pressure cylinders are placed above the low-pressure, and connect to a common cross-head, the connecting-rod being coupled to the forward pair of driving wheels. The high-pressure cylinders are 13 inches, the low-pressure 22 inches in diameter, the diameter of the stroke being 26 inches. The valves are of the balanced piston type; the boiler is 58 inches in diameter and carries a working pressure of 215 pounds. The firebox, following the French custom, is of copper; there are 282 2-inch tubes, 12 feet 1 inch in length. The heating surface is divided as follows: Firebox, 128 square feet; tubes, 1,764 square feet; making a total of 1,892 square feet. The grate area is 25 $\frac{1}{2}$ square feet. The driving wheels are 84 $\frac{1}{2}$ inches in diameter, and the truck wheels 36 inches. The weight on the drivers is 34.9 tons, and the truck 24.1 tons, making a total weight for the engine of 59 tons. The tender is to be furnished by the company.

The chief points of difference between this engine and one built for an American road, it will be noticed, lie in the absence of the pilot and bell, and in the fact that the firebox is shorter, bringing the driving wheels closer together than would be customary in an American engine. It is to be regretted that this first locomotive built in America for a French road is not to be put in service on the Northern Railway of France, for it would then be possible to make some comparison of results between it and the celebrated compound locomotives of M. de Glehn.

New Practice in the Copyright of Photographs.

The following interesting article on the copyright of photographs, and the great hardship often inflicted through the severe penalty provided by the present law irrespective of the merits of the case, is republished from a recent issue of *The New York Sun*.

It has been a notorious fact for a long time that many photographic establishments have made a regular practice of levying a species of blackmail upon publishers, who have, unwittingly perhaps, published a copyrighted photograph without permission. It is not necessary that any damages should be proved, it being sufficient to establish the fact of the infringement. The penalty in many cases would amount to many thousands of dollars, while the photograph had, perhaps, no value whatever. The article says:

The law of copyright in its application to photographs is being interpreted through recent decisions of the Federal courts nearer to the evident intent with which it was enacted. The purpose of the law in declaring a property right in photographs was to enable a person photographed to retain control over his or her printed likeness and to prevent unauthorized use of it in publications or otherwise. The law had been turned so far from its original purpose that people rarely heard of a person photographed seeking its protection for his or her own sake, while attempts by photographers to mulct publishers who had used copyright photographs, often unwittingly, have been so frequent as almost to bring the law to scandal. The law's mandatory provision that for the infringement of the copyright \$1 should be paid to the holder of the right for each reproduction of the photograph made it possible in the case of publications of large circulation for a litigious holder of a copyright to descend upon publishers with ruinous claims.

This was so well understood that many more cases of infringement were settled out of court than came to trial, so as to avoid the expense and annoyance of litigation and sometimes the high damages which the letter of the law ordered. In the case of a newspaper these damages would be punitive beyond the intent of the law makers. It has been testified to in court in this city that many of these outside settlements have been made. If a man or woman photographed had been injured, little objection would have been heard, but usually the effort was by a photographer to collect alleged damage to his business. In England, as in this country, litigation increased rapidly after the extension of the copyright law to cover photographs was made.

The work of reducing the exorbitant damages possible in collection for infringement of the law in regard to photographs was begun last month. The Supreme Court, in the case of *Bolles against Outing*, declared that the penalty specified in the statute could

only be recovered "for each copy of the infringement which at the time of the announcement of the action was found by the photographer to be in the possession of the magazine and available for seizure, and that no penalties can be collected for such copies as had been previously distributed and sold."

This disposed of the opportunities to mulct publishers in \$1 for each copy of a photograph used, which in the case of some publications would mean a handsome fortune for the plaintiff and ruin for the publisher, even if he had done no real damage and though the person photographed was neither injured nor offended. On December 14 another decision in a Federal court defined further the line of demarkation between injuries and privileges which the law intended to confer and the damages which photographers, who might under certain circumstances share in the law's benefits, have sought to show and in one way and another to recover penalties for. Suit was brought in Denver, in the United States Circuit Court, by the Detroit Photograph Company, of Detroit, to restrain Frank S. Thayer, bookseller, of Denver, from selling copies of a colored photograph of "The Palisades and Alpine Pass," made by W. H. Jackson in a publication sold by Mr. Thayer entitled "Colorado in Color and Song." The point was raised whether a man could claim a copyright in a photograph of natural scenery, even if he colored it himself. Judge Hallett ruled that "a photograph of natural scenery is not the subject of copyright, because it is not an original conception of the artist. It is merely a skillful manipulation of the camera. Further, it is not shown that there was any originality about the coloring of the photograph in question, and it was shown in the defense that the result achieved was old and in common practice."

Recently the question of the application of the Copyright law to photographs came up in the United States Circuit Court for this district before Judge Wallace and a jury. The Copyright League's counsel, Lewenson, Kohler & Schuttman, instituted a suit for \$5,000 damages against Zucker, Levett & Loeb, who make a household preparation that has been advertised by a poster in which appears a woman's figure. It was contended that the figure was reproduced from a photograph of a chorus girl in a Broadway theater which had been made and copyrighted by Jacob Schloss. Schloss testified that he had made the photograph, that he had instructed the young woman how to pose to make the picture artistic and that he had then copyrighted the photograph. He brought one of the photographs to court.

The defense, represented by Simpson & Werner, said that an advertising poster design had been ordered by them from Gibbs & Williams, lithographers; that they had supposed the design original, and that they had ordered several thousand posters for use in cars. So soon as some of these had been put in the street cars a clerk of the prosecuting law firm, with a summons and a complaint, and accompanied by a United States marshal, called on the defendants, who were advised, one of them said, to settle the claim made for violation of the Copyright law. This suggestion the defendants decided not to comply with, not believing that they had violated the law, and holding that if it had been violated, the publishers of the posters, the lithographers, were the ones who had infringed the copyright. Their counsel contended that the photograph in question was not artistic and was not a proper subject for copyright. This issue Judge Wallace gave to the jury to determine as a matter of fact. The jury decided for the defendants. If the precedent set by this case stands, it may be found that the copyright on photographs of stage and platform celebrities is without value.

The United States marshal found 5,000 of the posters which it was alleged infringed the Schloss copyright in the possession of the defendants, and under the mandatory provision of the Copyright law this would have enabled the recovery of \$5,000. Schloss testified on cross-examination that he had taken out copyright on many photographs of actresses, and that a number of suits for infringement had been instituted by him, most of which had been settled out of court.

Most of such claims in this country have rested, it is said, on a decision in a suit brought some years ago by the late Napoleon Sarony concerning a photograph of a British aesthete whose name attracts little attention now. The decision governing in England since copyright extended to photographs was given in 1888 in the case of *Pollard against the Photograph Company*. A few years ago *The London Times* published letters which showed the great number of claims made in that country after the enactment of the law creating a copyright in photographs. The recent decisions in this country would seem to indicate a diminution of such claims here in the future.

THERE is a vigorous protest being made against the new sewage farms near Paris. All of the local wells are infected, and there is an epidemic of intestinal troubles. The sewage seems to escape between fissures in the soil into subterranean sources of supply to the wells.

Science Notes.

The earthquake in the province of Tiflis has been very severe. Many villages have been destroyed, and the bodies of 800 villagers were found.

The Chief Commissioner for the Paris Exposition of 1900, M. Picard, is sanguine about the completion of the buildings at an early date. Many of the buildings are now ready for occupancy.

Prof. Kreutz, of Kiel Observatory, has telegraphed to the Harvard College Observatory that a comet was discovered by Giacobini, at Nice, January 31, in right ascension, 2 hours, 57 minutes, 44 seconds and declination $-70^{\circ} 55'$.

The Egyptian government has appointed an Englishman as inspector of antiquities; Mr. Howard Carter was selected. He has been for many years identified with the Egyptian Exploration Fund. He will make an archaeological survey of the Soudan.

We have been favored by a correspondent in Germany with a post card on which is printed a red strawberry. When the strawberry is exposed to heat, the color of the fruit blanches and disappears. It can be brought back to its original red color by blowing the moist breath upon it.

The annual exhibition and reception of the New York Academy of Sciences will be held at the American Museum of Natural History on the evenings of April 25 and 26. Specimens, apparatus, and collections illustrating the advances in science and researches during the year will be shown.

One of the most interesting features of the Paris Exposition will be the restoration of Pompeii. Not the familiar ruins, but the living city will be represented, and arrangements are being made to have the finest spectacular performance in the world, and the work is making remarkable progress.

According to A. Gautier, arsenic is constantly present in the thyroid gland, apparently like phosphorus and iodine, combined in the nucleins. Arsenic is also found in minute quantities in the spleen and in the skin, but no other organ gives even the faintest trace. This precise limitation of its occurrence has important toxicological significance.

The Secretary of the Interior has decided that the models in the United States Patent Office cannot be removed for the purpose of displaying them at the Paris Exposition. Commissioner Peck was desirous that an exhibit should be made, but it was decided that the models were records of the office and could not be removed under the law.

The pilot chart of the North Atlantic Ocean issued by the Hydrographic Office at Washington, for January, contains a chart showing the average track of 121 storms over the North Atlantic during the ten-year period 1889-98. The chart shows that the region of maximum storm frequency for that month lies to the north of the steamship routes in a belt extending northeast from Nova Scotia and Newfoundland across the Atlantic, says Nature. Some of these storms are the most severe, the largest in area, and the longest in duration, and may be traced clear across the ocean, while others disappear to the northward. The storms are divided into nine classes according to the regions in which they first appeared.

In Nature P. Q. Keegan describes a series of experiments with the object of deciding between the view of Berzelius that the original color of anthocyan is red and that of Wiesner that it is blue. His conclusion is, on the whole, favorable to the former hypothesis; but he believes that there are different stages in the development of the floral pigment. In the lower stages the natural color is red, whatever the chromogen may be; while in the higher stages the natural color of anthocyan is blue: or rather, at least with some chromogens, it becomes capable of forming blue compounds with alkalies and certain metallic acids. There also exist chromogens which, except under very exceptional conditions, are incapable of producing a blue pigment. These, in all stages, naturally develop into a red, the brilliancy of which unquestionably attests its real, original and proper character.

We have been favored by Mr. Duane Doty, Civil Engineer of the Pullman Company, with the annual statement relating to the operatives and wage earners at Pullman, Ill. A canvass of them shows that there are 7,152 persons employed in the various industries which are carried on at that place. 6,858 being males, and 294 females. Of the total 7,152, 1,544 are reported as renting homes in Pullman, 1,698 as boarding in Pullman, and 3,242 in all reside in Pullman. Nine hundred and fourteen own their homes, 1,599 own homes outside of Pullman, and 1,397 board outside of Pullman, or 3,910 neither reside nor board in Pullman. The average length of time these working people have been employed at Pullman is a little more than $6\frac{1}{4}$ years. The nativity of these 7,152 workers shows that there are 2,906 native-born Americans; 1,489 Scandinavians; 714 British; 817 Germans; 205 Russians; 146 from Belgium, France, Italy and Switzerland; 616 from Holland, and 259 from other countries.

Engineering Notes.

Two mining experts have gone to Erythrea in order to investigate the nature and extent of the gold-bearing reefs. The Italian government is hoping that operations on a considerable scale will prove profitable.

Some of the employees of the Pennsylvania who are past 70 years of age are unwilling to retire on a pension, says The Railroad Gazette, and one of these remonstrants is a baggageman on the New York and Chicago Limited who is 91 years old.

The German railway authorities are considering a proposal to abolish return trip tickets, holiday excursions and all special rates, says The Railway Review, thinking by this means they will be enabled to reduce the regular fares one-third with no resulting loss.

The Shelton Street Railway Company has settled the last of the claims for damages arising out of the terrible accident of August 6th, 1899, when 29 persons were killed and 12 injured. The terms of the settlements have not been made public, but are said to be considerable.

In all probability a steel plant will be established at the United States Arsenal at Watertown, Mass. The necessity of such a plant has been apparent for some time. The force of men are at present at work turning out the guns for the protection of Nantasket, Rocky Point, Baltimore and Galveston.

The total Russian petroleum production of the principal districts for the ten months amounted altogether to 7,882,447 tons compared with 8,355,310 tons for the corresponding period of 1898. Of this quantity, 6,646,972 tons were obtained by pumping and 1,235,574 tons were received from spouters.

It is a practice with ocean liners to save up their soiled linen, towels, etc., until port is reached, and passengers are obliged to do the same thing. Now, however, the steamship "New England" of the Dominion Line has been provided with a complete laundry for caring for the wash of the ship and that of the passengers as well. It is capable of handling 7,000 pieces of linen a day.

The last rails were laid on the Trans-Baikal section of the Siberian Railway on December 28, thus completing that part of the enterprise and establishing a communication between western Europe and St. Petersburg and the eastern limits of the Russian empire on the Pacific coast. The length of this section is 693 miles, says The Engineering and Mining Journal. The trains are transported across Lake Baikal on an ice-breaking ferry boat. The rail line is under construction from Sretensk, through Manchuria to Port Arthur.

The United States Bureau of Labor has been investigating the effect of displacement of hand labor by machinery in the iron and steel trade. It was found that in 1857 a rifle barrel took 98 hours to make by hand. It is now made in 3 hours and 40 minutes. Half-inch bolts 6 inches long with nuts were made by hand at the rate of 500 in 43 hours, while by machinery the same product is turned out with only 8 hours labor. In 1835, 100 feet of 4-inch lap-welded pipe required over 84 hours of labor, while in 1895 the same product was turned out in 5 hours.

Consul Graham, of Winnipeg, under date of December 23, 1899, writes: The Dominion Government has undertaken the improvement of St. Andrews Rapids in the Red River of the North, to facilitate the navigation of that river. These rapids obstruct the river about 18 miles from its outlet into Lake Winnipeg. They are about 8 miles in extent, and are the only serious obstruction to navigation between the international boundary and the lake. It is proposed to construct a system of dams and locks, with a lift of about 18 feet. The estimated cost of the work is \$700,000 to \$800,000. An appropriation of \$150,000 has been made and is now available. The necessary surveying has been done and plans and specifications are now being prepared. A call for tenders for the construction will soon be made, and it is expected to have the work under way in the early spring. I trust that a number of American contractors will bid for the work.

We have already referred to the buffet car enterprise at Chicago; further particulars are now at hand. The cars will seat twenty persons, and the excess fare will be five cents. The crew consists of a conductor and porter, who will have charge of the small lunch counter and urns. Under this system, says The Street Railway Journal, a man may take his friends and customers to luncheon and show them the city at the same time. It will be very advantageous for the theatergoer who lives far out, and would like a supper after the performance ends. He may not wish to stay downtown and wait for the cooking of a supper, specially as he and his party may miss the last car. In the buffet car he will not only be getting what he wishes, but will be taking his party home at the same time, and will probably save the cost of a carriage and other expenses. The cars will be conducted as well as any transcontinental dining car.

Automobile News.

The Serpollet Company has constructed an artificial hill of 19 per cent grade on their property, on which to test their automobile vehicles.

The Berlin Electric Lighting Company is about to carry out some trials with automobile wagons for the conveyance of coal to their lighting stations, says The Motor Car Journal.

The electric cab and carriage service in Chicago has proved very successful. Notwithstanding the unfavorable conditions under which the company has labored as to stations, etc., the receipts have increased very largely.

The electric ambulance for St. Vincent's Hospital, New York city, is now completed and it is a most handsome vehicle. It is steered by the front wheels, with two 2-horse power motors driving it. Solid rubber tires are used and a rawhide gearing to lessen the noise of the machinery. The interior is lighted by a 10-candle power electric light.

The Street Car Men's Union of Cleveland, Ohio, are now building a large automobile stage, which is to be put in operation shortly on the Broadway route in Cleveland in competition with the Consolidated Company's cars, says The Street Railway Journal. The new carriage is $22\frac{1}{2}$ feet long and resembles a street car. It has a seating capacity for thirty persons and is equipped with a 30 horse power gasoline engine.

It is said that fifty-five automobile wagons have been specially built in Paris for inland service in Africa, says The Western Electrician. They will be used in the Congo Free State to transport freight and passengers from the present terminus of a railroad at Badunbe to the upper and lower Niger. As the railroad construction advances, the automobile routes will be shortened, and after the completion of the railroad the wagons will be transferred to the other side of the Niger, which will be connected by automobile routes with important places in the rich western Soudan. It is said that the new transport service will be much cheaper than human portage.

It is a curious fact that in France automobilists are obliged to make a declaration as to the quantity of hydrocarbon which they carry as fuel, at the gates of cities and towns, to the local customs officials of the "octroi," and The Motor Car Journal says that a service of motor omnibuses was about to be inaugurated between Sedan and Bourillon, the latter town being situated in Belgium. Although two-thirds of the projected route is on French territory, the French customs authorities demanded duty on the liquid hydrocarbon employed by the motor vehicles as fuel, and the promoters of the scheme preferred to abandon the scheme rather than comply with the extortionate order.

The Tailor and Cutter, of England, has considered the correct attire for automobilists and suggests the following: A double-breasted reefer, cut moderately easy-fitting in the body and fastened up to the throat, the neck being finished with a Prussian collar, the ends of which are placed under the top button, thus keeping it in place. Pockets are inserted in the fore part vertically, thus enabling the wearer to use them with greater ease than would be the case with the ordinary breast pocket. The material should be of herring-bone cheviot of some dark color, in order that it will not readily show dust or oil stains. The sleeves are finished with a tab, which can be fastened so as to bring them quite close to the wrists.

Juvenile Research.

Prof. H. E. Armstrong, F.R.S., described, in an interesting address before a conference of science teachers held at the Imperial Institute, the methods he had employed with his own children at home to educate them in the way of discovering for themselves the answers to questions which were presented in their daily life. The address was illustrated by practical demonstrations by Prof. Armstrong's little daughter and two sons, and a series of lantern slides made it quite clear how the system described had been developed. In reading a book by the late Henry Drummond, called "The Monkey that would not Kill," the children came across the statement that a stone weighs lighter in sea water than in air, and to satisfy them of the truth of the statement was the object of the piece of research which the children entered upon under the general supervision of their father. The steps in the inquiry were worked through again before a large audience, and the children themselves explained with remarkable intelligence what the object and result of these experiments were. Throughout the course of training, which was exemplified by the demonstration, each child kept a careful account of everything which was done, illustrating each step by means of sketches and recording every numerical result obtained. Prof. Armstrong maintained, says Nature, that the teaching of science to children was not commenced at an early enough date and that too little faith is shown by teachers in the reasoning faculties of young children.

Models of the Navy Vessels.

The model shop of the United States navy is a part of the Bureau of Construction and Repair, and is under the direction of Rear-Admiral Hiebhorn. It is in the northwest corner of the house sheltering the marine railway in the Washington navy yard. Here are made exact reproductions of our war vessels from keel to truck and from stern to stern, only the models are, of course, on a very small scale. The workmen use the scale of a quarter of an inch to the foot, and the regular blue prints are used. The builder first lays the keel piece, then carves out another blank to make a horizontal section of the hull and glues it firmly above the keel piece, and by successive layers, each carrying approximately the shape of the hull for a new section, wood is added until the entire model is completed. The rough edges that remain after shaping and building up the hull are finished with knife, plane, and sandpaper before the paint is applied. Other model makers are engaged in making the tiny guns of different calibers, which are made of steel. The gun mounts are exact reduced copies of those actually in use on the war vessels. All the fittings are made with the utmost fidelity. The government possesses models of a large number of war vessels, says The New York Times, from which we glean our facts, and the larger ones are quite expensive, the "New York" and "Columbia" costing \$7,000 and even the small ones cost \$2,000, including the case. In all, something like \$75,000 has been spent on models. It is considered, however, by the Navy Department that the money is well spent. The models are exhibited at various expositions which have been held throughout the country and have been seen by many thousands of visitors and doubtless many will never see the real warships. The completed models are to be seen ordinarily in the hall at the main entrance to the Navy Department at Washington, and in the hall above, just outside the door to the reception room of the Secretary of the Navy, and they are a never-failing source of interest to visitors. Several of them will be exhibited at the Paris Exposition.

AUTO-QUADRICYCLE AT THE BICYCLE AND AUTOMOBILE SHOW.

Continuing our notice of the display of automobiles at the recent Bicycle and Automobile Exhibition at the Madison Square Garden, New York, we now present illustrations of the auto-quadracycle, a four-wheeled vehicle which is arranged to carry two persons, tandem fashion, one in front on an upholstered seat of the kind commonly used in a buggy, and the other on a saddle, of the bicycle type, in the rear. It will be noticed that this compact little machine marks a transition stage between the bicycle and the automobile, retaining many features of the one and embodying the essential features of the other.

The framing of the auto-quadracycle is arranged in three fore and aft planes. The central frame, which carries the saddle, is of the standard diamond frame construction, except so far as the rear stays and forks are spread and additional stays inserted to accommodate the necessities of a four-wheel vehicle. On either side of the center frame is a light frame built up of angle iron and steel brackets. The whole is well braced together and forms a light but very strong construction. The machine is carried upon four 26-inch wheels of the common bicycle type with $2\frac{1}{2}$ -inch pneumatic tires. It is 7 feet 6 inches in length, 3 feet 6 inches in width. The motive power is supplied by a gasoline engine of the Otto type with a flange-cooled cylinder, which is mounted over the rear axle, and when running at economical speed develops $1\frac{3}{4}$ horse power. The band brake on the rear axle is controlled by a lever at the handle bar of the ordinary bicycle type. The speed may be controlled from five to twenty-five miles per hour. When it is complete, all ready for service, this machine weighs only 350 pounds. It was built at the factory of the Canda Manufacturing Company, Carteret, N. J.

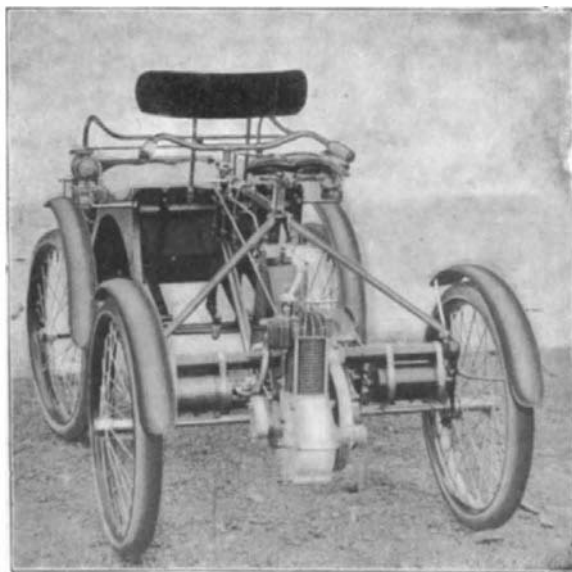
R. H. BIFFEN describes a fungus belonging to the Hypocreaceæ found on germinating cocoanuts, which has the property of breaking up the oil contained in the endosperm. The reproductive bodies observed were megaconids, microconids, pycnidiospores, and peritheces; but no ascospore could be discovered in the latter. The author attributes the property of splitting up oil to an enzyme, which can be obtained as a flocculent precipitate by the addition of an excess of absolute alcohol.—Annals of Botany, 1899, p. 363.

Old Fort Ancient.

BY W. G. IRWIN.

One of the many remarkable relics of prehistoric races to be found in the upper Ohio Valley is old Fort Ancient, in Warren County, Ohio. Grass-grown circumvallations, shaded by majestic trees moss-grown with age, and stray mounds containing broken pottery, fragments of bones, arrowheads, and buried altars where the sacrificial ashes still linger, mark the former home and final burying place of an unknown race.

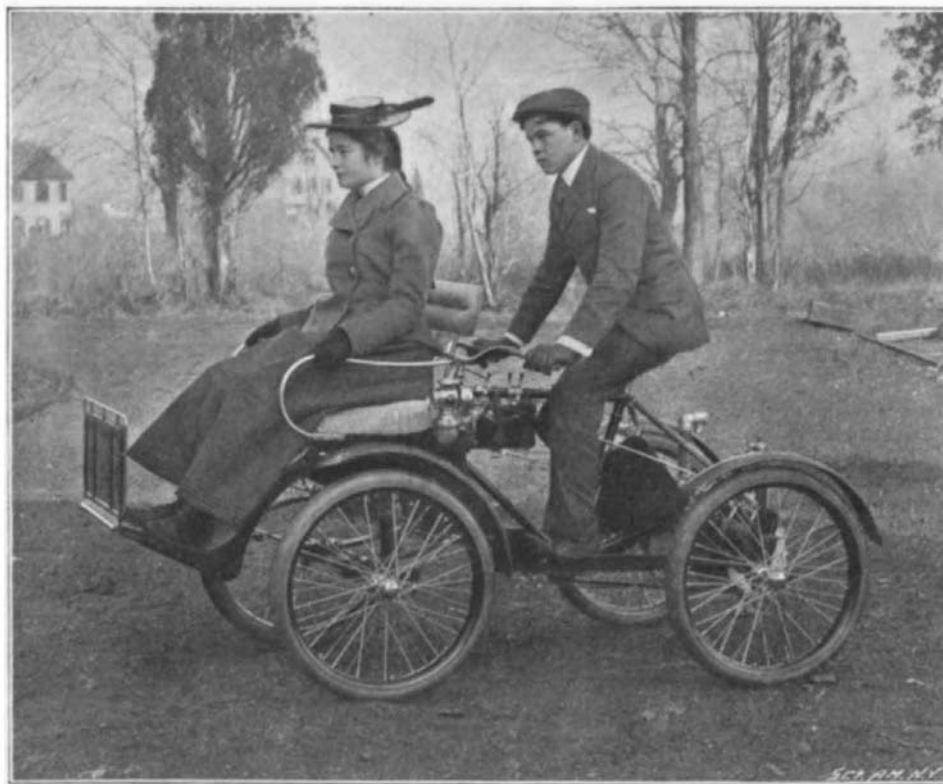
The old fort is located close to the banks of the Lit-



REAR VIEW OF QUADRICYCLE, SHOWING THE GASOLINE MOTOR.

tle Miami and is surrounded by fully 5 miles of breastwork. This outer earthwork follows the irregular line of the hill, its greatest length north and south being about one mile, while its greatest breadth is probably half that distance. It is 10 to 20 feet in height and its thickness at the base is fully 75 feet. The outline is not unlike North and South America, and the fanciful theory that the mound builders designed to imitate the form of these continents has been advanced.

At a point to the east, where there is no natural defense, there are parallel walls run out from the main embankment which extend nearly half a mile, the parallels being about 300 feet apart. At the eastern termini of these are two small mounds, which probably served as watch towers. In the entire wall there are seventy openings, some of which have been made by the action of the water, while others, it is almost



AUTO-QUADRICYCLE EXHIBITED AT THE BICYCLE AND AUTOMOBILE SHOW.

certain, were used for exit and entrance to the fort. Trees which are over 200 years old are now growing from the walls, and much of the earthwork is covered with trees and bushes which will protect it for ages to come.

The fort is divided into three sections: the northern, which is called the New Fort, from indications that it was built last; the Middle Fort, which is narrow and had gateways and walls dividing it from the others, and is thought to have been designed as a citadel; and to the south the Old Fort. Opening into it from the Middle Fort is the Great Gateway, which is flanked on either side by a large mound. This central point is perhaps the most interesting of all. Bones, weapons, and other signs of human occupancy which have been

found lying near the surface, indicate that a battle once raged at this point. In the Old Fort is a part known as the cemetery, where many stone graves have been located. When the earth is removed, the stones are found in regular order on the top of the grave, making a complete covering, and beneath the stones the skeletons are found buried in the earth. Weapons and pottery are also found in the graves.

The skeletons which have been exhumed in the fort, and nearer the surface, are supposed to be the remains of those who fell in battle; while a large number of human bones found on the west side of the hill under a pile of stones are supposed to be remains of enemies who were interred after the battle. The skulls that have been exhumed are of two classes, the long heads and the broad heads, which indicate either that two races have occupied the fort, or that its occupants were a mixed race. The arrow heads and spear heads are of several kinds of flint, red, white, black, and yellow. As flint is not found in the vicinity, the natives doubtless procured their supplies from other sections. A few pieces of quartz arrow heads as well as pieces of quartz have been picked up. Specimens of copper, hammered in the cold state, have here been discovered, as have perforated ceremonial slates. The pottery bears a resemblance to that found in the mound ruins of Western New York, rather than in those of Tennessee. Some of it is decorated with curved lines, some with dots, while some bear the marks of wicker-work.

There is but one natural spring within the walls of Fort Ancient, and there has been considerable speculation as to where the people obtained their water supply during times of siege. At several places there are indications that artificial reservoirs were constructed, and there are also traditions of a subterranean passage to the river. Within the inclosure there are many evidences of long occupation. Weapons of all shapes and sizes are found, and the flint flakes, the chips of their weapon making, are innumerable. The circles of lodges are discernible as depressions, and half a century ago these were more numerous. In the valley of the west are the remains of two villages, one above the other. From the older village at a depth of 5 feet the pottery obtained resembles that found in the fort; while that of the upper village, at a depth of 2 feet, is of ruder manufacture. Numerous graves as well as the ash-pits of these villages have been opened. Some of the skeletons are well preserved. Bones of animals and the antlers of deer have been dug up, and shells of the mollusks which flourish in the river on whose banks the village stood are found in the graves and in ash heaps, showing that they were used as ornaments, and that their contents were appreciated as food. The natives valued the pearls that these mussels produced, and there is a theory that the great heaps of shells at the mouth of the river were cast there by pearl hunters.

To the north and south part way down the Fort hill and on the hills opposite, are terraces 20 feet in width, which extend distances of several hundred feet. These, like the stone pavement which lies between the parallel walls, are a puzzle to antiquarians. They are the only specimens of pavement known to have been the work of the aborigines, and two suggestions have been made as to their purpose; one that it was used for games, the other that it was a place for sacrifices.

Thousands of relics have been already carried away from the Old Fort and its vicinity, and many good specimens can still be easily obtained. The Smithsonian Institution made a survey in 1892, and numerous relics were exhibited at the World's Fair. As early as 1820, the walls of the Fort had been opened; but there yet remains much to be done in the way of a complete study and exploration of this great work of prehistoric man.

The similarity of the weapons and of the mound indicates that one people inhabited the whole region. We may conclude that Fort Ancient was a citadel erected by a union of forces as a retreat in times of danger.

There are few Indian traditions which throw any light upon the history of these great pre-historic works. As to the age of the Fort, it has been asserted by some to be four thousand years old; but the weight of opinion is that one thousand will cover its existence. Meanwhile the walls of old Fort Ancient, the graves of the moundbuilders, their tools, implements, weapons, relics of their spoils and the ashes of their fires, are mute as to the origin or destiny of the race.

ALUMINIUM tubing used in the sciences is made so fine that 1,000 feet of it weighs but a single pound.