THE HARVARD PHYSIOLOGICAL LABORATORY.

THE physiological laboratory of the medical school of Harvard university presents some peculiarities of arrangement and appointments which seem worthy of a brief description. The rooms occupied for this purpose include about one-fourth of the available space of the second floor in the new building of the school at the corner of Boylston and Exeter Streets in Boston. The disposition of these rooms is shown in the accompanying plans (figs. 1 and 2). The large lecture-room, it will be seen, has also an ante-room leading to the chemical laboratories, which occupy the remainder of the floor, the lectures of both departments being given in this room. It may be mentioned here that the stories of the building are in general quite high, permitting the frequent use of mezzanines with great economy of space.

In the lecture-room itself the table is the most interesting feature. When ready for use, it is merely a plain black walnut table, with a thick top about 5 metres long, 90 centimetres wide, and 86 centimetres above the floor. On this are water and gas cocks (*W*, *G*), and a waste-pipe (*WP*), to which the overflow from any apparatus may be conducted. This pipe runs into a small open sink lying below that portion of the table, and having also its own water-supply. Near the middle of the table are the binding-posts of a pair of electric wires (*E*) coming from the general laboratory, and close to these is the air-pipe (*A*) from the respiration apparatus, to be presently described. The course of the wires and pipe beneath the floor is shown by a dotted line in the plan. At the same end of the table is a movable cover over a large pneumatic trough. Here, as elsewhere on the table, the water-supply is from a tank at the top of the building, so that the pressure is constant. As the pipes are independent, the necessary conditions of the water-supply for hydraulic experiments are satisfied. The middle half of the table presents more novel features. It is movable, running on wheels, and exists in duplicate, each of the two departments using the lecture-room being thus provided for. This section can be run off into the laboratory, and there loaded with any apparatus or material required for the lecture. It is thus possible to

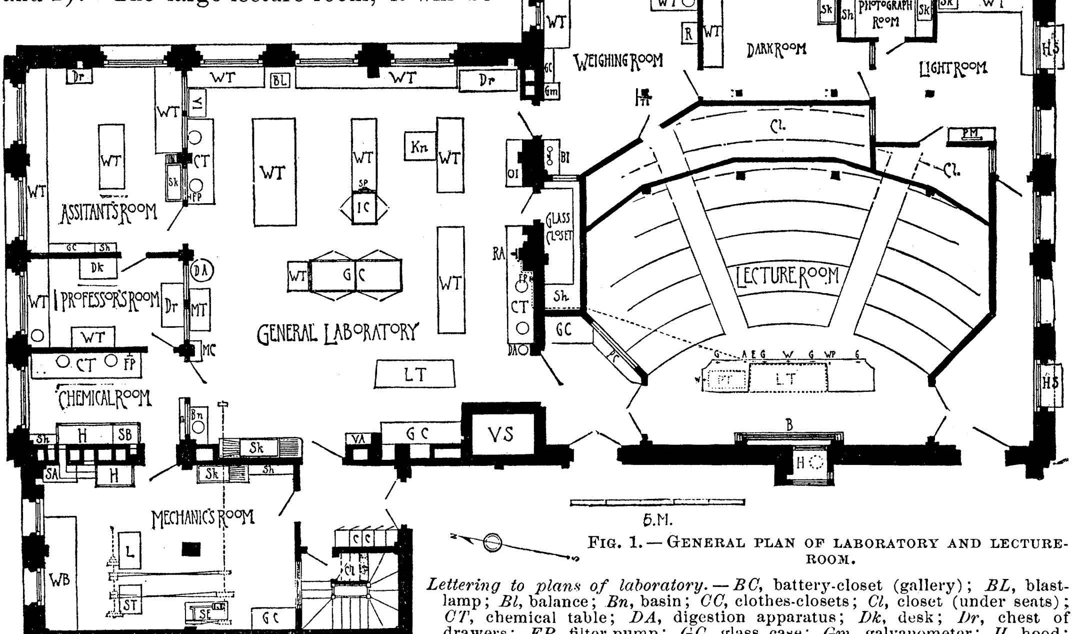

FIG. 1.— GENERAL PLAN OF LABORATORY AND LECTURE-ROOM.

Lettering to plans of laboratory.— *BC*, battery-closet (gallery); *BL*, blast-lamp; *Bl*, balance; *Bn*, basin; *CC*, clothes-closets; *Cl*, closet (under seats); *CT*, chemical table; *DA*, digestion apparatus; *Dk*, desk; *Dr*, chest of drawers; *FP*, filter-pump; *GC*, glass case; *Gm*, galvanometer; *H*, hood; *HS*, heliostat shelf; *IA*, injection apparatus; *IC*, interrupter case; *Kn*, kymographion; *L*, lathe; *LT*, lecture-table; *MC*, meat-cutter; *MT*, mercury-table; *OI*, operating instruments; *PC*, portfolio-case; *PM*, pendulum myograph; *R*, refrigerator; *RA*, respiration apparatus; *SA*, soldering apparatus; *SB*, steam-bath; *SE*, steam-engine; *Sh*, shelves; *Sk*, sink; *SP*, seconds pendulum; *ST*, saw-table; *Tl*, telescope; *VA*, varnishing apparatus; *VS*, ventilating shaft; *WB*, work-bench; *WT*, working-table. *Lecture-room.*— *A*, air-blast; *B*, blackboards; *E*, electricity; *G*, gas; *PT*, pneumatic trough; *W*, water; *WP*, waste-pipe.

prepare a difficult experiment much more readily and completely, or to leave complicated apparatus set up for some length of time. The section has also a set of drawers containing such operating instruments, glassware, towels, etc., as are constantly required in the demonstrations, a shelf below carrying sand-baths, lamps, and the like. In the plan the movable table (*LT*) stands in the laboratory, as when waiting for its lecture-load. Behind the table in the lecture-room are three sliding blackboards (*B*), 280 centimetres long and 120 centimetres wide, which run up and down in front of a small hood (*H*), communicating also with the adjoining chemical laboratory. In this way unpleasant smells or noxious gases are easily avoided; and apparatus may be set up while the lecture is going on. Along the upper edge of each blackboard is a small brass rod, which has been found convenient for suspending diagrams and tables. Below are cupboards for further lecture-supplies, four electric bells being placed at the side to summon various persons whose help may be required during the lecture. The seats slope upward with a gradually increasing pitch (in accordance with the rule of construction given by Lachez), so that each person in the audience has an equally good opportunity of seeing over the heads of those in front of him.[1] Above the seats is a broad platform or gallery leading to the entrances for students, and corresponding to the mezzanine of the floor. At the back of this gallery the windows are provided with shelves for such microscopical demonstrations as the lectures require. The room is lighted almost entirely from windows in the eastern and southern gallery; but, as the lectures for which the room was planned are usually delivered in the morning, no difficulty has arisen. A large chandelier has been found sufficient for the later hours of the winter afternoons and in the evening. A beam of light may be brought into the lecture-room by placing a heliostat on the shelf (*HS*) of the proper window in the southern wall of the building, and this ray can also be carried into the laboratory. At present no arrangements have been made to darken the lecture-room for lantern demonstrations; but this can be easily done, should it become desirable.

A small ante-room at the side opens both into the main hall and the general laboratory. The latter is a large room (10.8 by 9.6 metres) and of the full height (6.25 metres) of the story. Light is furnished by three large windows in the eastern wall, and by the five windows of the gallery at the northern end (see fig. 2). As the partition-wall which shuts off the small rooms is partly of glass, the light-supply is ample. A general view of this room and of the gallery, taken from a point near the door of the weighing-room, is given in fig. 3. The arrangement of the working-tables (*WT*) is evident from the plan. Those along the walls are firmly fixed in position, as is also the middle table adjoining the interrupter-case (*IC*): the other working-tables can be moved as required. Two chemical tables (*CT*), with the

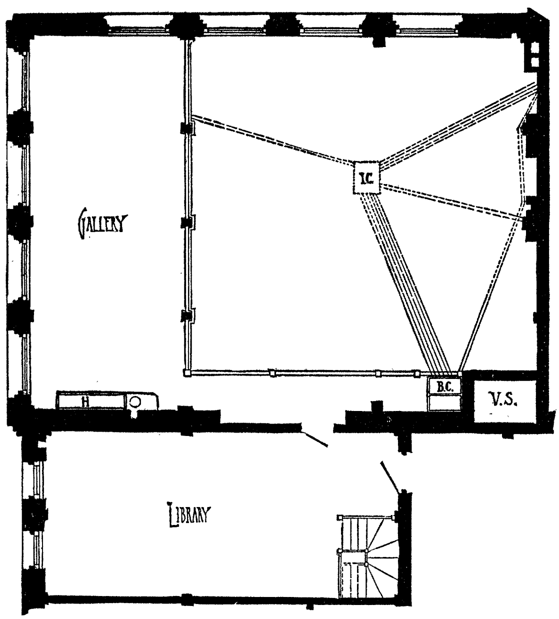

FIG. 2. — HALF STORY.

necessary shelves and chemicals, bowls, and filter-pumps, furnish places for from six to eight students in the practical courses or for special work. The working-tables adjoining the kymographion (*Kn*) and interrupter-case (*IC*) can be extended to the long table below the windows by a board, which is hooked into position as needed. In this way it is possible for two persons to operate in the most favorable light and position. The cases holding the operating instruments (*OI*) will be seen to be very conveniently placed against the wall near the operating-table: at the side are shelves containing the ether, morphia, curare, etc., likely to be required.

The ventilation of this room, like that of the

[1] See Czermak: Ueber das physiologische privat-laboratorium an der Universität Leipzig. 1873.

building in general, is provided for by large shafts in the wall, which, however, for the sake of simplicity, are not fully indicated in the plan. There are similar shafts for warming the rooms with heated air. There are also numerous steam-radiators for the coldest weather. Besides the waste-pipes belonging to the sinks and bowls, shown in the plan, there are many extra waste-pipes with stop-cocks, to which, by means of hose, water may be carried off from any apparatus which can possibly be set up in any of the rooms. The sink in the north-western corner of the laboratory and the adjacent basin (*Bn*) have both hot and cold water. With one exception, the water-supply comes directly from the ordinary city pipes. The exception is the chemical table against the southern wall, which has an independent supply from the tank already mentioned, and therefore useful for hydraulic experiments.

To avoid any misapprehension, a word as to the purpose of this laboratory may not be out of place here. It is intended to serve primarily as a laboratory of research, and secondarily as an adjunct to the lectures on physiology in the preparation of suitable apparatus and experiments. Courses in 'practical physiology' are also given in the laboratory to the class in sections of a convenient size, but no instruction in 'biology' is contemplated. All histological work proper is carried on in a special department in another part of the building. It seems desirable to mention these things more particularly, lest any one should miss those features which are prominent in some American laboratories of recent date.

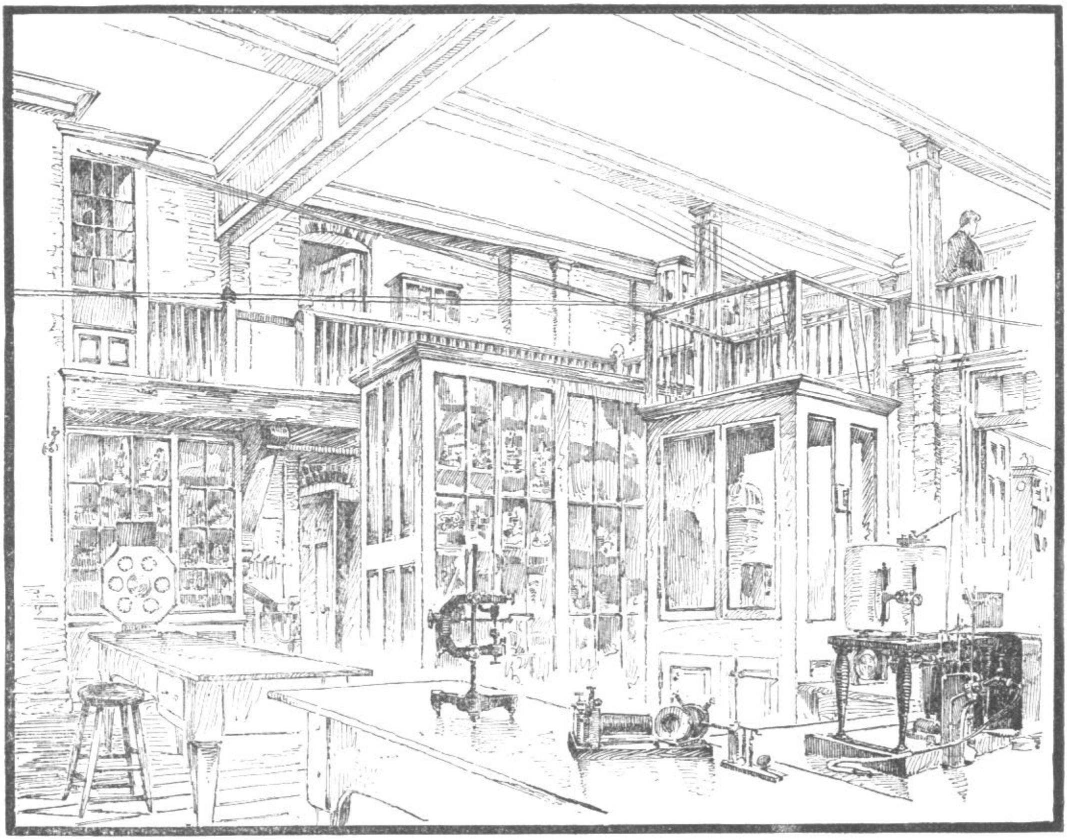

FIG. 3.—INTERIOR OF GENERAL LABORATORY.

The centre of the room is occupied by a large double case (*GC*), with glass doors on both sides, intended to hold such pieces of apparatus as are used in laboratory-work. Another glass case at the side of the room to the west serves the same purpose, while that in the little ante-room contains such special apparatus and preparations as are used regularly in the lectures. Alongside the latter is a portfolio case (*PC*) for the diagrams and drawings required in the same courses. Near the large case in the laboratory is the structure familiarly known as the 'tower,' but called the interrupter-case (*IC*) in the plan, which has been found to be a great convenience. A view of the upper portion of the tower is given in fig. 4, the lower part being merely a large closet for wire and other supplies. Its purpose is to hold various pieces of apparatus for interrupting or regulating the galvanic current. As a rule, all the batteries made use of in the laboratory are set up as required in the battery-closet in the gallery, and connected with wires running to the tower, whence the current is conducted to the apparatus, or to wires running into the rooms where electricity may be needed, as well as to the lecture-table. The general relation of the wires to the battery-room and the tower is shown in the plan of the gallery (fig. 2). A special line of very large copper wires is also shown, which goes directly, without a break, to the remoter work-rooms. This line has been found necessary for the battery required to work a large Ruhmkorff coil at that distance. The present system of wires has been planned chiefly to meet the demands of ordinary work, but is capable of such extension as may be required. Outside the tower hangs the seconds pendulum (*SP*), which is heavy enough to swing for about half an hour. It can be put in any circuit, and thus give very exact time or regular interruption in any room of the department. In the tower itself the only pieces of apparatus considered permanencies are those seen in fig. 4, — a clock and a new interrupter, recently imported from Leipzig. The latter rather complicated instrument seen on the left of the figure has valuable features; the platinum contacts being under alcohol or petroleum, and so arranged that either the closing or opening induced current may be short-circuited. The rapidity of the shocks can be considerably varied within the limits of thirty in one second, and one in thirty seconds. This apparatus was constructed by Baltzar. In principle it is the same as that described by Bohr, in his article, "Ueber den einfluss der tetanisirenden irritamente auf form und grösse der tetanus curve" (*Arch. anat. u. physiol., physiol. abth.*, 1882, p. 233). Many changes have, however, been made in the details before the present form was arrived at. In this a metallic cylinder turned by clock-work carries two sets of pegs (like the pins in a musical box), which strike against levers, and thus break contacts in the trough below. The pins of each series are so set that the contact is broken in one lever a little sooner than in the other, and consequently is still broken in the latter when the former closes. In this way a simple change of the wires from the induction apparatus permits the short-circuiting of the opening or the closing induction shock at pleasure. By an ingenious arrangement a cog-wheel can be shifted so as to give the cylinder a very slow or a rapid motion, as desired: the series of pegs thus do double work, and permit the great range of interruptions already mentioned.

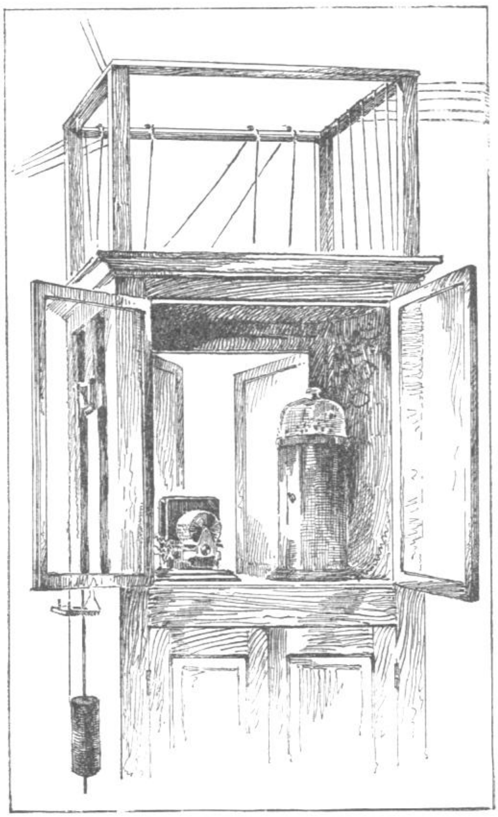

FIG. 4.—INTERRUPTER-CASE.

The clock, seen on the right of the figure, has a revolving pendulum, and a set of toothed wheels, which interrupt the electric current at intervals of one, two, three, four, five, ten, fifteen, twenty, thirty, or sixty seconds. The duration of the interruptions may be any thing less than four seconds. By using a relay these may be changed into closures of corresponding length and interval. This clock was constructed by Zachariae of Leipzig, and has been described by Dr. Bowditch in his communication, "Ueber die eigenthümlichkeiten der reizbarkeit, welche die muskelfasern des herzens zeigen" (*Ber. sächs. gesellsch. wiss. Leipzig*, xxiii. 1871, 658).

Besides the more ordinary forms of interrupter in common use, the laboratory possesses several home-made ones, which have proved useful, and are set up in the interrupter-case as required. One is merely a simplified Bernstein's acoustic interrupter, in which a steel bar of variable length (determined by a sliding clamp) is kept swinging by a temporary magnet above, while a platinum point makes and breaks in a cup of mercury below. Another very simple and inexpensive form, which is easily made, and probably admits of more general application, consists of a steel rod swinging on a knife-edge at one end, while the other is attached to a long spiral spring fixed above. The swing is determined by the tension of the spring, and the position of variable weights on the bar. This arrangement has proved useful for slow interruptions, one to three in a second, the apparatus before mentioned permitting four to ninety in the second.

Against the wall, above the end of the chemical table on the southern side of the room, is the respiration apparatus (*RA*), whose construction is made clearer by the adjoining sketch (fig. 5). It is merely a water-bellows of the ordinary form, receiving its water-supply by the upper pipe at the right, from the constant-pressure tank at the top of the building.

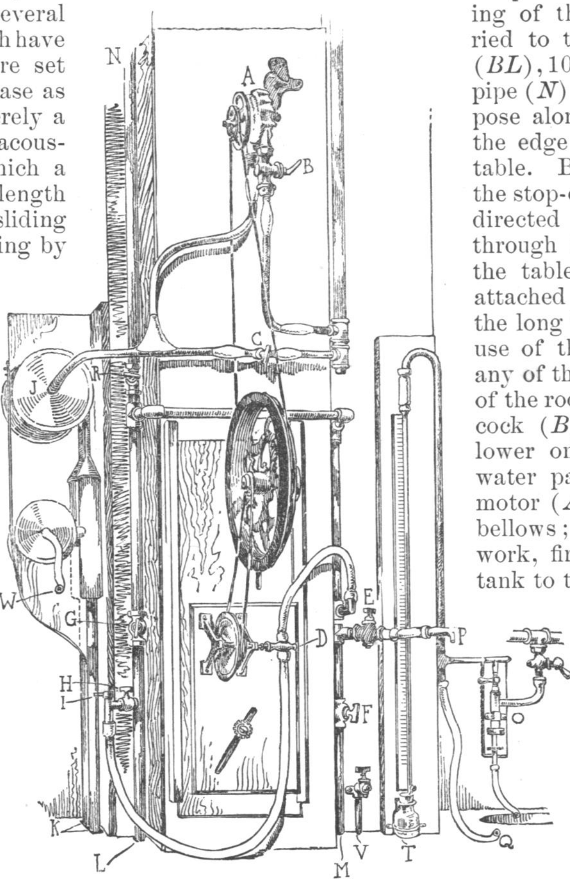

FIG. 5.—RESPIRATION APPARATUS.

Lettering to respiration apparatus.—*A*, water-motor; *BC*, stop-cocks for water-supply; *D*, revolving stop-cock; *EFGHR*, stop-cocks directing stream of a r; *I*, regulating-cap; *JKW*, water-bellows; *L*, air-supply from bellows; *M*, pipe to lecture-room; *N*, pipe to working-tables; *O*, filter-pump; *P*, air-pipe for blast-lamp; *Q*, rubber pipe of filter-pump; *T*, mercury-gauge; *V*, gas for blast-lamp; *W*, air-inlet to bellows.

The water enters the upper cylinder (*J*), and passes down through the pipes marked *K*, into the air-chamber in the basement two stories below, the compressed air coming up to the laboratory by the pipe *L*. If the water enter the bellows by the lower stop-cock (*C*), a steady blast of air is obtained, which may work a blast-lamp at *P*, or, by a proper closing of the stop-cocks, be carried to the glass-blowing table (*BL*), 10.5 metres away; a gas-pipe (*N*) being laid for this purpose along the wall, and under the edge of the long working-table. By a different closure of the stop-cocks, the air-stream is directed to the lecture-room through the pipe *M*, reaching the table at *A*. Rubber hose attached to a stop-cock below the long wall-table permits the use of the same blast of air on any of the other working-tables of the room. If the upper stop-cock (*B*) be opened, and the lower one (*C*) be closed, the water passes through a small motor (*A*) before entering the bellows; thus doing double work, first in falling from the tank to the motor, and then in falling further to the basement. The motor gives motion to the cone below, and a small stop-cock in the axis at *D* regularly breaks the otherwise constant stream of air, which, opening the stop-cock *H*, and closing that at *G*, permits free passage to this portion of the apparatus. A slotted cap (*I*) regulates the amount of air delivered, while the rapidity of the interruptions can be nicely adjusted by the amount of water flowing through the motor, and by the size of the wheel used on the cone. Another combination of high pressure and slow movement can be obtained by so adjusting the stop-cocks *B* and *C* that more or less water enters the bellows without passing through the motor. The large wheel and the cone are on sliding boards, so that the tension of the belts may be readily regulated. This form of stop-cock was arranged some years ago by Dr. Bowditch, to be run by the clock-work of the kymographion, and has been described by him in the *Journal of physiology* (ii. 3, p. 202). This interrupted blast of air is carried by the pipes already mentioned to any table where it is required. The system was planned for the present needs of laboratory-work, but could be readily extended even to other work-rooms. It has thus far proved quite satisfactory, and readily adaptable to the artificial respiration of dogs, cats, or rabbits.

Adjoining the respiration apparatus, the sketch shows a filter-pump (*O*) and its simple mercury-gauge (*T*), which can be attached to the same system of piping, and used at a distance. This is done by connecting the rubber tube *Q* with the pipe *P*. Although the system was not originally planned for use with negative air-pressures (the revolving stop-cock not being quite tight enough for such a purpose), it is very easy to produce a negative pressure of two hundred and forty millimetres (mercury) on the table in the lecture-room, or on the more remote working-tables of the general laboratory.

At the other end of the room is a small mercury-table (*MT*). This is merely an ordinary table, with a raised edge, made tight and thoroughly varnished. A little shelf at one corner holds a bottle to catch the refuse mercury directed to a hole in this corner by a suitable shortening of the legs. A firm shelf on the pilaster near by holds a small meat-cutter (*MC*), and a press for extracting meat-juice and the like. At the other side of the mercury-table stands the large digestion apparatus (*DA*), or constant temperature box. This consists of two cylindrical boxes of sheet-copper of different sizes, joined by a rim at the top, and resting on legs made of iron rods. The inner box has a diameter of forty centimetres and a depth of twenty-nine centimetres, the corresponding dimensions of the outer casing being fifty-eight and thirty-eight centimetres respectively. The rim has two holes for corks carrying a thermometer and a glass tube of the regulator. At the side is a stop-cock for removing the water which fills the space between the two shells. The inner box is the air-chamber, and has a double-walled cover packed with charcoal. An extra cover has also been made, a thick wooden rim carrying two plates of glass, with an air-space between, so that any changes going on in the chamber kept at a constant temperature may be followed without removing the cover. The apparatus stands thirty centimetres above the floor, and, being covered with a layer of asbestos packing two centimetres thick, it parts with its heat so slowly that a single Bunsen burner suffices to keep it at a temperature of 60° C. The size of flame is determined by a glycerine regulator. A large glass tube suspended in the water contains the glycerine, which also fills a rubber tube communicating on a shelf above with the regulator, and ending in a small funnel. The glycerine, as the water warms, expands, and rises into the funnel, until, at the desired temperature, a stop-cock is closed. After this any further expansion forces a rubber membrane against the end of the gas-pipe above, and shuts off the main gas-supply to the flame, leaving only a small amount regulated by another stop-cock, the 'pin-hole' of the ordinary mercury regulators. The contraction of the glycerine, on cooling, draws the membrane down again, and thus increases the gas-supply. This regulator has been found very trustworthy; and the temperature of the air-chamber has remained quite constant for weeks at a time, with only a very small flame. Only temperatures from 38° to 60° C. have been tested, but for these the variation has not exceeded half a degree C. As the volume of water to be heated is large, about sixty-four litres, considerable time is required to raise the temperature sufficiently; and this is the only practical objection to the apparatus. This is, of course, compensated for by the size of the air-chamber, rather over thirty-six litres. For experiments calling for speed, there is a small digestion apparatus at the table near the lecture-room. This is merely a water-bath, with an ordinary mercury regulator, and a water-supply from a Mariotte's flask on the shelf at the back. For lecture demonstrations of artificial digestion, the laboratory has another piece of movable apparatus of convenient size and some elegance.

Adjoining the glass case on the western wall is the varnishing apparatus (*VA*). This is a simple tin trough, slightly tipped at one end, where a rubber pipe runs to a supply-bottle, whose position on the shelves at the side determines the filling or emptying of the trough. The smoked papers are run through the varnish, and then suspended from rods, to drip into the trough, and thus into the bottle. This form of apparatus was originally devised by Professor Kronecker of Berlin.

In the north-eastern corner of the laboratory, adjoining the chemical table, stands a large and convenient injection apparatus (*IA*) for the preparation of animals or organs for microscopic work. It is merely a copper box, used as a water-bath, big enough to hold a large cat and several bottles of injection-material. Pressure is obtained by letting water from the tap run into a large bottle below the table. The compressed air then forces the injection-mass into the body, every thing being kept at a suitable temperature by a lamp below. By using T-tubes several vessels may be injected with different substances at the same time. On a small table by itself, but at the side of one of the working-tables, is the kymographion (*Kn*). This is of the Ludwig pattern, with a long roll of paper. It has special wires from the tower and from the pendulum. Over the kymographion is a large cover of painted cloth, stretched on a light wooden frame. By aid of a pulley in the ceiling, this cover is raised or lowered as required. A similar cover hangs above the table adjoining the pendulum, and an extra one is on hand to be placed where needed. The use of these dust-proof protectors makes it possible to keep complicated or delicate apparatus together for an experiment of indefinite duration, and safe from all ordinary disturbance when work is not going on.

To the north the main laboratory opens directly into two small rooms of less height, half-stories in fact, — the chemical room and that of the assistant. Between the two is the small private room of the professor. This contains working-tables, with water and gas, and can be conveniently used for private work. The assistant's room has also a long work-table especially arranged, as regards light and height, for microscopical work; and the room is, in fact, partly occupied at present for the preparation of material for histological demonstrations. This arrangement was made for the economical use of the animal supplies of the department. Another large table is intended for the examination of curves and records. There are also all the conveniences in the way of gas, water, waste-pipes, and electrical wires, needed to make the room convenient for private work. The chemical room has a large work-table, with numerous drawers to hold the more delicate glass apparatus. There are also the necessary shelves for chemicals and reagents. At the side of the commodious hood is a steam-bath, which has proved a great convenience. The fittings of the room, and the apparatus, are merely such as are required for ordinary physiological work, the nearness of the chemical laboratory on the same floor making a larger room for this purpose unnecessary.

The chemical room opens directly into the workshop of the laboratory, where the instruments are cared for and repaired, and where not a little even of the more delicate apparatus can be made. This room has its own sink and hood for such work as may be unpleasant to the nose, or otherwise irritating. A large and convenient work-bench occupies nearly all the northern end of the room. More in the centre of the room are the lathe (*L*) and saw-table (*ST*), each capable of receiving motion from the little steam-engine (*SE*), of about two and a half horse-power. This receives steam from the same pipes which come to the steam-bath already mentioned. The shafting at present runs only a few feet into the main laboratory, but can be readily extended as occasion shall require.

At the chief entrance of the main laboratory and the mechanic's room is a small ante-room with clothes-closets (*CC*) for those regularly working in the department. This room also opens upon the staircase leading to the room above, and to the 'gallery' of the general laboratory, these forming the mezzanine of this portion of the floor. Their arrangement is seen in the second plan (fig. 2). This space has been left more or less open with a view to its future adaptation to such needs as shall arise. A portion of that over the mechanic's room will probably soon be shut off by a glass partition, to make a quiet reading-room which will hold the working-library of the department. The larger space over the small rooms has its own hood and a water-supply, and is well provided with gas. During the past year, extended experiments in bacilliculture have been carried on here. A part is soon to be fitted up with large plain tables for the courses in practical physiology, which are given for the students of the first year in as large sections as can be conveniently managed. It would be easy at any time to make this space into several separate rooms, should they be required.

At the end of the gallery proper, along the wall to the west, is the battery-closet (*BC*). This opens into its own ventilating-shaft, and has two large soapstone sinks, in one of which the battery plates and cups are washed, the other serving to hold the porous cups kept constantly under water. On shelves at the side are large bottles with glass stop-cocks to hold the acids and other solutions. A glass case near by contains such battery-material as is not in frequent use, or fails to find room in the large storage-drawers below the closet. Should such a necessity arise, a broad gallery could also be built along the southern wall of the large room.

The door in the middle of this southern wall on the main floor opens into a large closet, a store-room for glassware. The remaining door leads to a set of smaller rooms under the gallery of the lecture-room, intended for special work, and to be more fully fitted up at some future time, or as the needs of investigation shall make desirable.

Under the seats and openings into two of these small rooms are closets, dotted in the plan, which are convenient places for storage. The first of these rooms is known as the 'weighing-room.' It contains a delicate balance (*Bl*) on a firm shelf, and a Wiedemann's galvanometer (*Gm*) fixed on a pier near the door. The telescope (*Tl*) of the latter is attached to a column in the centre of the room. In the corner is a small refrigerator (*R*) with a waste-pipe. This room, as well as its neighbors, has water, gas, and wires from the tower. The next, or 'dark room,' has no windows, and is intended for optical experiments, or for any work requiring the exclusion or perfect control of daylight. A shutter near the door to the south permits any arrangement of diaphragms and lenses which can possibly be called for. At some future time a Thomson galvanometer will be set up in this room.

The corner room, known as the 'light-room,' has no special purpose, but is to be used for such work as may require a very good light and perfect quiet. The position of this room, in the corner of the building farthest removed from the streets, is very favorable for uninterrupted, quiet investigation. In one corner is the 'photograph-room' for the preparation and development of the plates. Against the wall, in the opposite corner, a pendulum myograph (*PM*) is fastened permanently in position, and covered by a dust-proof case. This is the instrument made by Dr. J. J. Putnam, and described by him in the *Journal of physiology* (ii. p. 206). Wires run from this apparatus to the adjoining closet,—an arrangement that is found convenient for experiments with reaction time. One of the southern windows of the light-room has also a broad heliostat shelf (*HS*) outside, so that a beam of light may be sent even into the assistant's room, or, by a suitable disposition of mirrors, into any part of any other room. The remaining door of the light-room opens upon a passage-way which leads to the chemical laboratories, and makes the departments independent of the main hall or the lecture-room for communication.

KRAKATOA.

THE more the information accumulates with regard to the eruption of Krakatoa on Aug. 27, 1883, the more this phenomenon proves to have been remarkable and unique as a series of violent explosions.

From *Nature* of July 17 we learn, that, at the meeting of the Meteorological society of Mauritius on May 22, several interesting communications were made with regard to this eruption; among others, a letter from a M. Lecomte, dated at Diego Garcia (latitude 7° 20′ south, longitude 72° 35′ east of Greenwich) on April 24, describing how at breakfast, on the morning of Aug. 27, they had heard detonations, low but violent, and, attributing them to a vessel in distress, had run, and had sent men, to different points of the shore of the island, who were unable to see any thing to cause such sounds; also how the captain and mate of the Eva Joshua, just leaving Pointe de l'Est to anchor at Pointe Marianne (these places I cannot find, but suppose, from the account, that they are near Diego Garcia), had heard the same detonations, and sent men to the mastheads, without seeing any thing. These, with the previous reports from Rodriguez, showed that in three distinct cases the sounds of the Krakatoa explosions were plainly heard at distances of at least twenty-two hundred miles, and, in the case of Rodriguez, of nearly three thousand.

It will be remembered, that in *Nature*, May 1, it was stated by Herr R. D. M. Verbeek that these sounds were heard in Ceylon, Burmah, Manila, New Guinea, and at Perth on the west coast of Australia, and, in fact, at all places within a radius of about 30°, or two thousand miles. But these later reports from Rodriguez and Diego Garcia show, that across the waters of the Indian Ocean, with no land intervening, they were carried distinctly to much greater distances.

The still more remarkable atmospheric gravity-waves which travelled round and round the globe in all directions from the Straits of Sunda, and which were fortunately registered on the self-recording pressure-guage of the large gasometer at Batavia, close by Krakatoa, were also registered on the barograms at Mauritius; and here there were distinctly recorded four successive transits of the waves from east to west, and three from west to east, the same as shown by Gen. Strachey to have occurred at some of the European stations. But, what is still more remarkable, there is a faint trace of a *fifth* transit of the waves from east to west on the morning of Sept. 2; i.e., *more than six days after the explosions*, and when the waves had travelled *more than four times round the earth*, or about a hundred and two thousand miles. The most sensitive barograph at the signal-office in Washington also shows small waves, which are probably the record, also, of this fifth transit (and barely possibly of the succeeding *sixth* transit of the same): but the phenomena at Washington are complicated by the fact that it is within about 33° of the antipodes of Krakatoa, and that the waves have different velocities east and west,