forces it along through the air. In constructing this machine, the question of weight was an all important one, and everything had to be reduced to the minimum. The ærodrome, weighing less than thirty pounds, carries about four pounds of water. This is about two quarts, and the little engine is so wasteful of it that its flight must be proportionately short, for when the water has been once converted into steam, the ærodrome must stop flying, as there is no more water to furnish steam to run it. The machinery of the air-runner is very light, indeed, but it requires a considerable force to move it in proportion to its weight. Its engine is equal to more than one horse power, and the movable parts of the machinery weigh twenty-six ounces. You could put all of its machinery into a peck measure. Now, a horse weighs a thousand pounds Think of reducing the size of a horse to a peck measure, and its weight to that of a kitten, and you have some idea of Mr. Langley's aerial engine.

What does the acrodrome look like?

I have described it in flight. I examined it at rest and I have gone carefully over its different parts. It is about fifteen feet long and about fourteen feet wide from the tip of one wing to the other. The machine moves through the air on much the same principle as that by which the twinscrew steamer forces its way through the water. On each side of the aerodrome there is a sort of screw propeller or pair of blades in the shape of one cutting of a screw so hung upon a pivot that when the steam is on they fly around at the rate of a thousand revolutions a minute. They look, in fact, much like the wheels of an electric fan when in action. They cut the air so rapidly that you cannot see the blades, and they are, in fact, a pair of wheels about four feet in diameter flying at this wonderful speed around through the air. As they move they screw the air ship onward, and this advancing motion keeps it up in somewhat the same way that a swift skater can be supported by thin ice.

The machinery is in a metal receptacle which ends in a smokestack. This is hung to a frame work of steel. The wings, which are stationary, are fastened to the upper part of the frame work, and they extend out above the body holding the machinery.

The machinery is wonderfully delicate, but it is as strong and at the same time as light as scientific investigation can make it. The fuel is gasoline, which is converted into gas before it is used, and which furnishes such an intense heat that it would melt the boiler in a second if there were not a special pump by which the water is kept flowing rapidly through the boiler, the intense heat converting some of the water into steam as it flows. Every part of the machinery is of the most practical nature and it has been constructed at an enormous expense of patience and experiment. It may be said that nearly every atom of the aerodrome as it is now put together is the result of experiment. The making of the boiler alone consumed months of work. Every bit of the machinery had to be constructed with scientific accuracy. It had to be tested again and again. The difficulty of getting the machine light enough was such that every part of it had to be remade many times. It would be in full working order when something would give way, and this part would have to be strengthened. This caused additional weight and necessitated the cutting off of that much weight from some other part of the machinery. At times, the difficulty seemed almost heartbreaking, but Mr. Langley went on piece by piece and atom by atom, until he at last succeeded in getting all the parts of the right strength and proportions. Even after he had completed his model and had it ready for flight, he was confronted with an unexpected difficulty, which was, it seemed at the time, almost impossible to surmount.

This was the launching of the machine into the air. One of the most difficult things that large, soaring birds have to contend with in flying is in getting a start. You know how difficult it is to launch a ship into the water. It is far more difficult to launch an air ship. Mr. Langley found that his machine had to be clamped down on the launching stage and to be arranged in such a way that the machinery could be started, so that it should receive a slight initial velocity and then be released with a spring. This looks easy. It was hard. But Mr. Langley at last succeeded in launching his machine by hanging it to a movable table, so that it could be turned to face the direction in which the flight was to be made, and so that the wheels of the table would carry the aerodrome straight out in a horizontal line and launch it off into the air. The launching apparatus which we used on November 28, was built on the top of a house boat, and the work of arranging the table was no small one. As I stood upon it and examined its construction Mr. Langley said:

"It don't seem to be much, but it is the result of five years of experiments."

I here asked Mr. Langley what first attracted his attention to aerial navigation.

"I can't tell when I was not interested in it," he replied. "I used to watch the birds flying when I was a boy and to wonder what kept them up. I afterward heard the theory that they possessed great muscular power. You know some scientific men have stated their belief that the muscular strength of birds must be enormously greater in proportion than that of men. But this it seemed to me could not be true. I could not believe what some French mathematicians calculated, namely, that an eagle must be nearly as strong as man. It finally occurred to me that there must be something in the condition of the air which the soaring birds instinctively understood, but which we do not. This idea I held for a long time, the flight of birds continuing to be a wonder to me. It is curious how an idea of that kind sticks to you. I seldom saw a bird flying that I did not think of it, and even lately I have watched them for hours, trying to understand how they could move about through the air, rising and falling, soaring up and sailing down without any motion of the wings."

But, Mr. Langley, I thought that birds used a great deal of strength to fly. They can't fly without moving their wings, can they?"

"The soaring birds can," replied Mr. Langley, and they do fly long distances with apparently very little exertion. Darwin once watched the South American condors, which, you know, are immense birds, for hours. He says they ascended and descended, soared and circled about, with scarcely the movement of a feather. He could not detect a single flap of their wings.

"I remember," continued Mr. Langley, "how I stood one cold November day on the Aqueduct bridge that crosses the Potomac river above Georgetown and watched a turkey buzzard which was lazily soaring round and round watching something in the river below. The wind was blowing a gale. It was going at the rate of at least thirty-five miles an hour, still the bird moved about with the greatest ease, keeping generally on one level, but swaying a little as it went round and round. It was not more than sixty feet above me. I could see it perfectly and could not note the flapping of a wing, though I watched it for a long time. I stayed, in fact, until I got so cold that I had to leave."

"Then you early saw that there was something wrong in our theories as to the wind, Mr. Langley?"

"Yes," was the reply, "I have always felt so, and I remember well when I began to experiment to see if my supposition was correct. It was after a meeting of a scientific association, in which some one stated that an inanimate thing could, under certain circumstances, be made to move in the air against the wind by the power of the opposing wind itself. He claimed that he had made experiments proving this fact, and he stated as an evidence of the truth of his theory that he had seen birds not only come close to the earth and hang stationary in the air, but even advance against the wind and ascend in the air without flapping their wings. He was laughed at, but it is now conceded that what he claimed is not theoretically impossible. I, myself, did not believe he was right at the time, but it set me thinking. My old interest in the subject revived and I began at once to make experiments. I wanted to know the actual facts as to the power needed for flight, and how it was possible that bodies heavier than the air they displaced could keep themselves in the air without falling. I did discover that there was no doubt but that a machine could be made which could support bodies in the air, and which would carry them forward. I have shown you here today a machine which will do this. I have proved that we have the power, and the only question now is to learn how to direct and control it."

"Tell me something of your experiments, Mr. Langley," said I.

"My first experiments were made when I was connected with the astronomical observatory in Pittsburg. It is now more than fifteen years ago that I built my first laboratory for aerial investigation there. A friend of mine, Mr. William Thaw, a wealthy citizen of Pittsburg, supplied the means and I was enabled to make all sorts of tests to ascertain the power used in aerial motion. One device which I had was a whirling table. This was an arm about thirty feet long, which swung about on a central pivot, ten feet above the ground.

It was moved by a ten horse power steam engine, and it went flying around, moving at all speeds up to seventy miles an hour. Now, on the end of the arm I put instruments which would measure the lifting power of the wind upon any inclined surface hung to them. I had, for instance, a spring scale hung there, and to this brass plates were attached. When the arm was put in motion I found