trestles were built along the toes from which to dump material from Culebra cut. The trestles failed after the dumping from them began, and the material overlying the rock moved laterally, carrying the superimposed mass with it. When the unsuitable nature of the ground became evident, a careful examination of the canal route from Pedro Miguel to the Pacific was undertaken, and a study of the data thus obtained led to the conclusion that one lock at Pedro Miguel and two at Miraflores offered the most economical and desirable solution. The advantages of this plan over the then existing project were that dams of lower height, less length, and resting on rock comparatively near the surface could be more easily constructed and could be completed at an earlier date; and finally that the locks in this location would be protected against all possibility of distant bombardment and would be less exposed to gunboat or torpedo boat attack. As a consequence, the commission recommended a change in the project, which received the approval of the President on December 19, 1907.

The designs for the locks are still in course of preparation, but the studies have reached such a stage that the general features will be definitely determined at an early date.

Gatun locks.—Investigations were continued during the year to ascertain the depths of the underlying strata and to determine also whether suitable material extended sufficiently far below the level on which the lock walls are to be built to carry the weight; a depth of 50 feet below this level was fixed and the borings were so made. The materials encountered may be briefly summarized as a layer of argillaceous sandstone, overlying a layer of conglomerate which is composed of pebbles and other hard aggregates held together by a cementing material, and which subsequent excavation shows to be hard enough in texture to require blasting for its removal. The borings disclosed an underground flow through the sandstone, the source of supply being apparently ground water from the hills to the southeast and at a considerably higher elevation than the lock site. It is intended now to prevent access to the foundation of this water by means of curtain walls connected with the underlying impervious stratum of argillaceous sandstone, and additional precautions will be taken if developments during construction make such advisable or necessary.

The excavation for the locks was continued throughout the year,. The total amount removed from the site was 1,769,115 cubic yards.

Gatun dam.—Investigations, primarily undertaken to verify data already on hand concerning the character of material for the foundation of the dam, were continued. A test pit, 12 feet square, was sunk in the hill through which the spillway is being cut and near its head, and this has been carried down to about 35 feet below sea level. The rock formation here is practically the same as that at the lock site. On Gatun Island a test pit 20 feet square was sunk to a depth of 68 feet below sea level. Wash borings were resorted to, but care was taken to secure drive samples whenever there were indications of any change in the character of the material.

The examinations made of the spillway indicate that the rock is of sufficient strength to bear safely any of the loads that will be placed upon it. What seepage there is occurs in the top stratum; and though this is small, it is proposed to cut it off by sheet piling projecting up into the core of the dam and down into the impervious layer.

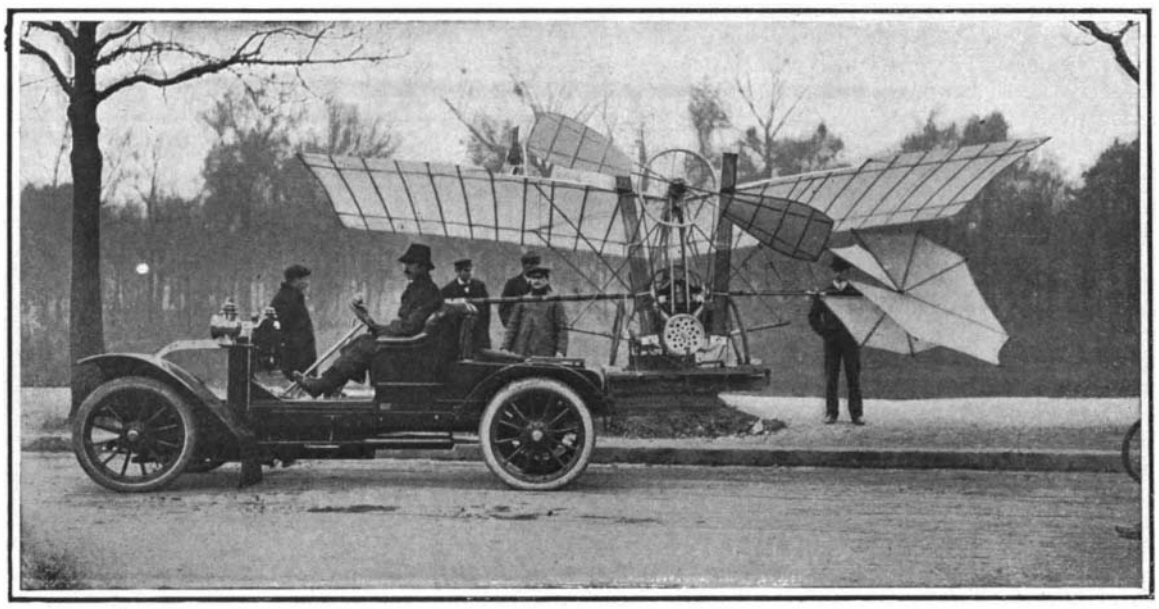
Two experimental dams, with dimensions corresponding to the dam as it is to be built, were made on the scale of 1 inch to the foot, and these experiments show not only the suitability of the available material, but that a stable and water-tight dam can be built by hydraulic methods. Construction work at the dam during the year consisted in the removal of 918,920 cubic yards of material from the spillway.

Pedro Miguel.—As it was more advisable and economical, the Culebra division excavated the lock site down to reference 40, practically completing it to this grade at the close of the fiscal year, and removed 1,071,696 cubic yards, which amount is included in the total yardage under Culebra division.

Miraflores locks and dams.—It is shown conclusively by test pits and borings that the locks will rest on rock of ample strength to make suitable foundations. A hard limestone is found for the upper part of the site, changing to argillaceous sandstone at the lower end. The borings disclosed no such variations in the formation as exist at Gatun.

Municipal engineering.—The work of this division consisted of the completion of the waterworks, sewerage system, and paving in Panama and Colon, the cost of which is to be reimbursed to the United States through the collection of water rates in those cities, and of the construction of waterworks and sewerage systems, paving, grading, and road making in the Canal Zone. The total cost of the work done was $1,067,150.52.

Work in Panama and Colon, as originally planned, is practically completed.



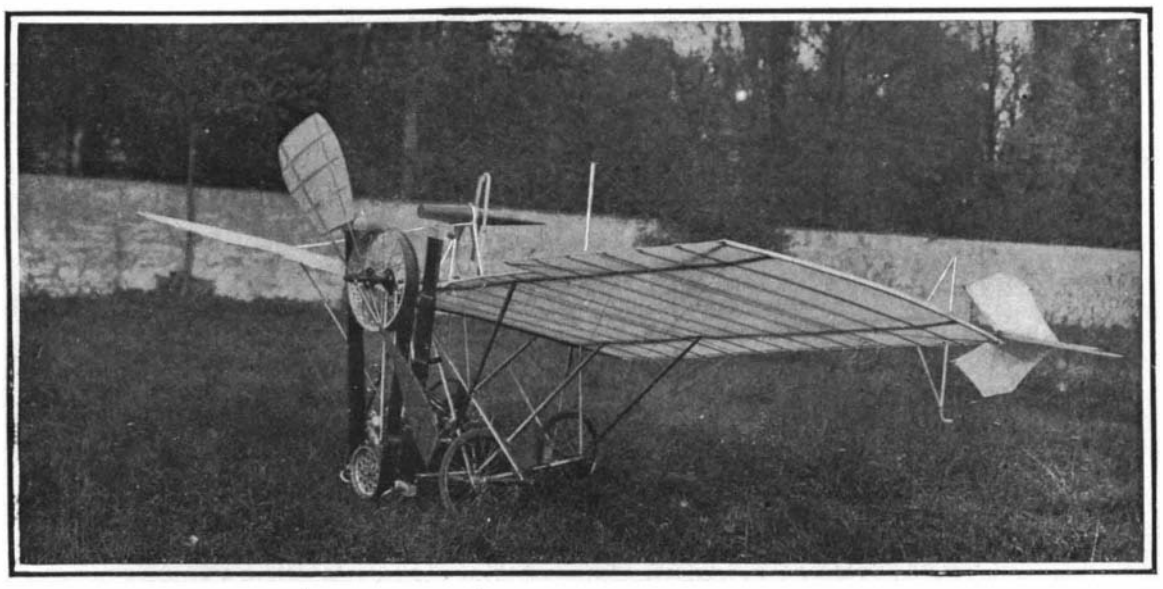
Santos Dumont transporting his new monoplane on his automobile from Paris to his experimental field at St. Cyr.

This miniature aeroplane complete with its 24 horse-power motor weighs only 297 pounds. A speed of about 36 miles an hour must be attained with it on the ground before it will rise in the air.

SANTOS DUMONT'S LATEST AEROPLANE.

The tiny aeroplane illustrated on this page is the latest one to be produced by Santos Dumont. The noted Brazilian experimenter has not been actively engaged in continuing his experiments in aviation for the past few months, but he has now taken up the subject again, and has brought out once more the tiny aeroplane with which he made some experiments last spring.

To give his monoplane good transverse stability, Santos Dumont has placed the two wings at a slight dihedral angle and has located his seat and the motor about 3 feet below. This brings the center of gravity well below the line of support. The propeller, which is mounted upon a hollow steel shaft running in ball bearings, is placed at the front edge of the plane at the center. It is about 6 feet in diameter, with a 6½-foot pitch, and runs at a speed of 700 R. P. M. The machine as it now stands has a 24-horse-power 8-cylinder Antoinette motor, arranged on a 3-wheeled running gear. The motor drives the propeller by a wide belt. A speed reduction of about one-half is arranged for from the motor to the propeller. The normal speed of the motor is 1,300 R. P. M. Its weight complete is 127.6 pounds. A seat is provided just back of the motor for the aviator, who controls the combined vertical and horizontal rear rudder by means of a vertical wheel placed beside the motor. The entire machine complete in running order weighs only 297 pounds. The spread of the wings is but 5 meters (16.4 feet), the dimensions of each wing being 2.5 x 2.1 meters. The total supporting surface is only 10.5 square meters (113.02 square feet). A speed of about 36 miles an hour must be developed upon the ground before the machine will rise in the air.



The 24-horse-power, 8-cylinder motor drives the large propeller by means of a belt. The motor is mounted upon a 3-wheeled running gear and the aviator's seat is immediately behind it. Note the long vertical radiators on each side of the propeller, the gasoline tank above the wings, and the combined vertical and horizontal tail at the rear.

SANTOS DUMONT'S LATEST MONOPLANE, THE "DEMOISELLE."

This reconstructed monoplane is by far the lightest and most powerful machine of its kind that has ever been produced. With Santos Dumont in the aviator's seat the total weight to be lifted is about 411 pounds, which gives a loading of the single surface of 4 pounds per square foot. This is about the highest ratio of weight to surface that has ever been employed.

On the 12th ultimo M. Dumont tried his new monoplane (which he has christened "Demoiselle") at St. Cyr. A number of short flights were made, no particular difficulty being experienced in getting up in the air. One of these flights terminated rather suddenly, with the result that one of the wheels buckled.

On account of the small size of his monoplane, Santos Dumont was able to carry it from Paris to St. Cyr on the rear of an automobile, as is shown in one of our illustrations. This is the first time, so far as we know, that an automobile has been used for transporting an assembled aeroplane from the city to a suitable place in the country, where the aviator can conduct his experiments.

THE FOURTH AEROPLANE OF THE AERIAL EXPERIMENT ASSOCIATION.

The photographs reproduced herewith show the latest aeroplane—"The Silver Dart"—of the Aerial Experiment Association, and also the third, or "June Bug," aeroplane, which has been remodeled and mounted upon pontoons for experiments upon the water.

The fourth aeroplane which the association has constructed has the same general lines as the "June Bug," which preceded it. Some modifications, however, have been made in the curve of the surfaces and in their size and spacing, while the new machine has no tail whatever, since the later experiments with the "June Bug" showed this to be unnecessary.

While the ribs of the former aeroplanes had a reverse curve at the rear (which form of curve the experiments of W. R. Turnbull demonstrated to be the most efficient), it was thought that the upward pressure of the air upon the flexible rear edges of the planes made this reverse curve too pronounced, and tended to check the forward motion of the aeroplane. Consequently, the ribs of the new machine have only a single curvature, and it is believed that the air pressure upon the rear edges of the planes will automatically produce the slight upward curvature at this point. The width of the planes from front to back at the center has been reduced from 6½ to 6 feet, and the spacing apart of the planes also has been reduced to this figure. The width of the planes at their outer