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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RETROSPECT OF THE YEAR 1908.

Industrial Conditions.

Although the industrial and financial depression which marked the early months of the past year was deplorable, there is some satisfaction to be derived from the fact that the commercial fabric of the country, considered as a whole, has passed through such an exceedingly trying ordeal with so comparatively few disasters of the first magnitude; a result which testifies to the greater stability of our financial and industrial institutions, and proves that the people as a whole are less liable than formerly to become the prey of a wild, unreasoning panic. Institutions which in former periods of financial stringency would have gone down into irretrievable ruin, have passed through their period of receivership, and, after reorganization, have resumed their activities upon a sounder basis and with every confidence of future permanence. The closing months of the year have witnessed a gradual, but unmistakable improvement in conditions, the most encouraging feature of which is the absence of that tendency toward artificial stimulation of business, which has been one of the marked features of recovery from the panics of former years. This spirit of conservatism augurs well for the permanence of the era of prosperity upon which we have undoubtedly entered.

Civil Engineering.

Of all branches of industrial activity, those which are covered by civil engineering have ever been the first to feel, and the last to recover from, a period of depression. During the greater part of the year a great amount of engineering work was either closed down altogether, or the force was reduced to what was necessary merely to keep the plants in order and prosecute such work as was absolutely necessary. One of the most encouraging signs of the present revival, however, is the fact that most of these enterprises are again being carried forward on something of the extensive scale which marked the activity of the preceding year.

PANAMA CANAL.—In spite of the many alarmist rumors which have recently been started regarding conditions on the Panama Canal, it may be stated, without any qualification, that the work has been carried on throughout the year at a speed and with a success beyond the most sanguine expectations. With the arrival on the Isthmus of the complete excavating plant and other collateral equipment, there was a remarkable acceleration of the work. The total quantities of monthly excavation rose from 2,709,613 cubic yards in January to a maximum of 3,480,270 cubic yards in March, the last being the highest monthly record for the year. With the advent of the rainy season there was a natural falling off in results; but the total for the month of November reached 2,920,494 cubic yards, which was the highest ever made in the rainy season, and was over 1,000,000 cubic yards more than the excavation in November of the previous year. If the present rate of work be maintained, the whole of the total amount of 142,000,000 cubic yards will have been taken out in about two and one-half years from the present date. The present satisfactory conditions at the Isthmus reflect the greatest credit upon the army engineers who, under Col. Goethals, have full control of the work of building the canal. As to the probable time of completion, it has become evident that this will depend upon the time necessary for constructing the Gatun dam and locks. The latest estimate of Col. Goethals sets the time for the opening of the canal for navigation in the early months of the year 1915. Several very important revisions have been made of the original plans, including an increase in the clear width of the locks to 110 feet and the usable length to 1,000 feet. At the Pacific end of the canal a revision has been made, which involves the sustitution for a flight of two locks at La Boca and one at Pedro Miguel of one at Pedro Miguel and two at Miraflores. The advantages of this plan are that the dams can be built of lower height and less length, and that they will be founded upon rock lying comparatively near the surface. Moreover, being further inland they will be protected against all possibility of distant bombardment from the sea. During the year exhaustive examinations have been made of all the lock sites and also of the site of the Gatun dam and spillway, with the result that the army engineers, who are always strictly conservative in their judgment, express themselves as satisfied that these structures will rest upon stable foundation having a wide margin of safety for carrying the load imposed. The excellent sanitary conditions brought about by Col. Gorgas have continued throughout the year, and the United States employees on the Isthmus are living under conditions which compare favorably in point of health with those of the average city in the United States.

WATER SUPPLY AND IRRIGATION.—There never was a time when so much activity was manifested in the construction of reservoirs for water supply and irrigation. Foremost among those designed for municipal service is the Catskill water supply which, when the whole scheme is completed, will be capable of supplying New York city daily with over 700 million gallons of pure mountain water. That portion of the scheme now under construction includes the building of a dam and reservoir with a full level capacity of 170 billion gallons, capable of supplying the city with 250 million gallons of water a day, and the construction of an aqueduct 17 feet in diameter and 90 miles in length from the reservoir to New York. The construction of the dam and certain sections of the aqueduct is under way, and the present indications are that water will be delivered into the Croton watershed within the next five years, and that the aqueduct will be completed to the city within the next seven or eight years. During the year rapid progress has been made on the Croton Falls reservoir, in the Croton watershed, which will add an additional 14 million gallons of storage, bringing the total storage capacity of the watershed up to 104,530,000 gallons. The most important national undertaking of the time is the work being done by the United States Reclamation Service in the irrigation of so-called desert lands. The whole scheme when completed will render available for cultivation nearly 5,000 square miles of land which now is barren for want of water. The work is widely distributed and includes no less than twenty-five separate projects in the States lying west of the Mississippi River. The most important of these involve the reclaiming of from 100,000 to 400,000 acres of land, and will necessitate the construction of some of the loftiest dams and largest reservoirs in the world. Excellent progress has been made during the year, particularly upon the great Roosevelt dam, a masonry structure 284 feet in height and 1,080 feet long, which will store 1,284,000 acre-feet of water. Two other notable dams are the Shoshone, 326 feet in height, which will store about half a million acre-feet, and the Pathfinder, 215 feet high, with a storage capacity of over 1,000,000 acre-feet. The New York State Barge Canal, which, because of its great length of 442 miles, must be considered one of the greatest undertakings of the kind in history, is at last making something like satisfactory progress. It is being built with a least depth of 12 feet and a least bottom width of 75 feet to accommodate barges of 1,000 tons capacity. Leaving Lake Erie at an elevation of 565.6 feet above sea level, it enters the Hudson River near Albany at tide level. It requires the excavation of 133,000,000 cubic yards of material, and its total estimated cost will be $101,000,000. During the summer material was excavated at the rate of over 1,000,000 cubic yards per month, which is about equal to the amount taken out at Panama during the corresponding year of active operations. The work of increasing the height of the Assouan dam in Egypt, as planned by the late Sir Benjamin Baker, has been made the subject of spirited criticism on the ground that it will be impossible to secure a satisfactory bond between the old and the new work. To insure that the dam would have ample stability, it was decided to widen it by 15 feet, building the new masonry upon the apron which was built a few years ago to protect the toe of the dam from erosion. The additional work is being built with an 8-inch space between the face of the old work and that of the new, the two portions being tied together by steel beams. When the new work has been completed and its temperature has reached that of the older work, the intervening space is to be filled with concrete and thoroughly grouted up.

BRIDGES.—It begins to look as though in the domain of bridge construction our annual review was to be a record of disaster or failure, at least as regards bridges of the first magnitude. Last year the most notable event was unquestionably the tragic fall of the Quebec bridge, and certainly the most sensational event of the present year was the discovery by a special commission that the other mammoth cantilever structure, that across the East River at Blackwell's Island, would, if completed upon the present plans, have been even more seriously overstressed in some of its members than was the Quebec bridge. Coming so soon after the Quebec failure, the Blackwell's Island fiasco has struck a severe blow at the prestige of American bridge building. It is but fair to point out, however, that had it not been for the pernicious effect of political changes upon the Bridge Department of this city this magnificent structure would not be in its present deplorable condition. Nevertheless, it is a fact that experience with the Quebec and Blackwell's Island bridges has produced a certain revulsion of feeling on the part of bridge engineers against the cantilever system for bridges of over 1,000 feet span, particularly where the live load is of an unusually heavy character. Under these conditions the suspension bridge, with a well-stiffened floor system, presents undoubted advantages of economy and safety. During the year plans were made public for a mammoth arch bridge of reinforced concrete with a span of 703 feet, which it is proposed to build in this city as a memorial to Henry Hudson. As this span will be more than double that attempted in any previous arch bridge of the same type, it has been urged that, in view of our somewhat limited knowledge of the behavior of reinforced concrete, the erection of a bridge of this size involves no small amount of risk. On the other hand, the reinforcement constitutes in itself a steel arch of unusual strength and rigidity, and it is claimed by the designers that a collapse of the structure is thereby rendered practically impossible. The question of the construction of a bridge across the Hudson River, which engineers generally believed to have been answered in the negative for all time to come, has been again brought to the front by the action of a joint commission of the States of New York and New Jersey, which has reported in favor of building the bridge, if a suitable site can be found. If it be built, its location must be placed somewhere above 110th Street, since the prohibitive cost of real estate would prevent its erection anywhere south of that location. The bridge, moreover, must necessarily be reserved for vehicular, trolley, and foot passenger traffic, the cost of constructing it for the operation of heavy railway trains being too great for serious consideration.

The construction of a four-track railway arch bridge of 1,000 feet span across the East River at Hell Gate, after having been postponed on account of the recent financial stringency, is about to be undertaken by the Pennsylvania Railroad. This will be by far the largest and heaviest arch bridge of any kind in the world.

TUNNELS AND TERMINALS.—Progress on the large amount of tunnel and terminal work in and around New York city has been seriously delayed by the industrial depression. Both the Pennsylvania and the New York Central railroads have maintained a limited working force on both of their extensive projects, although with the bettering of conditions toward the close of the year, the working forces have been increased and the work pushed forward with considerable activity. The Pennsylvania tunnels beneath the Hudson and East Rivers and beneath Manhattan Island have been completed so far as the excavation is concerned, and the work of lining them with concrete is now in progress. The terminal station is well on toward completion, as far as the steel work and granite facing are concerned; but a vast amount of work remains to be done in the laying of tracks and the interior finish. The latest official announcement sets the date of opening of this system early in 1910. During the year the old trainshed of the Grand Central Station, New York Central Railroad, was removed; a large number of tracks were transferred from the old level to the lower level at the temporary Lexington Avenue station, and the work of excavating the 45-foot depth of rock is being pushed as rapidly as the restricted conditions will allow. At the present rate of progress it will take at least four years to complete the excavations and transfer the tracks to the new levels. During the year the northerly tunnels of the Hudson Companies system at Morton Street were opened for service, and at the present writing trains are running regularly from Hoboken to Twenty-third Street and Sixth Avenue, Manhattan. The connecting subway in Jersey City has been completed, as have also the two tunnels below the Hudson River from Jersey City to Cortlandt Street. At the present time a short length of tunnel remains to be completed between the ends of the river tunnels and the terminal station at Cortlandt Street. It is expected that this part of the system will be in operation by the early summer of this year. Although the financial depression has caused the abandonment, for the present, of the construction of extensions of the Rapid Transit Subway in Brooklyn, work has been steadily prosecuted on the Subway loop connecting the Manhattan ends of the Williams-

burg and Brooklyn bridges. The opening of the Subway tunnel from the Battery to Brooklyn, and the completion of the line to Flatbush Avenue, have served to lessen the congestion on the Brooklyn Bridge. The "Belmont " tunnel, at Forty-second Street, built under the old Steinway franchise, has been completed and is now under offer of purchase by the city for the sum of $7,000,000. The system of subways in Philadelphia has proved to be as great a success as that which is in operation in New York. Boston also is increasing its facilities, the most recent addition being a short stretch of subway, one mile in length, which, because of the difficulties of the site, has proved to be the most costly bit of tunneling ever built. Mention should be made of the railway tunnel which is making satisfactory progress beneath the Detroit River. The method of construction involves the dredging of a large trench, and the floating into position and sinking of steel tubes, around which is built up in place a mass of concrete which forms the tunnel proper.

Naval and Military.

In a review of the naval events of the year, the two facts which stand out with prominence, at least as far as the United States is concerned, are the remarkable cruise of the Atlantic Squadron around the world, and the acrimonious controversy which has been aroused as to the efficiency of the navy. The sweeping criticism of our ships had its origin among a few of the more progressive and ambitious of the younger men among the seagoing officers. The motives which prompted this criticism were, we believe, honorable and disinterested; but the manner of their presentment was about as unfortunate and deplorable as it could well be, the medium chosen being a popular magazine, and the writer a layman who allowed his zeal to run away with his discretion, and offered his arguments in a manner so marked by exaggeration and extravagance that he defeated the very object in view. That the ships of our navy are capable of improvement in certain particulars is undeniable; and had these improvements been suggested with moderation and a strict agreement with the facts, the criticisms would have been heard, and the ultimate results more quickly secured. In the long-drawn-out controversy which has ensued, the most important of the alleged defects have been disproved, and the fact established that our battleships are fully comparable with the ships of foreign navies of the same date of design. At the Newport Conference, which followed a few months after the Senate inquiry, it was also proved, if proof were necessary, that the designs of our latest ships of the "Dreadnought" type were not only abreast of the times, but that they have served in some particulars as a type which other naval powers are closely following. Perhaps the most significant tribute to the excellence of our navy was the punctual arrival of the battleship fleet at the various ports of call, and the even more important fact that the fleet to-day, in spite of its long and arduous cruise, is in excellent condition, the deterioration being only such as is inevitable in any fleet on a cruise of this great duration. Progress in the upbuilding of our navy during the year has been very satisfactory. The three scout cruisers "Birmingham," "Chester," and "Salem" have passed through their trials successfully. These vessels, of 4,580 tons displacement, were designed for a trial speed of 24 knots. The "Birmingham," equipped with twin reciprocating engines, averaged 24.32 knots on her four-hour trial; the "Chester," furnished with Parsons turbines, made 26.52 knots; and the "Salem," equipped with Curtis turbines, averaged 25.94 knots. These three ships are about to engage in a series of competitive trials, which will furnish data of unusual interest. During the year, all of our battleships under construction, except those of the "Dreadnought" type, have been completed; with the result that of the later designs we now possess six "Connecticuts," of 16,000 tons and 18 knots; two smaller "Connecticuts," the "Idaho" and "Mississippi," of 13,000 tons and 17 knots; and five "Virginias," of 15,000 tons and 19 knots speed. All of these ships carry modern 12-inch guns in the main battery, and a heavy intermediate battery of 8-inch guns. We have six "Dreadnoughts" under construction. The "South Carolina" and "Michigan," of 16,000 tons, carrying eight 12-inch guns, are about two-thirds completed; the "North Dakota," 20,000 tons, carrying ten 12-inch guns, has recently been launched; and her sister the "Delaware" will shortly take the water. The slips are now being prepared for the laying down of the 20,000-ton "Florida" and "Utah." The last report of the Chief of the Bureau of Ordnance states that our 45-caliber 12-inch gun is fully the equal of any mounted in any foreign navy; but in view of the fact that some of these navies have 12-inch 50-caliber pieces under construction, whose muzzle velocity will be from 3,000 to 3,100 foot-seconds as against 2,700 foot-seconds for our guns, it is evident that a new 12-inch piece should be designed. On the other hand, there is a movement on foot favoring the arming of our future "Dreadnoughts" with a new 14-inch piece; and it has been suggested that our next appropriations should be either for 20,000-ton ships carrying eight 14-inch guns, or 23,000-ton ships carrying ten 14-inch guns. Outside of the construction of battleships, our efforts are being devoted to the construction of sea-going torpedo boats and submarines. The United States is building no armored cruisers. The crying need of the navy to-day is for a fleet of large, fairly fast colliers. The Atlantic fleet, on its trip around the world, has to depend almost entirely on foreign tramp steamers for its coal supply. In time of war these would not be available. We have no merchant marine to speak of; and, in its absence, the construction of a fleet of colliers is as essential as the construction of battleships. Great Britain, with a total displacement of armored ships of 1,395,930 tons, continues to lead the world in the number, power, and quality of her ships; the United States being second with 607,241 tons, and France third, with 573,364 tons. If battleships alone be reckoned, Germany takes third rank. Great Britain records no failures. She serves as the great experimental ground for the world, and the ships which she evolves seem to stand as types for other nations. The "Dreadnought" has been followed by six other ships of the same general design, in which have been incorporated the experience gained during the extensive cruises of the "Dreadnought." Hitherto the British have not followed our system of mounting the 12-inch guns on the central line of the ship; though it is rumored that in their next ships they will incorporate this valuable feature. The most sensational success of the year was the brilliant performance of the battleship-cruisers "Invincible" and "Indomitable." Both of these, on their trials, made over 27 knots an hour, and the "Indomitable" crossed the Atlantic from Newfoundland to Southampton at an average speed of a fraction under 25 knots an hour. Sensational, also, were the speeds achieved by what is known as the tribal class of torpedo-boat destroyers, vessels of 750 tons, which steamed for six hours at average speeds of from 34 to 35.36 knots an hour, the "Tartar" on one run reaching a speed of slightly over 37 knots. Later in the year the ocean-destroyer "Swift," of 1,800 tons, maintained for some hours a speed of 38.3 knots, or between 44 and 45 miles an hour. It is probable that the next radical departure in warship construction will be the adoption of gas engines for motive power. Yarrow & Co. built during the year two 250-horse-power, gasoline-propelled gunboats for the Austro-Hungarian navy, and Beardmore & Co., of Glasgow, have equipped an old British gunboat, the "Rattler," with producer-gas engines, which, compared with the old steam plant, show a large saving in weight and fuel consumption and have driven the ship at a speed of between 11 and 12 knots an hour. Encouraged by this success they are installing producer-gas engines of greater power in another vessel, from which even better results are expected. The question of equipping a battleship with a plant of this kind cannot be settled, except by a gradual increase in the size of the equipment, until it has been proved that the various difficult problems incidental to a large marine producer-gas engine have been successfully mastered. The present indications are that this will eventually be done, and when it is, the efficiency of the warship will be vastly increased. There never was a time when naval powers exhibited so much activity in the enlargement of their fleets as just now, the greater part of the appropriations being devoted to the construction of battleships of the all-big-gun type. Outside of these, new constructions are being confined to fast scouts of about 5,000 tons displacement and 25 or 26 knots speed, destroyers of from 600 to 800 tons, and submarines. The development of the last-named type has been steady, both the size and speed having been materially increased during the year. It is gratifying to realize that the United States navy now holds the second position in fighting power. This is due to the fact that we have put most of our displacement into heavily-armed battleships; and if we continue to follow the proposed plan of building two battleships a year, we shall have no difficulty in maintaining this position.

Merchant Marine.

In respect of the addition of new merchant vessels of the first size and speed to the merchant marine, the past year has been less notable than its immediate predecessors; but it has been remarkable for the performances of some of the ships already afloat. Precedence is naturally taken by the two latest transatlantic liners, the "Lusitania" and "Mauretania," which, after the stormy experience of the winter, settled down to a steady run of record-breaking across the Atlantic. The most puzzling performance of the year was that of the "Mauretania," when, during a trip early in June, in which, because of an accident, she was run under only three out of her four propellers, she covered the longer northern route in four days, twenty hours, and twelve minutes, at an average speed of 24.86 knots, not only beating her own record made with four propellers, but also that of the sister ship "Lusitania"—a result which would seem to show that the boiler capacity of these vessels is not equal to that of the turbines. Later in the same month the "Lusitania," in making a passage in four days and fifteen hours, at an average speed of 25.04 knots, earned the distinction of being the first 25-knot transatlantic liner. On a subsequent trip the last-named vessel covered 650 knots in one day, at an average speed of 25.66 knots. The fact that the "Mauretania" made her best speed with one of her high-pressure turbines out of commission afforded further evidence that the most efficient work of the steam turbine is done in the low-pressure turbines, and confirmed the judgment of those marine engineers who believe that a combination of high-pressure reciprocating engines and low-pressure turbines will give the best results. Hence great interest attaches to the performance of the 14,500-ton "Laurentic," which was launched during the year for the transatlantic service of the White Star Line. Her motive power consists of two reciprocating engines driving two outside propellers, and a low-pressure turbine on the center line of the ship. Evidently, the limit of size in ocean steamers has not yet been reached; as witness the construction which has recently been commenced at the Belfast yard, of two ships, the "Olympic" and "Titanic," for the White Star Line, which are said to have the enormous dimensions of 930 feet over-all length, and 60,000 tons displacement. These vessels, also, will be driven by a combination of reciprocating and turbine engines, and they are expected to show a sea speed of 21 knots an hour. There is no indication of a desire on the part of any of the leading steamship companies to emulate the high-speed performance of the Cunard liners. The German companies seem to be satisfied with the 23¼ to 23½ knots speed of the "Kaiser Wilhelm II." and the "Cecilie"; and if they have any plans for winning back the blue ribbon of the Atlantic, nothing has been made public to that effect. The prevailing type of transatlantic liner of the future seems destined to be the combined freight and passenger steamer of moderate speed. Unfortunately, the American merchant marine remains in the moribund condition which has characterized it for many years past. In spite of the earnest support of the President, Congress failed to pass the measures which had been proposed with a view to its resuscitation. Meanwhile our merchant marine on the Pacific is being rapidly swept out of existence; and it is a fact which cannot be disputed that, were we suddenly to find ourselves engaged in a naval war, we would be terribly crippled for want of transports and colliers, to say nothing of a body of seamen from which to recruit the personnel.

Steam Railroads.

The depression of the past year was felt so severely by the steam railroads, that there has been but comparatively little new construction undertaken, the efforts of the railroads being directed mainly to the upkeep and improvement of track and equipment. An important agreement has been reached between the railroads and manufacturers on the question of the composition and rolling of steel rails, and, as an immediate consequence, orders have been once more coming freely to the mills. It is probable that the principle observed by the Pennsylvania Railroad Company in its new specifications will be followed pretty generally throughout the country. The most important feature of the specifications is the placing upon the manufacturers of more of the responsibility for the character of the rail produced. No specification is made as to the amount of crop from the ingot, and considerable latitude will be allowed in the methods of manufacture, it being merely provided that the rail be free from injurious mechanical defects and flaws. Track construction is being greatly improved by the more general introduction of steel tie-plates between the rail base and the tie; and it now remains for American railroads to adopt some form of screwed or bolted fastening in place of the present unsatisfactory spike, to render our best track comparable with the best that can be found in Europe. The rail spike must go, and the sooner the better. The steel car having demonstrated its good qualities for every kind of traffic, is now being introduced in considerable numbers. The steel Pullman car shows only a slight increase of weight over the wooden car, and it possesses the advantage of being practically unwreckable, and therefore a great safeguard to life and limb. Fashions change in locomotives, and just now the once popular Atlantic type is being discarded for heavy express service in favor of a six-coupled twelve-wheeled locomotive of greater hauling power. In freight locomotives there is a disposition to introduce more extensively the Mallet system, particularly on heavy mountain grades. The average speed of our fastest trains is still far below what it should be. This will be evident when we remember that both England and France have over fifty expresses

(*Continued on page 5.*)

MOVING PICTURES THAT SING AND TALK.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

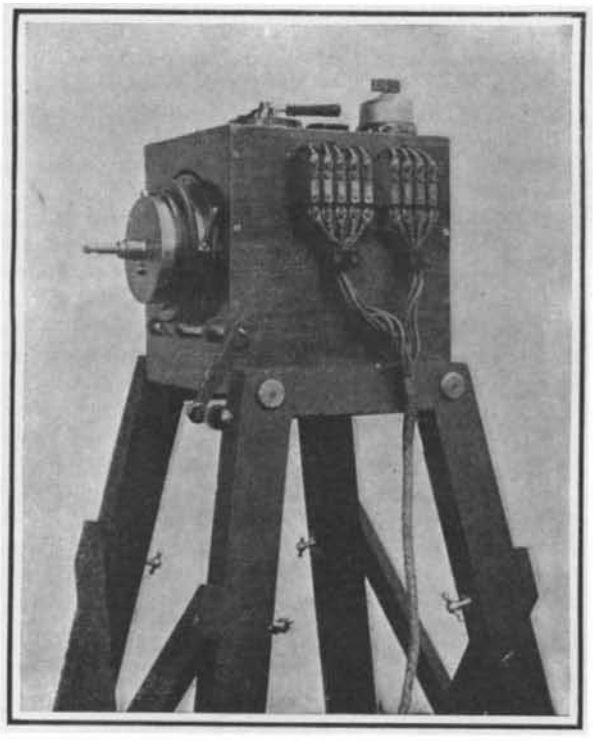
In view of the success which is obtained by the moving picture apparatus, the idea naturally occurred to use the phonograph in connection with it, so as to hear the voice at the same time that we see the picture upon the screen. Among such devices we may mention one brought out by Pathé. It is the invention of Capt. Couade. In his method, the actor utters the words or song into the phonograph, but without the gestures or facial expression.

The actor takes his position before the camera and his movements are photographed. Coupled with the moving picture machine is the phonograph of the flat disk type which was before used. A jointed rod coupling is used in order to connect the phonograph mechanism with the picture machine, and the latter is driven by a small electric motor. While the phonograph is repeating the actor's words, he goes through the necessary motions to accompany the words. The moving picture machine thus secures the photographic record of the series of gestures during the whole time that the phonograph disk is working.

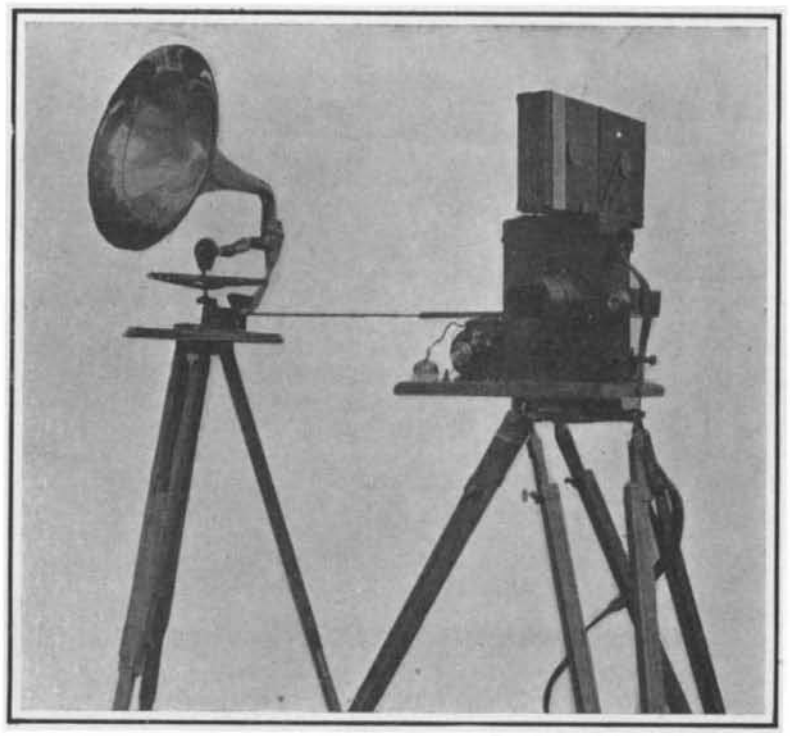
In reproducing the two records at exactly the same rate of movement, the moving picture machine is placed as usual at a point behind the audience at the back of the hall, while the phonograph is located near the screen. The weight-driven mechanism of the phonograph is coupled to a revolving electric device which serves to produce a current, and this current is sent to the moving picture machine. In the latter there is mounted an electric motor, which drives the machine. As this motor receives current from the electric device on the phonograph, its speed is exactly the same as that of the phonograph. By this means we have a perfect concordance between the two apparatus.

Capt. Couade seems to have solved the problem of working the two machines in harmony. Both apparatus start up simultaneously and afterward run at the same speed, by simply placing the phonograph needle on a marked point of the disk and on the other hand using a marked image of the picture film at the same time. These points were previously obtained when the phonograph and picture machine were directly coupled by the shaft as above mentioned.

Capt. Couade's invention consists in the use of a revolving device which is driven by the weight mechanism of the phonograph. The device resembles a revolving commutator, and it receives direct current from the city mains and transforms it into alternating current. The motor is mounted in connection with the moving picture machine, and it consists of a simple two-pole electric motor which is arranged to run upon the three-phase current. Such a motor takes exactly the same speed as the driving mechanism of the phonograph.



The motor in its portable case. The handle serves to operate the differential so as to keep the phonograph and moving picture apparatus in step.



The phonograph repeats the previously recorded utterances of the actor while he performs the necessary gestures in synchronism for the moving picture machine.

Weight-driven phonograph used to send a current into the distant moving-picture machine motor.

MOVING PICTURES THAT SING AND TALK.

Motorless Aeroplanes.

Is it possible to soar in the air for an indefinite time without motive power? Deprez in the SCIENTIFIC AMERICAN SUPPLEMENT has shown how the soaring flight of certain birds can be explained by the pressure of the air on the various parts of their bodies, provided that the surrounding air possesses some velocity in an upward direction. No such continuous upward flow of air has been detected by meteorological observations. In a paper recently presented to the French Academy of Sciences, Esclangon dispenses with the upward flow and shows that every variation of the velocity of the wind, in magnitude or direction, from its mean horizontal velocity may, in theory, be utilized as a motive power by a soaring bird or an aeroplane. Every such variation increases the total energy of the system composed of the aeroplane and the surrounding air, and every such increase in energy can be transformed either into the kinetic energy of speed or into the potential energy of elevation. In order to reduce to a minimum the power required to propel an aeroplane, it will be necessary, first, to learn how to convert speed into elevation, and conversely, with little loss of energy, and secondly, to devise aeroplanes which, like birds, shall be able to adapt themselves instantly to changed conditions, so as to utilize the incessant fluctuations of the wind. The practical solution of the latter problem will undoubtedly present great difficulties.

Moving Pictures in Colors.

After the successful solution of the problem of color photography by the Lumière brothers, the problem of color chronophotography seemed to be nearing its final solution. But the practical difficulties encountered were far greater than in ordinary photography. Flexible films of 100 feet and more in length must be handled instead of glass plates of limited size. On the other hand the Lumière process is suitable only for the making of transparencies. Duplicate positives from a series of negatives are out of the question.

A novel system has recently been invented by a Roman painter, Signor Barricelli, for the cinematographic reproduction of animated scenes in their natural colors. The coloring of the films is obtained by means of the three-color process, but in a novel way. Instead of coloring the film itself, the inventor reaches his result by a rapid presentation of images, each of which is colored in one of the three fundamental colors (red, yellow, blue). By virtue of the well-known phenomenon of visual persistence, these images will give the impression of a complete three-color image.

In order to reproduce a given scene in its natural colors, it is sufficient to photograph the object three times through properly colored screens, each of which will allow only the light rays of a given color to pass. Thus three analytical color negatives are obtained. The corresponding positives printed from these negatives in black and white must be projected in rapid succession on a white wall, each through the same color screen used in obtaining the negative. The eye will then perceive a multi-colored image, provided the rate of succession be such that the individual impressions due to the various colors on the retina may superpose themselves on one another. The length of the photographic film as well as the speed of succession should accordingly be three times as great as in an ordinary cinematograph. The system adopted by Barricelli for insuring the succession of the various color screens in front of the objective, both during the taking of the views and during projection, is of remarkable simplicity. A glass disk divided into three colored sectors according to the fundamental colors, red, yellow, blue, is rotated in front of the objective so as to change the screen at each move of the cinematograph shutter.

RETROSPECT OF THE YEAR 1908.

(*Continued from page 3.*)

daily, running on schedule speeds of from fifty-five to sixty miles an hour. At the same time, it should be borne in mind that there are no trains in the world that can compare in long-distance, high-speed runs with our eighteen-hour trains between New York and Chicago.

Electricity.

Unquestionably the most important work at the present time in the field of electricity is its substitution for steam locomotives in the operation of railroads; and of the many changes of this character which have recently been made, the most important are those on the New York Central and the New Haven railroads in this country. In respect of the great density of the traffic on these four-track systems, the conditions for electrification are highly favorable; but because of the many track complications involved at the terminal yards and stations, the work of installment and operation has been perplexing and difficult. The operation of the New York Central electric zone has been carried on through the year with the same smoothness and regularity which have marked this highly successful work from the very day of its opening. Save for the one disastrous accident at Woodlawn, which was due, in our opinion, to gross carelessness in operation, there have been no serious accidents attributable to the electrical equipment, and the number of delays has been less, we understand, than in the days of steam service. The attention of the electrical world has been focused more particularly, however, on the New Haven equipment, for the reason that here, for the first time, the experiment (and it was surely nothing more nor less than a gigantic experiment) was made of equipping a four-track road carrying an exceedingly dense traffic with a high-pressure monophase system with overhead conductors. Toward the close of the year a remarkably candid and very detailed paper was read by the chief electrical engineer of the road, giving a history of the many obstacles encountered, and the way in which they have at last been successfully overcome. Serious troubles developed in the generators, in the line, and in the motors. Apparently these have been thoroughly mastered, and for some six months past the system has been running with a regularity which involves, according to the officials of the road, fewer delays than occurred in the days of steam service. What the technical world is waiting for, however, is the publication by the New York Central and the New Haven systems of the first cost and of the cost of operation of their respective plants. When these are available it will be possible to arrive at a pretty accurate estimate of the relative efficiency, under these particular conditions, of the single-phase and the direct-current systems. The present indications are that the direct-current is ideal for suburban and terminal roads, and the monophase system for long-distance lines outside of the suburban zone. Hence, we are not surprised to learn that the Pennsylvania Railroad Company has decided to use the direct-current on its tunnel zone from Long Island City to Harrison, N. J., with the probability that the alternating current will be adopted when the electrification is extended to Philadelphia. A contract for the electrification of the tunnel zone has recently

been let for $5,000,000. Next in importance to the work being done in this country is the electrification of certain of the Prussian railroads, one the Magdeburg-Bitterfeld-Leipsic line, 80 miles in length, and another the Leipsic-Halle line, 22½ miles in length.

As far as any material progress is concerned, wireless telegraphy stands at the close about where it stood at the beginning of the year under review. Attention has been directed rather to the improvement of mechanical details in the way of wave-detectors, transmitting keys, and the other mechanical features, than to the solution of the larger problems of selective synchronism and reliable long-distance transmission. All the wireless companies are endeavoring to perfect a selective system, but apparently they are no closer to the goal than they were four years ago. Any small boy armed with a Ruhmkorff coil is an *enfante terrible* in the path of a wireless message. The most satisfactory results have been obtained in the coasting trade and in naval operations, where messages may be transmitted with considerable certainty within the limits of 100 or 150 miles. But when it comes to a matter of transmission for distances of 1,000 miles or over, the maintenance of uninterrupted service is at present out of the question. Under exceptionally favorable atmospheric conditions, messages have been transmitted across the Atlantic and from the New York navy yard to Panama; but the connection is liable to sudden and complete interruption from causes which at present are purely problematical. Marconi, Fessenden, Professor Fleming, and others attribute the breakdown to what, for want of a better name, they call "atmospheric absorption." Conditions in the field of long-distance wireless telegraphy are such that it is safe to say that this field is not by any means ripe for commercial exploitation. The same may be said of wireless telephony, which, although it shows great promise for the future, has not as yet been placed on a practical commercial basis. Limitations of space prevent anything more than the mere mention of the great ingenuity shown in the transmission of writing by means of the telautograph and the transmission of pictures by Knudsen's ingenious process. For a detailed explanation of these the reader is referred to our issues of June 6 and November 21 of the past year.

Astronomy, Chemistry, and Physics.

Astronomically, the year has brought forth the usual number of celestial events. There were three solar eclipses, none of which was of much importance. Solar eclipses in such number occur only once in nine years, which is the only reason why the 1908 eclipses are here mentioned. At Greenwich Melotte discovered a faint body, which was at first taken for an asteroid, but which later proved to be an eighth satellite of Jupiter. Encke's comet, the more carefully studied of the periodic comets, duly returned. More remarkable than this body of Encke's was the comet discovered by Prof. Morehouse on September 1—remarkable because of its peculiar tail distortions and fluctuations. These tail phenomena will be discussed in a forthcoming issue of the SCIENTIFIC AMERICAN. Prof. Trowbridge, who has been conducting a series of important experiments, announced that gas phosphorescence and meteor trains have much in common. From this it would follow that the after-glow produced in the sky by meteors is merely a phosphorescent phenomenon.

Prof. Onnes's achievement in liquefying helium after many futile attempts must be hailed as a wonderful technical triumph. Although the most refractory gas has at last been conquered, the liquefaction of helium cannot be said to add very much to the sum total of our chemical knowledge.

The radio-active substances still command a prominent place in physical research. Perhaps the most dramatic event of the year was Madame Curie's announcement that, after careful experimentation conducted by herself and Mlle. Gleditsch, she failed to confirm Ramsay's assertion that radium emanation possesses the singular property of degrading copper to lithium. This leaves the whole question very much in the air. A third checking of the experiment is obviously necessary. If Boltwood's work is correct, ionium may be regarded as the true intermediate product between what is known as uranium X and radium, which gives no fewer than twenty-four new elements discovered by radio-active methods. Ramsay has presented evidence that the emanations of thorium and radium should be classed with such inert gases as argon. C. E. S. Phillips claims to have discovered radio-active powers in freshly cut sodium. The evidence (the discharging effect of the metal) is strong, but not strong enough to warrant us in believing that he has completely established his discovery.

Dr. Bechtold has devised what he calls a system of "ultra filtration," which has enabled him to separate dissolved substances from their solvents by the use of excessively fine filters consisting of paper or fabric impregnated with gelatine. This system actually carries the chemist within the region of molecular dimensions.

Aeronautics.

In tracing the development of aeronautics the historian of the future will point to the year 1908 as that in which the problem of mechanical flight was first fully mastered; and it must always be a matter of patriotic pride to know that it was two typical American inventors who gave to the world its first practical flying machine. To a natural mechanical aptitude the Wright brothers added a perseverance, a resourcefulness, and a daring, which have enabled them, at last, to realize this dream of the ages. In April of this year, the brothers went down to the sand dunes at Kitty Hawk and tried out their machine, preparatory to subjecting it to public test. On September 10, at Fort Myer, Orville Wright flew continuously for 1 hour, 5 minutes and 52 seconds, and subsequently made three other flights of over an hour. Finally, in making a flight with Lieut. Selfridge as a passenger, he was thrown to the ground, through the breaking of a propeller, Lieut. Selfridge being killed and he himself seriously injured. On September 21 Wilbur Wright, in France, made a continuous flight of 1 hour and 31 minutes; and, after three months of most brilliant work achieved the remarkable feat of flying continuously for 1 hour, 53 minutes, and 59 seconds, thereby winning the Michelin prize of $4000 and a trophy. In his flight he covered 61½ miles of distance at a speed of 36 miles an hour. Both of the brothers have proved their ability to carry an additional passenger. By his success in France Wilbur Wright effected the sale of his French patents for $100,000. Next in importance has been the work of Farman who, on October 30, made a straight-away cross country flight of 17 miles from Chalons to Reims at a speed of over 51 miles an hour. Of equal, if not greater merit, was the trip of Bleriot with his monoplane when he flew from Toury to Artenay and back, a distance of 17.38 miles, at an average speed of 53.78 miles an hour. For comparison with the long-distance flights above recorded, the following achievements will be of interest. On September 14 Santos-Dumont with a monoplane made a continuous flight of 8 minutes. On September 17 Delagrange with a two-surface machine flew for 30 minutes, 27 seconds. On October 31 Bleriot, with a monoplane, in his cross country flight, was in the air continuously for 11 minutes. Farman, on October 2, in competing for the Michelin prize, won by the Wright brothers, remained in the air for 44 minutes, 32 seconds. On August 21 a G. M. monoplane flew in a circle 1½ minutes, and on July 22, Breguet, in a gyroplane—a combined helicopter and aeroplane—made a flight of 20 meters distance. It has been estimated that the total duration of Wilbur Wright's seventy-two flights in France, up to October 15, amounted to 13 hours, 49 minutes; and that thirty persons have been carried a total distance of 431 miles, without accident. In the presence of such figures it cannot be disputed that mechanical flight is no longer an experimental proposition. In spite of the success of the Wright brothers, it looks as though Europe would be the developing ground for the aeroplane and dirigible, as it has been for the automobile. Proof of this is seen in the fact that cash prizes to the total of $350,000 have been offered in Europe for aeronautic contests of various kinds. In America the only prize offered for competition is the SCIENTIFIC AMERICAN trophy, which was won for the first time by Glenn H. Curtis on July 4 in a flight of over a mile in a straight line, made with a two-surface aeroplane, built by the Aerial Experiment Association. The speed was nearly 40 miles an hour. The machine carried a tail similar to that used on the Farman aeroplane, and was driven by a 25-horse-power air cooled engine. The same association has built a later machine, which is driven by a 40-horse-power, water-cooled engine. It has no tail, and, like the earlier machine, is characterized by a transverse arching in opposite directions of the two main surfaces.

No less striking have been the achievements of the various large dirigible airships. Conspicuous among these are the long-distance flights of Count Zeppelin with his huge but ill-fated craft, known as "Zeppelin IV." On the 29th of June he was in the air for six and three-quarters hours. On the second of July he made his first long cross-country trip to Luzerne, covering 248 miles in 12 hours at a maximum speed of 34 miles per hour. On August 4 he made his great attempt at a 500-mile 24-hour trip. He landed at Oppenheim after covering 260 miles in 9 hours; then passed over Mayence; returned to Stuttgart, and made a successful landing at Echterdingen, where his machine was destroyed by a thunderstorm. The Germans have three new military airships, the "Gross II," "Parseval II," and the reconstructed "Zeppelin III." France has "La Republique," the "Ville de Paris," and the old "Lebaudy." The giant Zeppelin airship was about 440 feet in length; the German and French dirigibles are generally a little less than 200 feet in length, and the approximate speed, under normal conditions, may be set down at about 30 miles an hour. In connection with the trials at Fort Myer, it should be mentioned that the small dirigible built by Baldwin, capable of carrying two men and of remaining in the air for two hours continuously, passed successfully its acceptance tests by the United States army.

Automobile and Motor Boat.

That the automobile has practically reached the limit of its development is suggested by the fact that during the past year no improvements of a radical character have been introduced. The six-cylinder machine grows slowly in favor; but there is no indication that it will become the prevailing type. There has been a great increase in popularity of the moderate-priced, medium-sized car, of 24 to 30 horse-power, and costing from $1,200 to $1,800. There is cause for congratulation in the fact that both in racing and touring cars the later American models show a decided improvement in durability; and it can be said without much fear of contradiction that the output of the leading builders of this country is at last fully comparable to the best of the foreign makes. The Glidden tour, that supreme test of reliability, bears out the truth of the above statement. It was run this year over a 1,700-mile course, through Buffalo, Pittsburg, New York, Albany, Maine, the White Mountains, and Saratoga. Although the conditions of the whole trip were exceedingly trying, the machines made an average speed of 20 miles an hour, and this in spite of the fact that no repairs were allowed in the garages. Of the forty-five machines that started twenty-eight finished with a perfect score, nine of them making up three three-car teams, fourteen others being touring cars, and five runabouts.

The two great races of the year—the Vanderbilt and the Grand Prize—were held successfully over courses on Long Island and at Savannah. The Vanderbilt cup race was won by the 1906 Locomobile racer of 120 horse-power, at an average speed of 64.39 miles an hour. Second place was taken by the Italian Isotta, which maintained an average speed of 63.7 miles per hour. The Grand Prize race over the 402-mile Savannah course was won by an Italian Fiat car of about 110 horse-power, at an average speed of 65.1 miles per hour, the second car being a German Benz, which was beaten by only 56 seconds. Over the same course the light stock car race was won by an Italian Lancia car, at an average speed of 52.6 miles per hour, an American Buick car being second. That these light cars with only about one-fourth the power of the racing machines should have made such good speed is highly creditable.

The motor boat racing of the year was signalized by the victory of the American "Dixie II" in the race for the Harmsworth international trophy, held on August 3 on Long Island Sound. The challengers were the British "Wolseley-Siddeley" of 400 horse-power, and the "Daimler II" of over 500 horse-power; and, to meet them, the Crane brothers designed the "Dixie," a beautifully-turned boat provided with but 200 horse-power. The "Daimler II" broke down, the "Wolseley-Siddeley" covered the course at a speed of 27.34 knots, and the "Dixie" at a speed of 27.71 knots, the American boat winning the race by a close margin of 49 seconds. A day or two later the "Dixie" in four runs over the government measured mile averaged 31.05 knots, thus establishing her claim to being the fastest motor boat in the world.

The Current Supplement.

Sir J. J. Thomson's brilliant paper on "Rays of Positive Electricity" is by far the most important contribution to the current SUPPLEMENT, No. 1722. Major Squier gives his views of the possibilities of aerial locomotion in warfare. Day Allen Willey describes a concrete coal-mine shaft. How roads are tarred is explained by Prevost Hubbard. The usual notes will be found in their accustomed places. Sir Oliver Lodge gives a simple explanation of the theory of electrons. The action of radium emanation on distilled water is discussed by Sir William Ramsay, the distinguished English chemist.

A $500 Prize for a Simple Explanation of the Fourth Dimension.

A friend of the SCIENTIFIC AMERICAN, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it.

Competitors for the prize must comply with the conditions set forth in the SCIENTIFIC AMERICAN of December 26, 1908.

A clear solution of shellac in alcohol, with an addition of picric acid and 1 per cent of boracic acid, makes a gold varnish that produces a fine hard surface and brilliant finish on metals.