THURSDAY, JUNE 25, 1874

THE NEW PHYSICAL LABORATORY OF THE UNIVERSITY OF CAMBRIDGE

ON the 16th inst., at a congregation held in the Senate House, Cambridge, the Cavendish Laboratory was formally presented to the University by the Chancellor. The genius for research possessed by Prof. Clerk Maxwell and the fact that it is open to all students of the University of Cambridge for researches will, if we mistake not, make this before long a building very noteworthy in English science. We therefore put before our readers, as prominently as we can, a description of it.

The Cavendish Laboratory has been erected entirely at the expense of his Grace William Cavendish, Duke of Devonshire, K.G., Chancellor of the University, who has also signified his intention of supplying it with the apparatus necessary for a complete physical laboratory. The building consists principally of three floors, of which the accompanying figures show the plan on a scale of 32 ft. to the inch; Fig. 1 representing the ground-floor, and Figs. 2 and 3 the first and second floors respectively. The west front consists entirely of Ancaster stone; with the exception of the lecture-room and the staircase, which will presently be described, the only ornate portion of the building is the great gateway, X Fig. 1, situated near the south end of this front. The doors, which are very massive, are beautifully carved in oak, and bear, in old English letters, the inscription "Magna opera Domini exquisita in omnes voluntates ejus," which is the Vulgate version of Psalm cxi. 2. Over the gateway are the arms of the Duke of Devonshire on the left, and the University arms on the right, the motto of the Cavendish family, "Cavendo tutus," occupying the centre; and the whole is surmounted with a beautifully carved statue of the Duke in his robes as Chancellor of the University, and bearing in his hand the Cavendish laboratory. The lower portion of the building on the right of the entrance is occupied by the resident attendant. The external walls are 2 ft. thick, the foundation being at a depth of 15 ft. below the surface: with the exception of the west front, the tower, and the portion occupied by the lecture-room, they are built of brick, with Ancaster stone dressings. The tower (marked A in the plans), which is about 17 ft. by 14 ft. 6 in. internal measurement, and 59 ft. in height, contains a very handsome stone staircase with carved oak balustrades.

In describing the internal arrangements seriatim, we shall commence with the room at the east end of the ground-floor marked B in Fig. 1. This room is set apart for magnetic and other observations requiring great steadiness. At *a* is a brick pier about 18 in. high, with a stone top about 4 ft. square. This pier is quite distinct from the tiled pavement of the room, the brickwork being commenced at a depth of about 18 in. below the pavement, and this resting on a foundation of concrete about 18 in. thick. On this pedestal is placed the great electro-dynamometer of the British Association, the two large coils of which are each about half a metre in diameter, and each contains 225 turns of No. 20 copper wire. The diameter of each circle of wire has been accurately measured, as has also the distance betweeen the two bobbins, which is about equal to the radius of either. The resistance of each coil has also been determined, and thus all the electrical constants of this instrument are known with great accuracy. It is by comparison with these coils that the electrical constants of all the other electro-magnetic apparatus in the laboratory will be determined. For example, the magnitude and position of each circle of wire in each coil being known, the coefficient of induction of the first coil on the second can be at once found. Suppose, then, we wish to find the coefficient of induction of a third circuit upon a fourth whose resistance is known. Let the same primary current be sent through the first and third circuits, and let resistances be introduced in the second or fourth until the currents in the two latter are equal. Then the electromotive forces in the second and fourth circuits are proportional to the whole resistance in the circuits, and thus the coefficient of induction of the two pairs of circuits are compared.

At *b* and *c* are stone slabs each 4 ft. square, supported on foundations similar to those last described. On the slab at *b* is placed a unifilar magnetometer of the pattern adopted at Kew. In the upper part of the north wall of this room is a small window for the purpose of determining the direction of the meridian by astronomical observations. This direction being once determined, vertical mirrors will be placed opposite each other on the walls, each mirror being supported by three screws and accurately adjusted by means of nuts so as to serve the purpose of collimation marks. Three mirrors will be placed respectively on the north, east, and south walls of the room, but the fourth mirror will be fixed on the west wall of the room marked F in Fig. 1, in such a position as to be visible through the doorways from the mirror on the north wall of room B. The room marked C in Fig. 1 is called the clock room. In it is a stone pier, *d*, on foundations separate from the rest of the building and intended to carry the principal clock. This clock will be in electric communication with the other clocks in the building, and will from time to time be compared with the clock at the Astronomical Observatory. In this room is also erected a massive stone frame, *e*, intended to carry an experimental pendulum. This, like the clock pedestal, is erected on a foundation similar to that which supports the electro-dynamometer.

Each of the rooms B and C is about 30 ft. by 20 ft. The windows in all the rooms throughout the building have wooden shutters fitted to them, by which they can be completely darkened. On the inside of each window is a large stone shelf, and on the outside a similar shelf in the same plane with it, so that an instrument may be erected with some of its feet inside and some outside the window, a small channel being left between the two to allow the escape of rainwater. The room marked E in Fig. 1 has two large windows on the north side, and will be used exclusively for balances. The best balance at present in the laboratory was constructed by Oertling, and when loaded with a kilogramme in each pan will turn to the weight of a milligramme. This balance, while capable of carrying a very considerable weight, is sufficiently delicate for most physical purposes.

The room marked F in Fig. 1 is called the heat room; in it will be conducted experiments in calorimetry, and the like. This room at present contains an apparatus devised by Prof. Clerk Maxwell for determining the viscosity of air.* This is done by causing three glass plates to vibrate between four parallel fixed plates in an air-tight receiver, by means of the torsion of a steel wire. A mirror being connected with the plates, the amplitude of vibration is determined by viewing through a telescope the image of a fixed graduated scale formed by the mirror. The room G on the ground-floor is used for unpacking apparatus, &c., which is brought directly into this room from the street. The apparatus is then raised to the floor above by means of a lift at *k*. H Fig. 1 is used for a workshop; it is furnished with a carpenter's bench and tools, two vices, &c. A 5-inch self-acting screw-cutting lathe will shortly be added, and

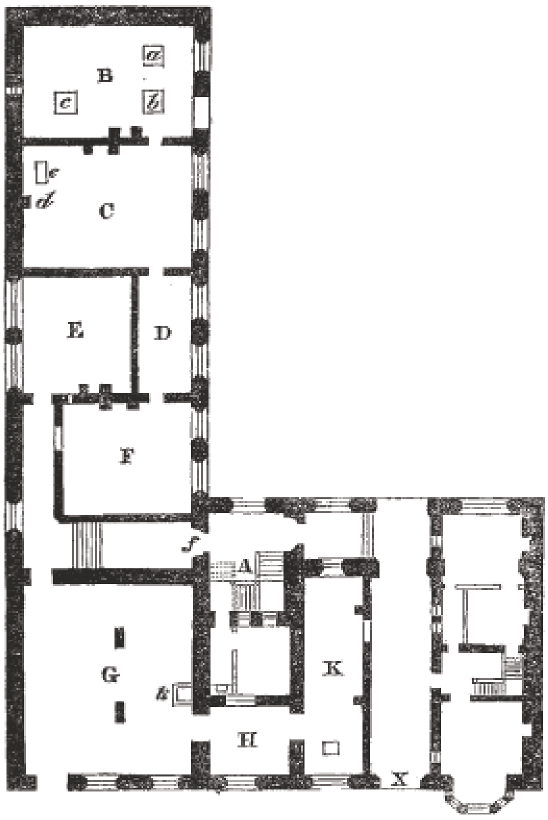

FIG. 1.—Ground Floor.

thus the means will be provided for adjusting and repairing on the premises most of the apparatus required in physical research. The room K is called the battery room; it is situated immediately under the lecture-room, into which wires will be carried from the battery through small hatches in the floor. The battery which will be employed is Sir William Thomson's tray battery, in which the zinc plates will be supported on porcelain cubes of 1-inch edge. The internal resistance of one of these cells is about ·16 ohm. A gas holder containing oxygen gas will also be kept in this room, from which pipes will be carried up into the lecture-room, so that the oxy-coal-gas limelight will be always at hand. The south wall of this room, which is 18 in. thick, passes up into the lecture-room independently of the floor, and carries the lecture table. The floor of the lecture-room is supported on two brick piers, which are built about an inch away from this wall. On the stone pavement of the ground-floor a long line will be carefully measured, and with this the other measures of length used in the laboratory will from time to time be compared. At *f* is an old stone gateway of the sixteenth century, which formerly served as the entrance to the Science Schools.

* See the Bakerian Lecture, Phil. Trans. 1866.

Passing now to the east end of the first floor we find ourselves in the general laboratory (L Fig. 2). This room is 60 ft. long and 30 ft. wide, and is designed to contain twelve large tables, though there are but ten in it at present. Each of the tables in this, as in all the rooms on the first and second floors, is supported independently of the floor on beams resting on brackets fixed in the walls of the

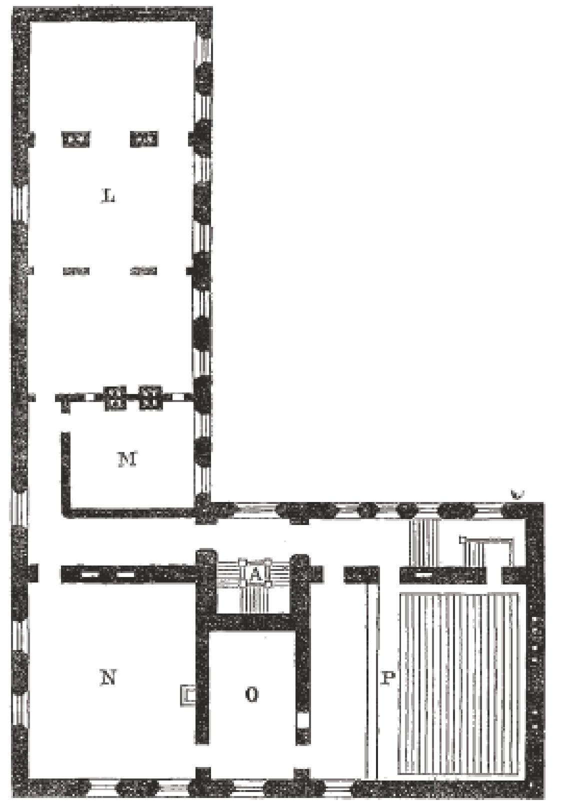

FIG. 2.—First Floor.

rooms below, holes being left in the floor and blocks placed upon the beams so as to be flush with the flooring; it is on these blocks that the legs of the table rest. A stand-pipe, conveying gas, passes up through the centre of each table, and carries connections for four Bunsen or other burners, but can be removed at pleasure. A closet, provided with a good draught into the chimney, will be erected at the east end of this laboratory, in which any experiment producing objectionable fumes, &c., can be conducted. This laboratory is intended for the general use of students. Each room, with one or two exceptions, is provided with an open hearth for a basket fire and a ventilator leading into the chimney near the ceiling. Water is also laid on to all the rooms, which are likewise furnished with leaden sinks; and a plentiful supply of indiarubber tubing lined with canvas will be always on hand in case of fire. The room marked M in Fig. 2 is the Professor's private room. It communicates with the general laboratory by two hatches, which can be opened or closed at pleasure. In the south-west corner of this room is placed Sir William Thomson's quadrant electrometer, made by White of Glasgow. N Fig. 2 is called the apparatus-room. This room will be furnished with glass cases and cabinets, in which will be kept the apparatus which is not in immediate use, and amongst others several classical instruments belonging to the British Association, as for example the original standard unit of electrical resistance and the governor, coil, &c., used in determining this unit. The room O Fig. 2 is called the "preparation-room;" it communicates through a hatch with the lecture-room P. It is intended that the preliminary arrangements

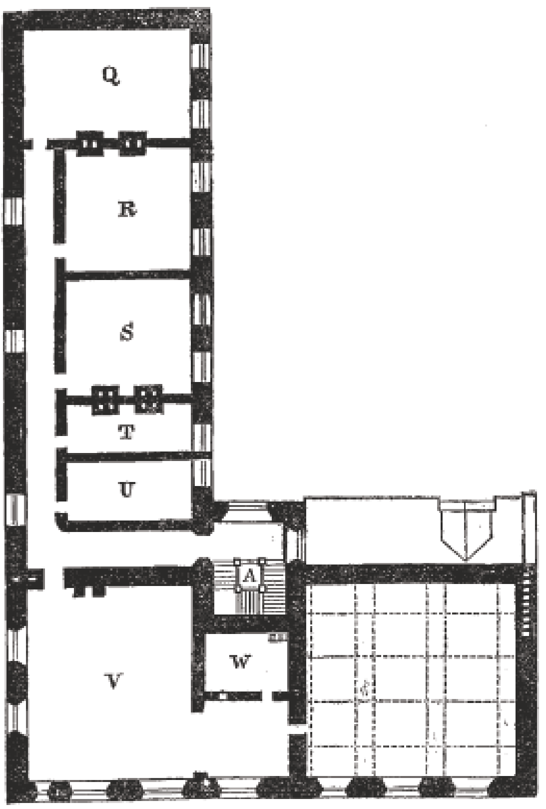

FIG. 3.—Third Floor.

necessary for making experiments during the lectures should be carried out in this room. The lecture-room P is about 38 ft. by 35 ft. and 28 ft. high, and will afford accommodation for about 180 students. The lecture table, which extends throughout the width of the room, is of oak, and is supported on the top of an 18-inch wall as previously described. The seats for the class rise at an angle of about 30°, and there are three doors to provide sufficient means of egress for the audience. The room is panelled to a height of about 9 ft., above which the walls are brick relieved by handsome pillars, which spring from triple conical brackets, and support the ceiling. The room is lighted by three windows at a height of about 17 ft. from the floor, and one window below. Each window is furnished with wooden shutters, which fold together, thus completely darkening the room. The shutters of the three upper windows are opened and closed together by means of endless screws attached to a horizontal shaft which runs under each. The ceiling of the room consists of wooden panels, those near the walls being perforated and forming the bottoms of two horizontal shafts, which lead into a chimney, thus providing an efficient means of ventilation. Three of the panels over the lecture table, as well as the styles between them, can be removed. Above these are two strong tie-beams of the roof, from which Foucault's pendulum or other heavy bodies may be suspended over the lecture table. The panels and styles adjoining the north wall of the lecture-room can also be removed to allow of diagrams being suspended against the wall. On the other three sides of the room the ceiling does not abut directly upon the wall but is coved in the form of a quadrant of a circle, giving the room a very beautiful appearance. This lecture-room is in every respect a model room of its kind. All the rooms on the ground-floor and first floor, with the exception of the lecture-room, are about 15 ft. in height.

On the third floor the room Q Fig. 3 is intended for experiments on acoustics. The room R will be employed for making drawings and calculations; S will be devoted to researches on radiant heat; and T and U are for optical experiments. V is the electrical room. The air in this room will be kept dry by Mr. Latimer Clark's contrivance, which consists of a heated copper roller over which an endless band of flannel passes. The roller is heated by gas-lights within it, and, being kept in constant rotation, every part of the flannel becomes heated in turn by passing over it. The vapour which rises from the heated flannel is carried off by the current of air which supplies the burners inside the roller, and escapes by the flue. The flannel when thus dried and cooled passes into the open air of the room, where it again absorbs moisture from the air, which thus becomes dried, so that the electrical instruments in the room are preserved in a highly insulating condition. From this room a small doorway enters the lecture-room at a height of about 17 ft. from the floor of the latter. An insulated wire connected with the prime conductor of the electric machine will pass through this doorway and thus supply electricity on the lecture table when the air in the lecture-room is too damp to allow of the satisfactory working of the machine. W is a small dark room for photographic and other similar purposes. A small window for a heliostat is placed in the west wall of the electrical room, opposite the door, from which a beam of light may be sent along the whole length of the building so as to allow of diffraction and other experiments, with rays of light 120 ft. in length. All the rooms are heated by hot-water pipes connected with a boiler in the basement. Near the east end of the building copper pipes are employed on each floor for the sake of the magnets in room B.

A lofty flight of steps in the tower leads from the second floor into the roof above the lecture-room, and a few more steps lead into the highest room in the building, which occupies the upper portion of the tower, its floor being more than 50 ft. above the ground. In this room will be placed a Bunsen's water pump, the water from which will thus have a vertical fall of considerably more than 50 ft. This pump will be used to exhaust a large receiver, from which pipes will communicate with the different rooms, so that if it be desired to exhaust the air from any vessel it will only be necessary to connect it with one of these pipes and *turn on a vacuum*. If a more perfect vacuum be desired than can be obtained by this means, the vessel may be subsequently exhausted by the Sprengel or other air-pump. A metal tube filled with mercury, with glass gauges on every floor for observing the height of the mercury within, will extend throughout the whole height of the tower and will serve as a manometer. The lower end of the tube will pass through the wall and terminate in F Fig. 1. On the top of the tower will be fixed a wooden mast carrying a pointed metal rod, for the purpose of collecting atmospheric electricity. The rod will communicate with the interior of the laboratory by an insulated wire.

The floors of the building are liberally supplied with hatches about 8 in. square, and in most cases those in the first floor are placed vertically under those in the second floor, so that wires may be suspended through the whole height of the building.

The laboratory was designed by Mr. W. M. Fawcett, M.A., of Jesus College, and the way in which he has turned to account the space available for his purpose, as well as the simple beauty of his designs have been the subjects of great admiration. Loveday of Kibworth was the contractor.

After the congregation on the 16th the Duke of Devonshire, Sir Bartle Frere, Sir Garnet Wolseley, Prof. Stoletow of Moscow, Prof. Balfour Stewart, Prof. Roscoe, and other distinguished visitors inspected the laboratory and expressed great satisfaction with the building and the arrangements.

Amongst the apparatus at present in the laboratory besides the electro-dynamometer of the British Association, may be mentioned the original B.A. units of resistance, together with the rotatory coil, speed governor, and bridge used in their construction; Sir William Thomson's quadrant electrometer, resistance coils up to 100,000 ohms (a megohm as well as some coils of very small resistance are expected shortly), three mirror galvanometers of different constructions, a 3 ft. 6 in. glass plate electric machine, and a 30 in. ebonite electric machine, Holtz's electric machine, and a hydraulic press, of a peculiar construction, made by Ladd and Co.

THE "CHALLENGER" IN THE SOUTH ATLANTIC

At the last meeting of the Royal Society a letter from Prof. Wyville Thomson on board H.M.S. *Challenger*, to Admiral Richards, was read, which contained results of such high importance to biological science that were it the only result of the expedition England might have been proud to have had a hand in it. It is most interesting too as carrying on the story of the daily life on board ship which has been touched upon by Prof. W. Thomson in former communications to NATURE. The letter, which is dated Melbourne, March 17, starts by telling us that south of the line observations in matters bearing upon Prof. Thomson's department were made most successfully at nineteen principal stations, suitably distributed over the track, and including Marion Island, the neighbourhood of the Crozets, Kerguelen Island, and the Heard group.

After leaving the Cape, several dredgings were taken a little to the southward, at depths from 100 to 150 fathoms. Animal life was very abundant; and the result was remarkable in this respect, that the general character of the fauna was very similar to that of the North Atlantic, many of the species even being identical with those on the coasts of Great Britain and Norway.

Marion Island was visited for a few hours, and a considerable collection of plants, including nine flowering species, was made by Mr. Moseley. A shallow-water dredging near Marion Island gave a large number of species, again representing many of the northern types, but with a mixture of southern forms, such as many of the characteristic southern Bryozoa and the curious genus *Serolis* among Crustaceans. Off Prince Edward's Island the dredge brought up many large and striking specimens of one or two species of Alcyonarian zoophytes, allied to *Mopsea* and *Isis*.

The trawl was put down in 1,375 fathoms on Dec. 29, and in 1,600 fathoms on the 30th, between Prince Edward's Island and the Crozets. The number of species taken in these two hauls was very large, and many of them belonged to especially interesting genera, while many were new to science. There occurred, with others, the well-known genera *Euplectella*, *Hyalonema*, *Umbellularia*, *Flabellum*, two entirely new genera of stalked Crinoids belonging to the Apiocrinidæ, *Pourtalesia*, several Spatangoids new to science, allied to the extinct genus *Ananchytes*, *Salenia*, several remarkable Crustaceans, and a few fish.

The *Challenger* reached Kerguelen Island on Jan. 7, and remained there until Feb. 1. During that time Dr. von Willemoes-Sühm was chiefly occupied in working out the land-fauna, Mr. Moseley collected the plants, Mr. Buchanan made observations on the geology of those parts of the island which were visited, and Mr. Murray and Prof. Thomson carried on the shallow-water dredging in the steam-pinnace. Many observations were made, and large collections were stored.

Two days before the expedition left Kerguelen Island they trawled off the entrance of Christmas harbour, and the trawl-net came up on one occasion nearly filled with large cup-sponges belonging to the genus *Rossella* of Carter, and probably the species dredged by Sir James Clark Ross near the ice-barrier, *Rossella antarctica*.

The *Challenger* reached Corinthian Bay in Yong Island on the evening of the 6th, and all arrangements had been made for examining it, as far as possible, on the following day; but a sudden change of weather obliged Capt. Nares to put to sea. Fortunately Mr. Moseley and Mr. Buchanan accompanied Capt. Nares on shore for an hour or two on the evening of their arrival, and took the opportunity of collecting the plants and minerals within their reach.

The most southerly station was made on Feb. 14, lat. 65° 42′ S., long. 79° 49′ E. The trawl brought up, from a depth of 1,675 fathoms, a considerable number of animals, including Sponges, Alcyonarians, Echinids, Bryozoa, and Crustacea, all much of the usual deep-sea character, although some of the species had not been previously observed.

Prof. Thomson gives a list of the various classes of