THE LEANDER McCORMICK OBSERVATORY OF THE UNIVERSITY OF VIRGINIA.

BY H. C. HOVEY.

Jefferson's last request was that no other memorial should be erected to his fame than a simple column, signifying his having been the author of the Declaration of Independence and the founder of the Virginia University. But he has still another memorial in Mount Jefferson, located on the grounds of the university, an eminence which he himself selected as a suitable site for an observatory. It is a beautiful elevation, 850 feet higher than Charlottesville, and 1,350 feet above the level of the sea. Monticello is in full view, six miles distant, as well as many another spot known in history. The Blue Mountains are about twenty miles distant, and toward the south are visible the Peaks of Otter at the distance of fully eighty miles, while in every direction may be traced the faint outlines of receding hills. Thus there is commanded a complete and wide horizon on every side. Geologically, Mount Jefferson is composed of rocks belonging to the Huronian age of the Archæan era.

The McCormick family, inventors of the well-known reaper, originated in Rockbridge County, Virginia. Leander, the younger of the three brothers bearing that name, residing in the city of Chicago, desired to do something to prove his affection for his native State; therefore contracted with Alvan Clark & Sons, of Cambridge, Mass., for a mate to the splendid telescope they were then making for the National Observatory at Washington, D. C., with certain noted improvements, and offered, on specified conditions, to present it to the Washington and Lee University, at Lexington, in the county where he had been born. As those conditions were not met, he next offered it to the University of Virginia, through Col. Venable, the professor of mathematics in the latter institution, who immediately took steps toward raising the necessary endowment. In answer to an appeal to the State legislature, that body passed resolutions recognizing the generosity of the donor and the importance of securing such a telescope, but did not deem it wise, in the condition of the State finances at that time (1878), to make the appropriation asked for. Gen. Johnston, now of the South Carolina Military Academy, at Charleston, then visited the alumni of the University, pursuant to an appeal made by the executive committee, and raised over $50,000, to secure the $3,000 salary of the astronomer in charge. Mr. Wm. H. Vanderbilt, of New York, added $25,000 as the beginning of a working fund. The university gave the ample grounds on the summit of Mount Jefferson, and also built the astronomer's residence, at a cost of $8,000. Mr. McCormick then gave the telescope, costing $46,000, and the building in which it is housed, costing $18,000; thus making a sum total, including the smaller buildings, etc., of $150,000. The observatory was completed in 1884.

The great cost of refracting telescopes is due to the difficulty of obtaining masses of glass sufficiently uniform in structure to secure accuracy of definition. The object glass, made by Alvan Clark & Sons, is 26 inches in clear dimensions and 33 feet in focal length. The inner surfaces of the lenses are made with slightly different radii, in order to avoid what is called "an object-glass ghost," which has been found an annoyance in the telescopes of the Washington and other great observatories. The tube is of steel, in three sections firmly bolted together. The micrometer wires, and the reading circles, are lighted by small incandescent lamps fed by an ordinary bichromate battery. An incandescent hand lamp is also used. No oil lamps are used for any purpose in the observatory. The driving clock is electrically connected with a Seth Thomas clock in the computing room. The magnifying power depends on the eye-glasses used with the great objective. The highest power that can be usefully employed is stated to be 2,500 diameters; which, if applied to the moon, would bring it to within 96 miles of the observer. "The space-penetrating power of the McCormick telescope, estimated by the ordinary rule, is 131. That is to say, the faintest star visible to the naked eye would still be visible through this telescope if the star were removed to 131 times its present distance."

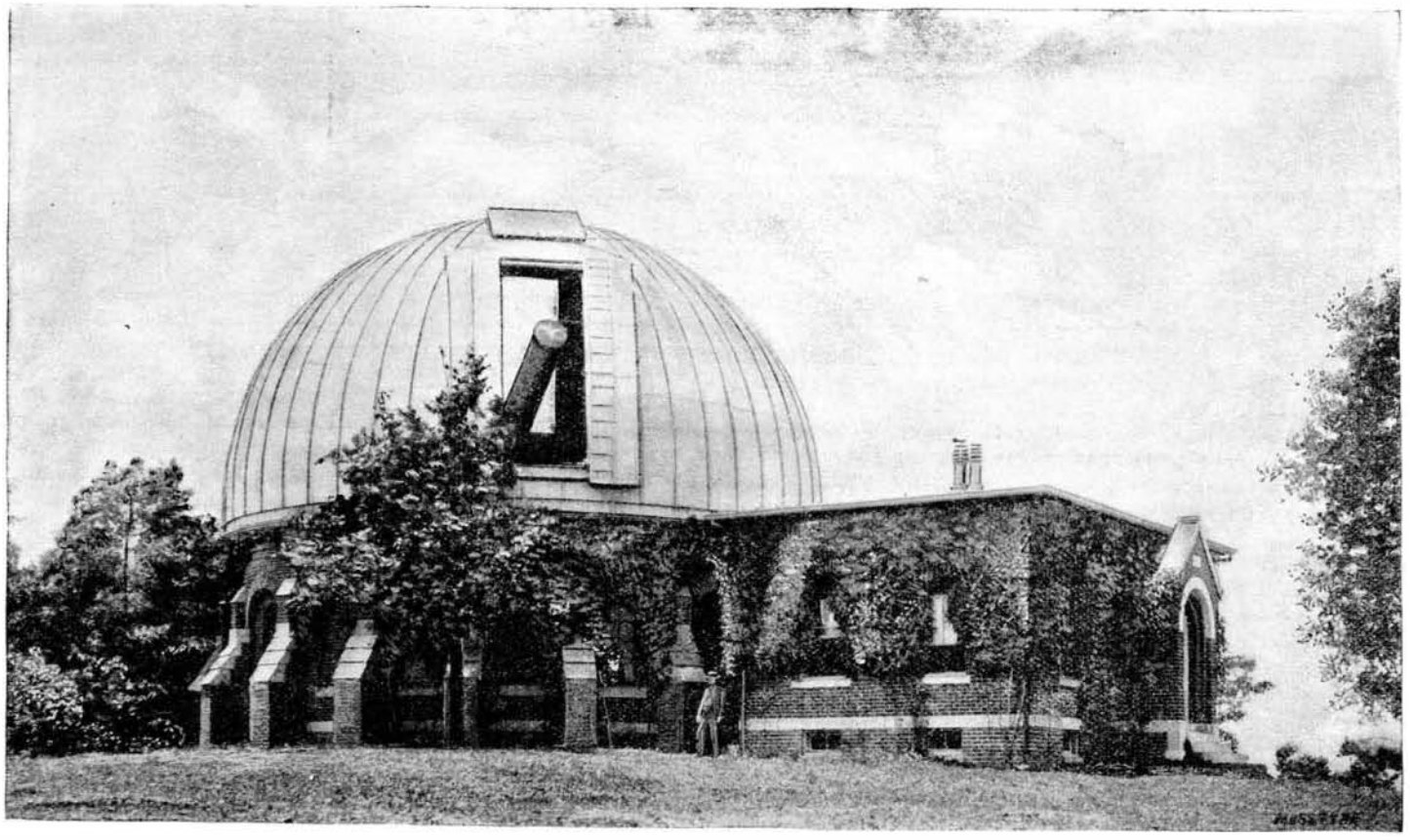
The dome is 45 feet in diameter, and weighs 25,000 pounds above the wheels on which it revolves. The running gear consists of a live ring of wheels in sets of three; the center ones of which support the dome, while the two outer ones rest on circular tracks. They are portions of exact cones, having their apexes at the center of the dome. Connected with each set of wheels are two guide wheels, one in front and one behind, which run between the tracks of the wall plate. These guide wheels are so adjusted as to keep the axis of the conical wheels at right angles to the track at that point. In this way sliding friction is changed to rolling friction. In the older forms of domes the effort was to make the live ring exactly circular; and the wheels were kept in place by the aid of flanges, and the connections between the sets of wheels were rigid. But atmospheric changes must necessarily change the shape of the dome, live ring, and tracks; the result being sliding friction. With the present arrangement each additional ton weight of the dome requires an additional starting pressure of less than two pounds; and with the gearing, about nine pounds pull on the rope will move the dome. Another important result is that the dome revolves more rapidly than any other of its size in the world. I timed Prof. Stone as he accomplished a complete revolution of it in exactly one minute and eight seconds.

The dome has three apertures, six feet wide, with closures six feet square between; the center of each closure being the same altitude as the center of an aperture opposite. This arrangement permits a very rapid and thorough ventilation of the dome, so as to get the same temperature inside as outside. Warner & Swasey, of Cleveland, Ohio, makers of the dome, conceived the idea, for the first time worked out in this apparatus, and took out a patent for it while the work was being done.

Attached to the circular building surmounted by the dome are computing rooms, containing the library, clocks, chronographs, seismographs for registering earthquakes, and various other apparatus. And in a smaller building near by are the transit and equatorial.

Three annual reports have been issued, showing what has been accomplished since the completion of the McCormick Observatory. From these we learn that numerous observations have been made of stellar pairs, nearly all of which are close and difficult, requiring 439 micrometrical measurements of angles and distances. A few cometic observations have been made. The catalogue of stars for the 23° zone has been completely revised. Lunar occultations have been observed, and the paths of numerous meteors noted. The nebula in Orion has received careful attention. The conclusion reached is that its figure has remained unchanged from 1758 to the present time, although variations have been and still are going on as to the brightness of its parts. Differences in this respect have been estimated in "steps," each being compared on the same night with brighter and fainter condensations. Estimates have also been made of the relative brightness of the stars in the brighter portion of the nebula, in order to trace, if possible, any existing connection between them and the nebula.

The director reports that 351 observations of miscellaneous nebulæ have been made, resulting in a large number of sketches and in the discovery of 270 nebulæ not hitherto detected. He says: "Our knowledge of the motions of the so-called fixed stars is steadily increasing; but astronomers have practically no knowledge of the motions of the nebulæ." This problem he has undertaken to solve. These bodies are so faint and diffused as to make meridian observations possible of only a few of them; and the positions of the remainder must be determined by comparison with neighboring stars. He has prepared a working list of all known nebulæ north of 30° south declination, and which are as bright as the 14th magnitude and condensed at the center. The filar micrometer is used in making comparisons of right ascension and declination, the wires being illuminated with red light regulated by a switch located at the back of the observing chair. This peculiarly delicate and important work is still continued, and will have to be carried on for several years to come; the results being published from time to time in various astronomical periodicals. The comparison stars needed for making the catalogue of nebulæ in course of preparation are being observed by Dr. H. C. Wilson, at the Carleton Observatory, in Minnesota.



THE OBSERVATORY BUILDING, UNIVERSITY OF VIRGINIA.

The sole director, under whose superintendency the McCormick Observatory was built, and by whom it is now controlled, is Prof. Ormond Stone, who proved his enthusiasm by sharing almost daily in the manual labor necessary for the proper construction of the buildings required to house the great telescope and its accompanying apparatus. Prof. Stone was born in Illinois, January 11, 1847, and received his astronomical education under Prof. Safford, at the Dearborn Observatory, in Chicago. He became, in 1870, the assistant at the Naval Observatory, at Washington, D. C., where he remained till 1875, when he was made the director of the Cincinnati Observatory, from which he was called to his present duties in 1884. He is also the vice-president of Section A (mathematics and astronomy) of the American Association for the Advancement of Science, and will make the opening address before that section at the Cleveland meeting.

Among the astronomers who have been trained for their work by Prof. Stone may be mentioned Prof. Wilson, of Carleton College; Prof. Upton, of Brown University; Prof. Howe, of Denver; Mr. Egbert, of Madison, Wis.; Mr. A. S. Flint, of the Naval Observatory at Washington, D. C.; and Prof. Leavenworth, of Haverford College. His present assistant is Mr. Frank Muller, and N. M. Parrish is also assisting, with special reference to seismographic observations. This latter work has just been begun, in accordance with an arrangement entered into by several observatories in

different parts of the country. Prof. Stone also edits the *Annals of Mathematics*, one of the few mathematical journals published in this country.

THE ENGINES OF THE STEAMER CONNECTICUT.

(*Continued from first page.*)

in the single cylinder construction. The wheels are of the feathering type.

The engine is carried by two parallel keelsons made of steel. These in their turn rest on yellow pine keelsons which rest upon the cross timber and are bolted to the hull timber. The surface condenser is carried on the after end of these steel keelsons. It contains 3,916 brass tubes ¾ inch in outside diameter. The distance between the tube sheets is 16 feet, giving a condensing surface of 12,150 square feet. A second condenser of 750 square feet is provided for use if necessary. The crank pin, whose bearings are 18 inches in diameter and 49 inches long, is shrunk into place, as are also the crank arms. Each of the shafts thus constituted is 33 feet 6 inches long, and has 23 and 25 inch journals. The steam is generated in six boilers 12 feet 6 inches in diameter and 20 feet 1¾ inches long, carrying 120 lb. pressure. They are of steel, with drilled rivet holes, and machine-riveted throughout. The engine will develop about 4,500 horse power, and may be driven 1,000 horse power higher. The steamer is 358 feet 6 inches in length over all, and 87 feet in width over the guards. Its width of hull is 48 feet 2 inches, and its depth of hold 17 feet 3 inches.

The engines were designed by Mr. George B. Mallory, of New York, and were constructed by the William Cramp & Sons Co., of Philadelphia, Pa. The steamer is of wood, and was built by Robert Palmer & Co. at Noank, Conn.

TRIAL TRIP OF THE VESUVIUS.

The new dynamite gun cruiser Vesuvius, built by Wm. Cramp & Sons, Philadelphia, was put to a trial test on January 11, off the Delaware Breakwater, and she proved herself fully equal to the government requirement, developing a speed exceeding that of any war vessel of or above her size in the world.

The Vesuvius is 252 ft. long, 26½ ft. beam, 9 ft. draught, with displacement of 725 tons. She has a four-cylinder triple-expansion engine, and developed 4,295 I. H. P. on her trial trip, or nearly 6 horse power to a ton of displacement, and not 17 H. P. per ton, as stated by some of the city papers. This ratio of power to tonnage far exceeds the power of any vessel of over 200 tons that has yet been built for war purposes.

The run was made, commencing at 9 A. M. January 11, each way over a course of 2·543 knots, laid off outside the Delaware Breakwater, marked by two buoys placed by government officials, and the trial was made under inspection by U. S. naval officers.

The speed of 22·947 knots with wind and tide, and of 20·346 knots against wind and tide, was easily accomplished; the mean of the two runs being 21·646 knots per hour, or an excess of 1·646 knots over the government stipulation, which makes the Vesuvius acceptable to the government on her first trial test, something we think unheard of in American naval accomplishments.

The after run of 90 miles from the Breakwater to Philadelphia was easily made under low steam at a speed of 16 knots per hour, about all that could be attained in the shallow waters of the Delaware without causing a drag wave.

The speed attained by the Vesuvius has only been exceeded by the following small vessels: A twin-screw torpedo boat, built for the Italian government by Yarrow & Co., with a displacement of only 100 tons; length, 140 ft.; beam, 14 ft.; with which a trial speed of 25 knots was attained (the developed horse power not being given). The Courier, a French torpedo boat, built by Thornycroft, of about 150 tons displacement; length, 147½ ft.; beam, 14½ ft.; draught, 5 ft.; which in a trial trip developed 1,550 I. H. P., or 10 horse power to a ton of displacement; attained a speed of 26 knots per hour. And also a small torpedo boat for the Dutch government, for which a speed of 27 knots per hour is claimed.

The relative horse power per ton of displacement plays so important a part in the performance of all vessels propelled by steam that we give the proportions in a number of war vessels of exceptional speed, as far as known: The Wattignies, a French cruiser of 1,273 tons displacement, having engines of 4,000 I. H. P., or 3·2 H. P. per ton. Just finished. Speed not yet tested.

A twin-screw naval steamer (English); length, 220 ft.; beam, 34 ft.; draught, 15 ft.; 1,560 tons and 3,115 I. H. P., or 1·99 H. P. per ton displacement. Speed on trial, 16·91 knots per hour.

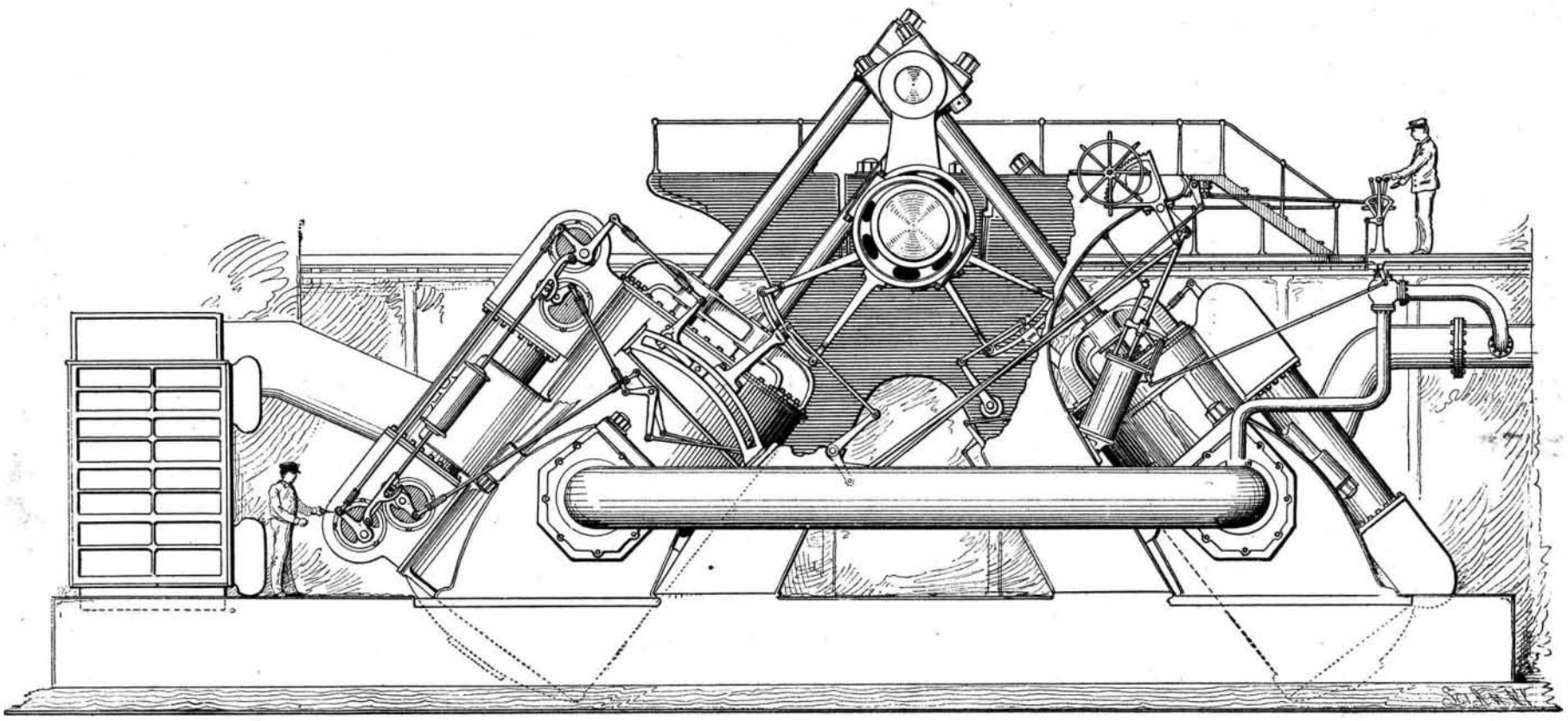
A twin-screw naval steamer (English); length, 300 ft.; beam, 46 ft.; draught, 19½ ft.; 3,584 tons displacement and 6,160 I. H. P., or 1·71 H. P. to a ton. Speed on trial, 18·18 knots per hour.

A twin-screw naval steamer (English); length, 315 ft.; beam, 61 ft.; draught, 25½ ft.; 7,645 tons, with 10,180 I. H. P., or 1·33 H. P. to a ton. Speed, 17·21 knots per hour.

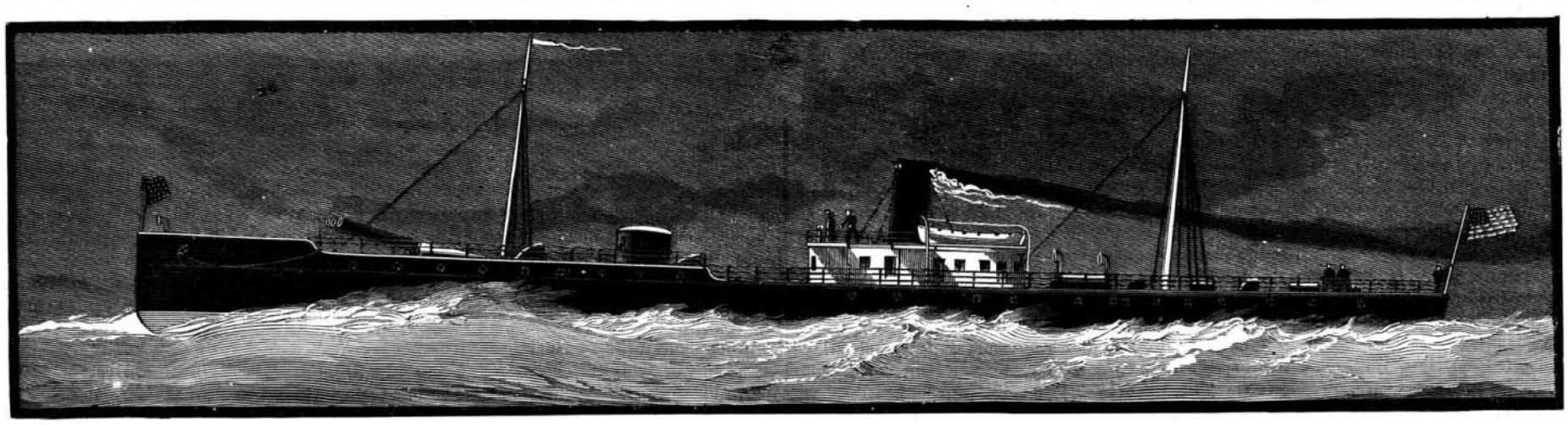
A twin-screw naval steamer (English); length, 325 ft.; beam, 68 ft.: draught, 27½ ft.; 9,690 tons, with 11,610 I. H. P., or 1·2 H. P. to a ton. Speed, 16·52 knots per hour.

The Italia, an armorclad ship, built by the Italian government, probably the largest war ship afloat; length, 400 ft. 6 in.; beam, 73¾ ft.; draught, 30½ ft.; having a displacement of 13,480 tons; has developed 18,000 horse power, with the extraordinary speed of 17·8 knots per hour. Considering that the ratio shows but 1·33 I. H. P. to a ton of displacement, this is an extraordinary speed for an armored cruiser.

Although none of the new unarmored cruisers has developed a speed equal to that of most of the vessels mentioned in the above list, it is expected that most of the cruisers, both armored and unarmored, that are as yet uncompleted will attain speeds that will compare favorably with the European standard. The Vesuvius has taken a long step forward, and marks a well defined line between the slow coaches of the old navy and the long hoped for high speed vessel of the new *regime*. That our American engineers are capable of rising to the emergency of the case has been pretty satisfactorily demonstrated; and that our marine architects have succeeded, with so little experiment and so few failures, in producing a vessel that can compare favorably with such veteran builders of high speed vessels and torpedo boats as the Yarrows and the Thornycrofts is a matter of congratulation.



VALVE MOTION AND GENERAL CONNECTIONS OF THE ENGINES OF THE CONNECTICUT.



THE DYNAMITE CRUISER VESUVIUS.

IN a paper lately read before the Academy of Sciences, Paris, on various methods of treating rabies, by M. Odo Bujwid, he said that, since his visit to M. Pasteur's establishment in 1886, he had been treating persons bitten by dogs, either mad or suspected of being mad, in his laboratory at Warsaw. At first he followed the simple processes of inoculation of M. Pasteur, and of M. Frisch, of Vienna, with some failures in both cases. But during the last sixteen months he has adhered exclusively to the intensive or severe treatment, which has been applied to 370 patients without a single fatality.