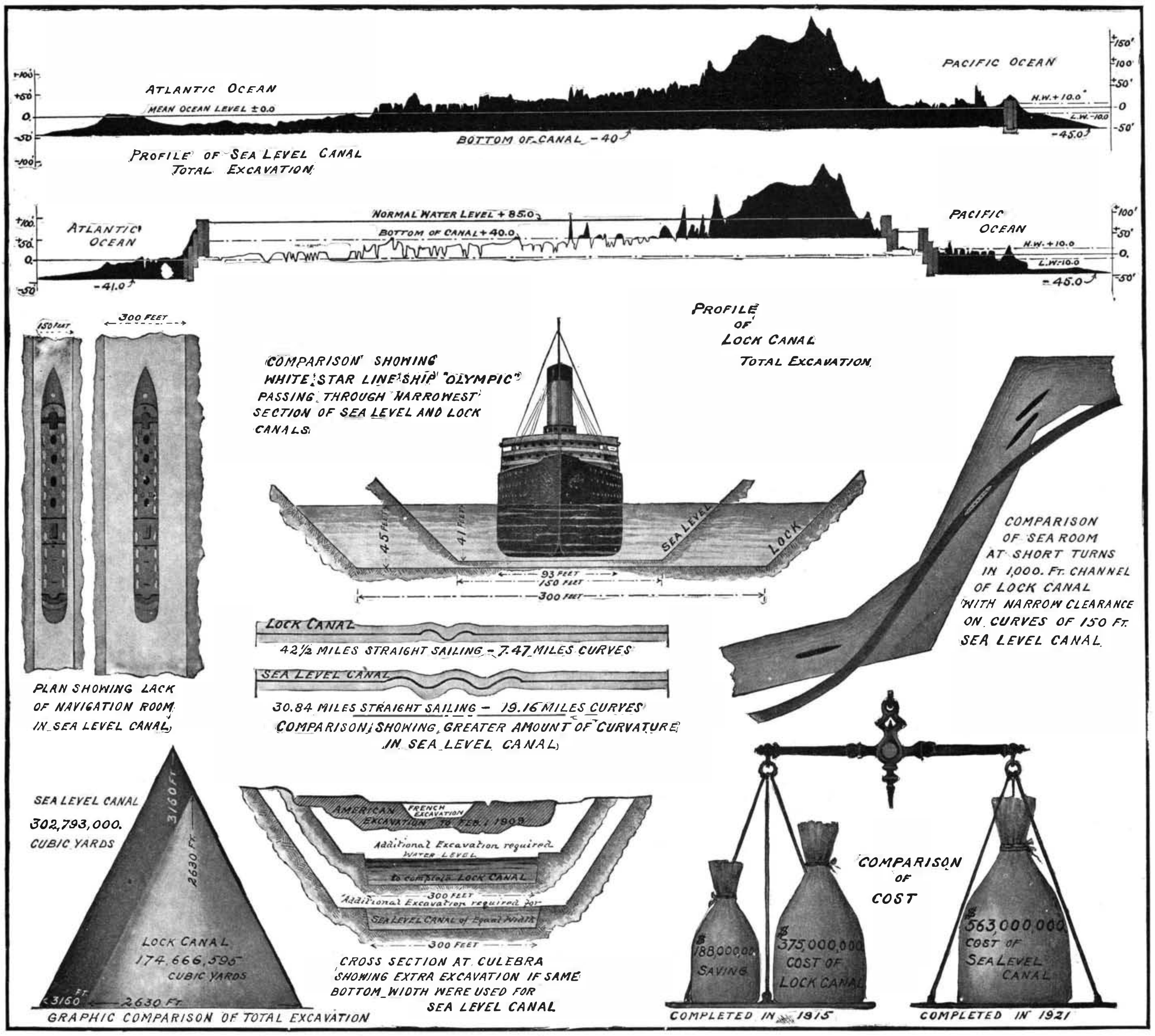
escent yellowish-green cloud floating in space. I am tempted in closing to tell of the remark made to me by one of the older inhabitants of Easthampton, who had paid my laboratory a visit. The Milky Way happened to be overhead, and the mouth of the pit, which was formerly an old well in a shed adjoining the barn, was filled with hundreds of star images. "What *are* they all, anyway?" he asked. "Suns like ours, only bigger," I replied. "You don't say so," he answered. "And have they earths and things going round 'em, and are they all inhabited?" "Very likely," said I; "some people think so." He scratched his head, and then turned to me with a restful smile and said, "Well, do you know, I dunno as it makes so *much* difference after all whether Taft or Bryan is elected."

My summer home at Easthampton was formerly an old farmhouse dating back to the reign of George the Fourth. On the door of the "observatory" we discovered a penciled memorandum "Heifer calf, born May 12"; under which my brother-in-law has inscribed, "Mercury telescope July 2."

Several cities in which ousehold refuse is disposed of by incineration, have utilized the heat evolved by the combustion in the production of power for electric lighting and other purposes. Chicago has improved on this plan by making its sewage serve, indirectly, as a source of power. The Chicago drainage canal, which connects Lake Michigan with the Illinois River, a tributary of the Mississippi, and which was constructed for the purpose of carrying the sewage of the city away from the lake and furnishing an ample flow of water for this purpose, is traversed by a swift current. This current is now utilized in driving generators which supply part of the electric lighting service.



DIAGRAMMATIC COMPARISON SHOWING SUPERIORITY OF LOCK CANAL TO ONE AT SEA LEVEL.

SUPERIORITY OF LOCK TO SEA-LEVEL CANAL.

The reasons which have led the government to decide upon the construction of a lock rather than a sea-level canal are simple, clear, and convincing. This will be evident from a study of the comparative diagrams shown in the illustrations which accompany this article, in which the physical characteristics of the two types of canal, the quantities, costs, convenience of operation, etc., are shown side by side. The lock canal has been chosen, first, because it can be built more easily, more quickly, and in less time; secondly, because when it is built, it will be a much better canal to operate, the ships being able to pass through it with less risk and in considerably less time.

I. THE LOCK CANAL IS EASIER, QUICKER, AND CHEAPER TO BUILD.

1. Control of the Chagres River.—The key to the canal problem is the control of the turbulent Chagres River. The greater part of the canal lies along the course of the Chagres, which meets the canal at about its mid-length, and then turns to the right on its way to the Atlantic Ocean. In the dry season the river is a sluggish stream; but during the tropical rainstorms it rises with great rapidity, and may quickly be transformed into a vast turbulent torrent, flowing at the rate of over 65,000 cubic feet a second. These mighty waters must be checked, held in reserve, and gradually released; otherwise they would flood the canal, damage its works, and render it, for a long period of time, unnavigable. To control these floods, the sea-level plan calls for the construction of a $6,000,000 masonry dam across the Chagres Valley, above the point where the river reaches the canal, which, in times of flood, will be subjected to a pressure, due to a depth at the dam, of 170 feet of water. From above this dam the waters will be gradually discharged through sluice gates into the canal. In the lock canal plan the floods of the Chagres are received into a vast artificial lake, 160 square miles in area, which will cover the greater part of the route of the canal across the Isthmus. On the Atlantic side, the waters will be impounded by a dam at Gatun, and on the Pacific side by a dam at Pedro Miguel. This lake will take the place of about 25 miles of the narrow sea-level canal, and, for 20 miles of its distance, it will offer unobstructed deep-water sailing, in which the channel will be from 800 to 1,000 feet wide. The surplus waters will be wasted through sluice gates, built in solid ground at the center of the Gatun dam. Because of the great area and volume of the lake, the heaviest floods of the Chagres will make comparatively little difference in the water level. It will thus be seen that, while the sea-level plan calls for a $6,000,000 dam exterior to the canal for the control of the Chagres, the lock canal plan makes the Chagres subservient to the canal by forming it into a huge navigable lake; saves an enormous amount of excavation; and for 20 miles of distance secures a broad navigable channel in place of one only 150 feet in width.

2. The Lock Canal Requires Less Excavation.—A comparison of the longitudinal profiles and cross sections gives an impressive idea of the vast amount of extra excavation necessary, if the canal be dug down to sea level. The total amount of excavation for the completed lock canal will be 174,666,595 cubic yards. For a sea-level canal the total amount will be 302,793,000 cubic yards. Moreover, when the two are completed, the least width of the sea-level canal will be just one-half of the least width of the lock canal, and its average width only 218 feet, as against 650 feet; so that it may be said that nearly twice the work will have to be done for only one-third the

result; at least as far as convenience of navigation is concerned.

3. The Lock Canal Will Cost Less.—The latest estimate of the engineers of the total cost, including expenses of sanitation, administration, etc., for the lock canal, is $375,000,000. There is no guesswork about these figures. The surveys and borings are complete; the character of the material to be dealt with is known. Using the same prices, and presuming that as the excavation goes deeper, the material to be taken out will be no more difficult, the cost of completing a canal only 150 feet wide down to sea level will be $563,000,000.

4. The Lock Canal Will Take Six Years Less Time to Build.—Sufficient work has now been done on the canal to enable the engineers to estimate closely the time that it will take to complete the work; and Chief Engineer Goethals has confidently expressed the conviction that the lock canal will be open for traffic by January 1st, 1915. Using the same basis of calculation, it is estimated by the same authority, that the sea-level canal cannot be open for traffic before the year 1821.

II. THE LOCK CANAL WILL BE EASIER TO MAINTAIN AND BETTER TO NAVIGATE.

1. Lock Canal Easier to Maintain.—The advocates of the sea-level canal, in speaking of the cost of operating the locks of the high-level canal, overlook the fact that locks will be required at the Pacific end of the canal, and that because the canal, in its course through the Chagres Valley, is cut through swampy alluvial soil, and is intersected by a score of rivers and streams, a large amount of dredging will be continually required. In times of flood these tributary streams will bring large deposits of silt into the canal. The only alternative to continuous and expensive dredging would be to build a subsidiary drainage canal on each side of the main canal, in which to receive these waters, and carry them off independently to the sea.

2. The Lock Canal Will Provide Much Broader and Deeper Channels.—For about one-half of its length, where it passed through earth formation, the sea-level canal would have the very inadequate width of 150 feet. Where the sea-level canal passed through rock it would have a maximum width of 200 feet, and only in the four or five miles of dredged channel through the ocean approaches would it be 500 feet in width. The depth of the canal throughout would be 41 feet. The lock canal, on the other hand, will nowhere be less than 300 feet in width, and throughout its whole length it will be 45 feet in depth. For 20 miles through the great Gatun Lake, the channel will be from 800 to 1,000 feet wide, and from 70 to 45 feet in depth. About 22 miles of the canal will be 500 feet in width, and the remaining 8 miles 300 feet in width.

3. The Lock Canal Would Have Less Curvature.—Out of the whole 50 miles of the sea-level canal, nearly two-fifths, or 19.16 miles, will be curvature, leaving about 31 miles only of straight sailing. The lock canal, on the other hand, will contain 7½ miles only of curvature, and ships will be able to sail a straight course over the remaining 42½ miles.

4. The Lock Canal Will Be Much Easier to Navigate.—The two points of superiority mentioned above, namely, the broader and deeper channels, and shorter length of curvature, will be appreciated at once by any navigator. The difference in this respect will be understood by reference to the plan view, showing the curves of the two canals at the same point in Gatun Lake. We have drawn a 900-foot ship in a curve of the sea-level canal, and also two such ships passing each other at a turn in the 1,000-foot channel of the lock canal. The lock-canal channel is laid out on long tangents, with quick turns at their point of junction. Pilots prefer to make the turns in this way, which is the method followed in navigating the channels of the Great Lakes. The ship proceeds on a given course, until the lights or buoys show her to be in range for the next course, when the helm is put over and the ship's head swung sharply around. It is a very difficult matter to steer a large ship on long curves, such as are provided for in the sea-level canal, and keep her exactly in mid-channel. No curves of this character exist throughout the lock canal, whereas, as we have shown, two-fifths of the sea-level canal consists of such curves.

5. The Lock Canal Will Take Less Time to Navigate.—The report of the Board of Consulting Engineers of 1906, speaking on the question of the time of transit, says: "In the narrow channels of the sea-level canal, with its large proportion of curves, night navigation will be more hazardous than by day, and ships will probably move at lower speed than that assumed for the calculation of time of transit. Unless ships arrive very early in the day, they will not be able to pass through the canal by daylight on the day of arrival, but will have to submit to delays of night navigation or tie up until the next day. The cost of this delay on a tonnage through the canal of 20 million tons annually would amount to $1,500,000." But even if a ship could enter the canal at once on arrival, it is estimated that at the rate of thirty ships per day, vessels 540 feet in length would require 12.9 hours to pass through the sea-level canal, as against only 10 hours through the lock canal; while vessels 700 feet long, which would pass through the lock canal in 11.1 hours, would require 18.9 hours to pass through the sea-level canal. The even slower speed of navigation required of an "Olympic" or "Titanic," 900 feet in length or over, would probably cause the time of transit to be twice as long through a sea-level canal as it would be through a lock canal.

THE SCIENTIFIC AMERICAN FLYING MACHINE TROPHY.

The SCIENTIFIC AMERICAN Trophy for heavier-than-air flying machines was offered by the SCIENTIFIC AMERICAN for annual competition under the rules and regulations formulated and promulgated by the Aero Club of America in 1907.

The first trial for this cup was held at Hammondsport, New York, on July 4th, 1908, by the Aerial Experiment Association of Hammondsport, New York. At the second attempt the "June Bug," in charge of Glenn H. Curtiss as pilot, rose from the ground and flew from a designated point a distance of 5,090 feet. Mr. Curtiss was awarded the trophy; he having fulfilled the requirements of the Contest Committee and performed in this aeroplane a flight of more than a kilometer, which was the minimum distance required under the rules adopted for 1908 by the Aero Club of America.

In accordance with the deed of gift, which provides that the conditions for each contest for this trophy shall be made progressive in their severity of test, in conformity with the progress of aerial navigation, the conditions to be fulfilled by the next person entitled to have his name placed on the Trophy shall be a flight of not less than twenty-five kilometers, including a return to the starting point.

MEDALS PRESENTED TO ORVILLE AND WILBUR WRIGHT BY THE AERO CLUB OF AMERICA.

RULES GOVERNING COMPETITIONS FOR THE SCIENTIFIC AMERICAN TROPHY FOR 1909.

I. It is distinctly understood that the trophy is to be the property of the club and not of the members thereof, except in the event that any one person shall win the trophy three times, in which case it is to become his personal property.

Should the trophy be won by the representative of some foreign club affiliated with the Aero Club of America through membership in the International Aeronautic Federation, it shall be held in the custody of such club, but it shall be subject to competition under the same terms and conditions as if it were still held by the Aero Club of America. Should the holding club, for any reason, be disbanded, the custody of the trophy shall revert to the Aero Club of America.

Should a contest or trial under the rules not be held within a year from the date on which a foreign competing machine shall have won the trophy, the foreign aero club having possession of the cup shall give up its custody of the same and shall return the cup to the Aero Club of America, in order that the competition or trial for that year may be held in the United States of America.

The conditions under which the competitive tests and trials shall be made, shall be determined by the Contest Committee of the Aero Club of America, and such conditions shall be made progressive in their severity of test, as far as possible, in order to foster and develop the progress of the art of aerial navigation.

II. All heavier-than-air machines of any type whatever (aeroplanes, helicopters, orthopters, etc.) shall be entitled to compete for the trophy, but all machines carrying a balloon or gas-containing envelope for purposes of support are excluded from the competition.

III. To compete for this prize each contestant must notify the club of his intention to compete, by telegraph or by registered letter, addressed to the club at its headquarters in New York, and must specify the days on which trials are to be held. He must also deposit the amount of the fare from New York to the place of trial and return. Sufficient time must be allowed for the representative of the club to reach the place where the contest is to be held, with an additional two days in which to make arrangements for the journey. If trials are to be made within twenty-five miles of New York city the club will send a representative without expense to the contestant.

IV. The person or committee having charge of the test or trial shall make careful measurements of the distance covered by the flight, and shall prepare a written report of the test or trial, which shall be delivered to the Contest Committee of the Aero Club of America, and in such report shall state fully whether in his opinion the machine can be handled with safety, and, as far as possible, he shall determine the speed attained during the flight. He shall also take into consideration the question of stability and ease of control, and he shall state in his report weather and wind conditions.

V. The flights will be made in as calm weather as possible, but the contest committee or its representative will at its discretion order the flight to begin at any time it sees fit, provided the velocity of the wind does not exceed twenty miles an hour. The machine may start by running on the ground or upon a track under its own power, but no special launching device will be permitted. There is no requirement as to the height above the ground at which the machine must fly, but it must demonstrate its ability to rise or descend and circle to the right and left at the will of the operator.

VI. Complete specifications of the competing machine, giving weight, supporting surface and power of engines, together with a description of the best trial of the machine, shall be forwarded to the contest committee at or before the time of making entry for the contest.

VII. The minimum distance which must be covered by the competing machines during 1909 shall be twenty-five kilometers, including the return to the point of starting, and a descent or alighting at a point not more than one hundred meters from the point at which the machine rose from the ground. Under the rules promulgated for the year 1909, bona-fide owners of machines may make application for a test or trial, as above provided for. No entrance fee shall be required from persons desiring to compete for the SCIENTIFIC AMERICAN Trophy.

VIII. No trial or test for the year 1910 will be allowed until the rules governing the competition for that year have been promulgated.

IX. All tests and trials shall be under the official supervision and direction of the Aero Club of America, and all questions that may arise in regard to such contest or trial shall be decided by the contest committee of said club, and its decision in all questions of dispute shall be final, and without right of appeal to a court of law or equity.

X. The winner of the SCIENTIFIC AMERICAN Trophy for 1909 shall be the entrant of the flying-machine which, in accordance with the above rules, shall make during the year mentioned the longest and best flight in excess of the minimum performance specified in Paragraph VII. His name and record will be appropriately inscribed on the trophy.

XI. In case the contest committee is unable to determine which machine has made the best performance during the year 1909, it shall arrange that a competition between such machines be held, and the machine making the best performance in such test shall be awarded the trophy for the year.

Waterproof Paper.

Japanese waterproof paper is made of fibers of bamboo and eucalyptus, mixed with fibers of the gampi and other shrubs. The fibers are torn apart, dried, cleaned, scraped, boiled in weak lye, and washed with water. They are then beaten and mixed with a viscous infusion of certain roots and a solution containing camphor, caoutchouc, and resin. The sheets formed from this pulp are calendered at various temperatures. The paper is light, washable, and very difficult to tear. It is used to imitate leather and India rubber, and for a great many purposes.

According to a contemporary, the electrolysis of water mains in Boston and vicinity is proceeding at a greater rate than ever before. The investigations made in 1907 by the Metropolitan Water and Sewerage Board show that the pitting and disintegration of the pipes by electric action have been serious, and that the destructive process is continuing even in places where insulating joints and other devices have been applied as a remedy.