

# INSTITUTE OF PHYSIOLOGY UNIVERSITY OF LOUVAIN

BY

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## PLAN OF BUILDING

In building the Institute of Physiology of the University of Louvain these principles were followed: first, to group in a single building the experimental branches of medical science that are more closely related to each other by the nature of teaching or by the nature of the research. Such a grouping was also

necessitated by the limited funds at our disposal. Under the same roof are now located accommodations for experimental physiology, physiological chemistry, and experimental pharmacology.

There is a disadvantage in such a system, for it prevents the free and natural development of the several branches; one branch will by its nature develop

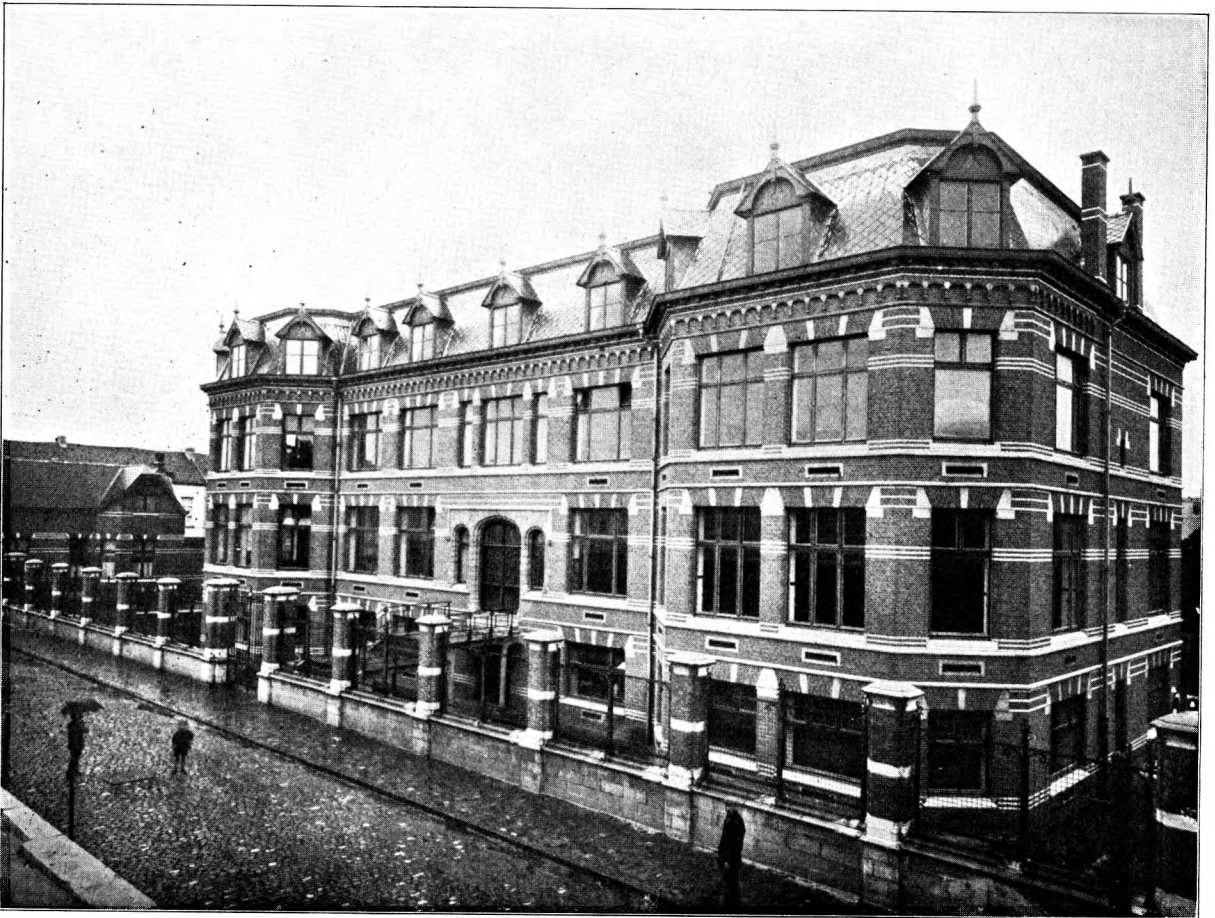
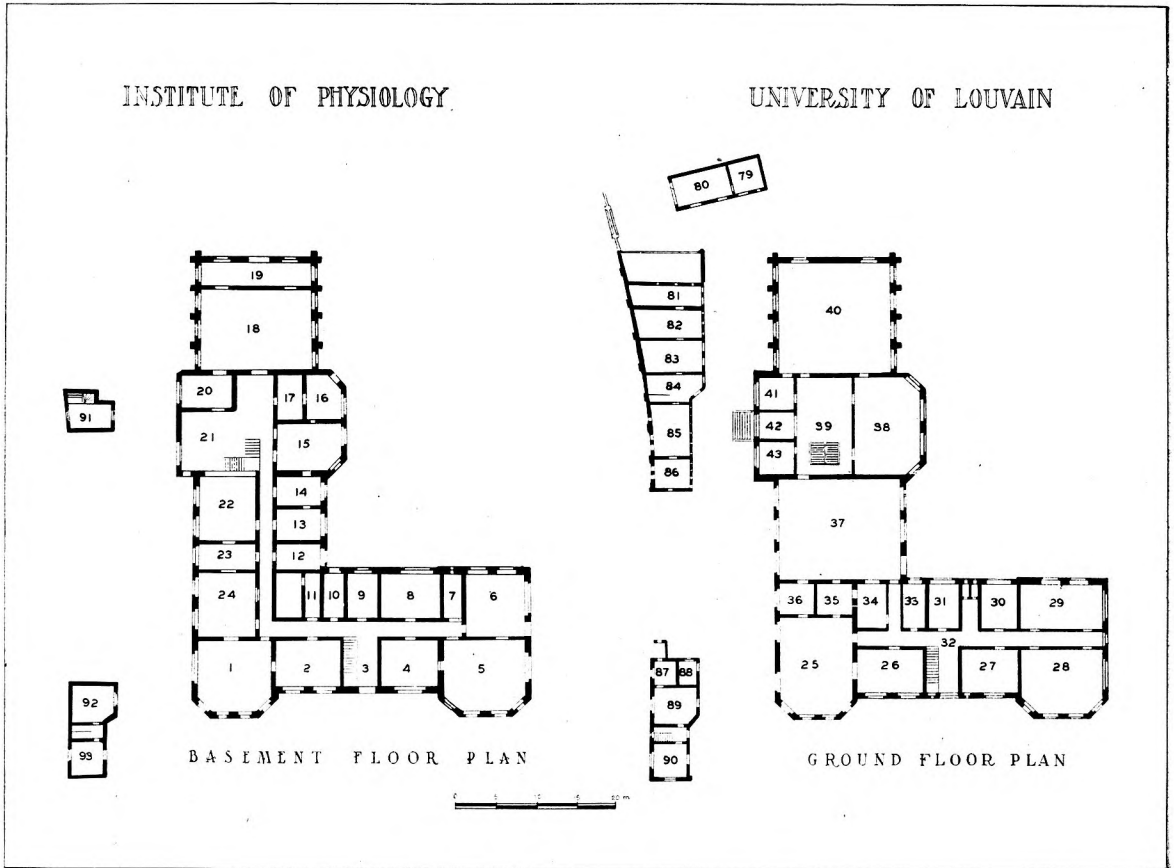


FIG. 1.—MAIN BUILDING. RESEARCH WING



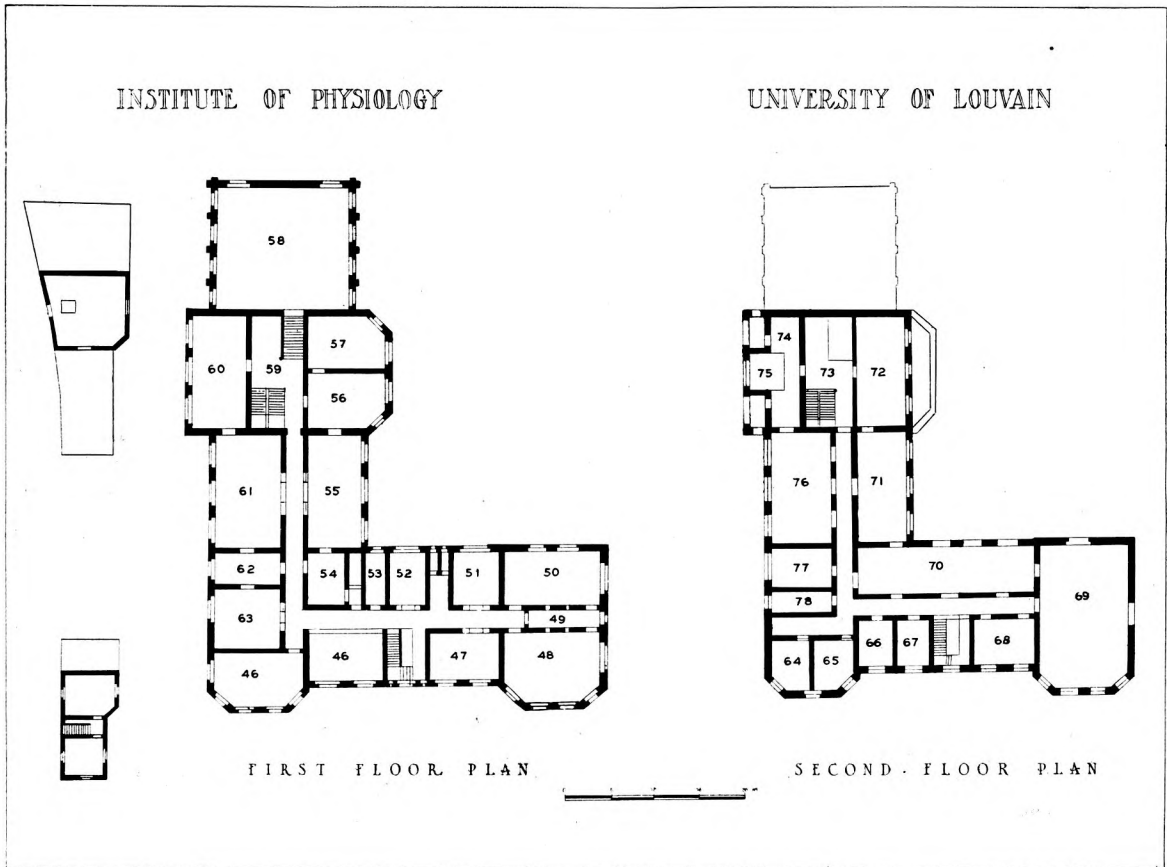
FIGS. 2, 3.

BASEMENT

- 1, 2. Animal research rooms
- 3. Hall
- 4. Spectrography room
- 5. Galvanometer room
- 6, 8. Electrophysiology rooms
- 7. Animal hospital
- 9,10. Storerooms
- 11. Refrigerating rooms
- 12. Battery room
- 13. Electrical equipment room
- 14. Testing room
- 15. Workshop
- 16. Glass-making workshop
- 17. Storeroom
- 18,19. Calorimetric research rooms
- 20. Heating and storeroom
- 21. Bicycle room
- 22,23. Chemistry rooms
- 24. Storerooms
- 91-93. Lodge of the attendant

GROUND FLOOR

- 25. General research department
- 26. Physicochemical room
- 27. Directors' department
- 28. Professor's private laboratory
- 29. Library and museum
- 30. Radiation room
- 31. Assistants' room
- 32. Hall
- 33. Histology room
- 35. Incubator room
- 36. Dark room
- 37. Students' laboratory
- 38. Spectatorium
- 39. Hall
- 40. Lecture-room
- 41-43. Waiting-rooms
- 79-80. Stable for large animals
- 81-86. Stable for small animals
  - 81. Dogs
  - 82, 83. Goats and cats
  - 84. Room for preparing animal food
  - 85. Rabbits
  - 86. Guinea-pigs, rats, and mice
- 87-90. Lodge of the attendant



Figs. 4, 5.

FIRST FLOOR

- 45,46. Metabolism rooms
- 47,48. Acoustics and phonetics room
- 49. Dark room
- 50,51. Optical research room
- 52,53. Special room for physiological chemistry
- 54. Dark room with incubator
- 55. Research laboratory for pharmacology
- 56. Private laboratory
- 57. Professor's office
- 58. Student's laboratory for physiological chemistry
- 59. Hall
- 60-62. Research laboratories for physiological chemistry
- 63. Special room for physiological chemistry

SECOND FLOOR

- 64-67. Sleeping rooms for assistants
- 68-70. Garrets
- 71. Laboratory for animal operations
- 72. Animal hospital
- 73. Hall
- 74. Sterilization and preparation rooms
- 75. Operating room
- 76. Exhibition room
- 77-78. Sitting rooms for assistants

more than another. In this case, where the number of branches is very limited, and where there is sufficient surrounding terrain at our disposal, the disadvantage is not great. The advantages of the plan are numerous but undoubtedly the greatest is the financial economy.

All professors teaching in our building employ the same lecture hall. The care of the animals is rendered more simple in that one stable is sufficient for the different branches. All expenses necessary for the installation of gas, electricity, vacuum pressure, and heating are

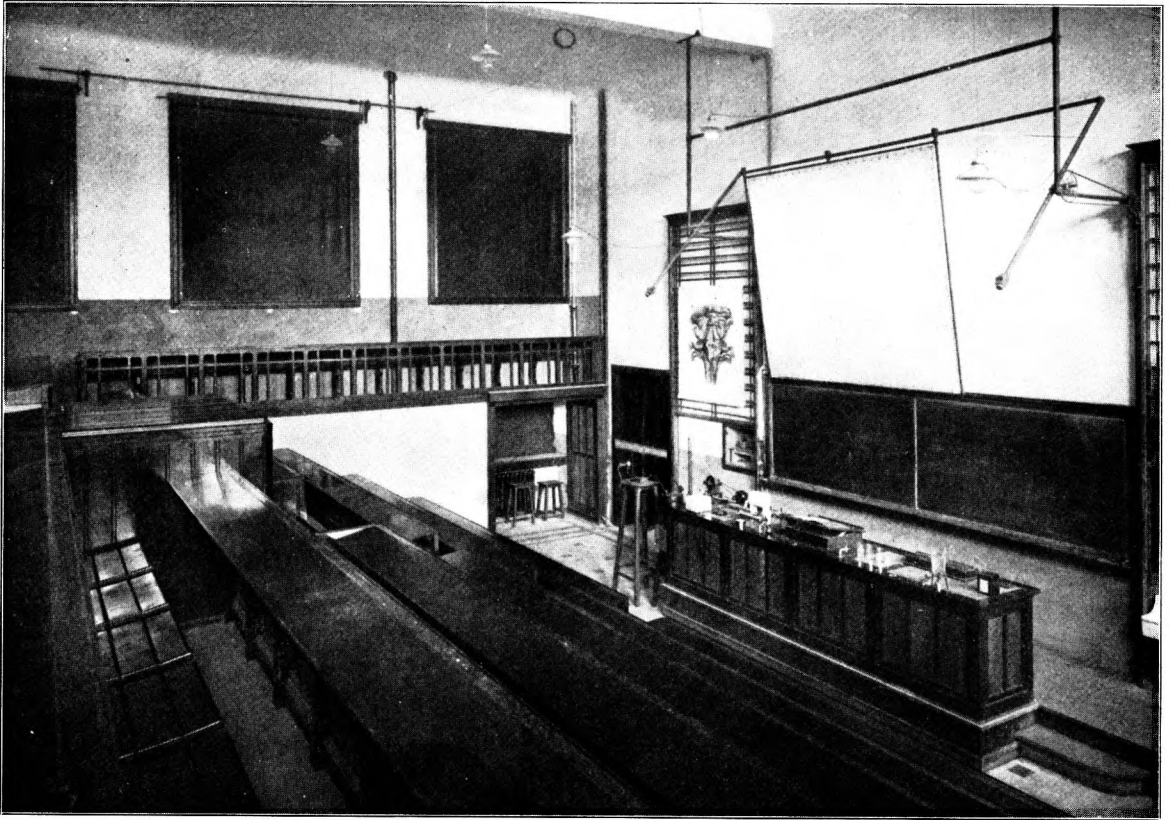


FIG. 6.—LECTURE-ROOM

considerably diminished. The buildings are so arranged that they can be extended in different directions at any future time.

The extent of the ground belonging to the Institute is 5,050 square meters of which 1,725 are actually occupied by the buildings of the Institute. The Institute is composed of the following special buildings: The Institute of teaching and research (No. 1-78),<sup>1</sup> the lodge of the attendant (No. 87-93), the stable for small animals (No. 81-86), the stable for big animals (No. 79-80), and the heating plant. The laboratory for experimental physiology occupies on account of the extent of its material a great portion of the buildings. This is required by the different methods that are peculiar to modern physiology.

The physiological laboratory has two purposes to fulfil: one, to furnish theoretical and practical teaching to students, the other to create the opportunity for scientific research. This double purpose required a special arrangement in the distribution of the rooms and in the interior planning of the building.

About 400 students follow the lessons that lead to a diploma of candidate in medicine. This diploma ob-

tained after two years, has the following program: (a) first year of candidature: experimental physiology, physiological chemistry, anatomy, histology, cytology, and zoology; (b) second year of candidature: experimental physiology, anatomy, psychology, and comparative anatomy.

After having received the degree of candidate in medicine, the student has to continue his studies further for three years to become a doctor of medicine and a new law under discussion concerning medical education demands a fourth year for that purpose. Students in medicine have to follow the courses of experimental physiology for two years; during the first year of that period they are all doing practical work in physiological chemistry and during the second year they have practical work in experimental physiology.

Because of the large number of students we have thought it best to make a complete separation between the part of the building given over to the teaching and that part reserved for scientific work. This is facilitated by the plan of the building, which forms a right angle, conforming to the ground at our disposal. From an architectural viewpoint, one side of the angle which

<sup>1</sup> See floor plans, Figures 2-5.

faces the main street is the principal building and is devoted to scientific research, the other side is occupied almost entirely by the teaching department. Such a disposition prevents the students from disturbing the quiet of the scientific wing.

The two wings, although united, are really two separate structures, having their own staircases running from the basement to the second floor, which aid in emptying the building in normal circumstances, and are of the greatest importance in case of fire. The principal wing runs east and west parallel at an average distance of ten meters to the Rue des Doyens; the teaching wing runs north and south at an average distance of fifteen meters, parallel to the Rue de la Brabançonne.

The Institute has two entrances. There is direct admittance from the Rue des Doyens to the principal wing of the building by a bridge from the street; this entrance is employed only on special occasions. The other entrance, normally used for the whole building, is a private one, which passes the lodge of the attendant and gives admittance to the teaching wing. In this way people on bicycle, entering the private ground of the Institute, can descend a declined plane to the hall of the basement of that wing where there is a place for a great number of bicycles. They can then reach

the hall on the ground floor by the staircase. Those who come on foot go directly to the hall on the ground floor. From here they can go on the left to the lecture-room, straight on to the spectatorium, or on the right to the students' laboratory. A staircase leads to the upper floors. By passing the students' laboratory you can enter the principal building. With the exception of the place occupied by the students' laboratory, the principal building as well as the teaching building has a central corridor.

The architectural embellishment has been limited as far as possible, the principal objects aimed at being economy, simplicity and efficiency of construction, stability, and light. Special precautions have been taken to prevent the vibration of the precision instruments. The earth between the main building and the street is dug out; the bridge giving admittance to the main building is not in direct contact with the building. Several rooms of the basement are provided with vibration-free pillars. On the different floors very thick walls are employed to support the precision instruments.

Certain features of the construction must be mentioned. To render the whole Institute as silent as possible, the floors of the ground floor, the first story, and of part of the second story are made of different materials, reinforced concrete, vaults of bricks between

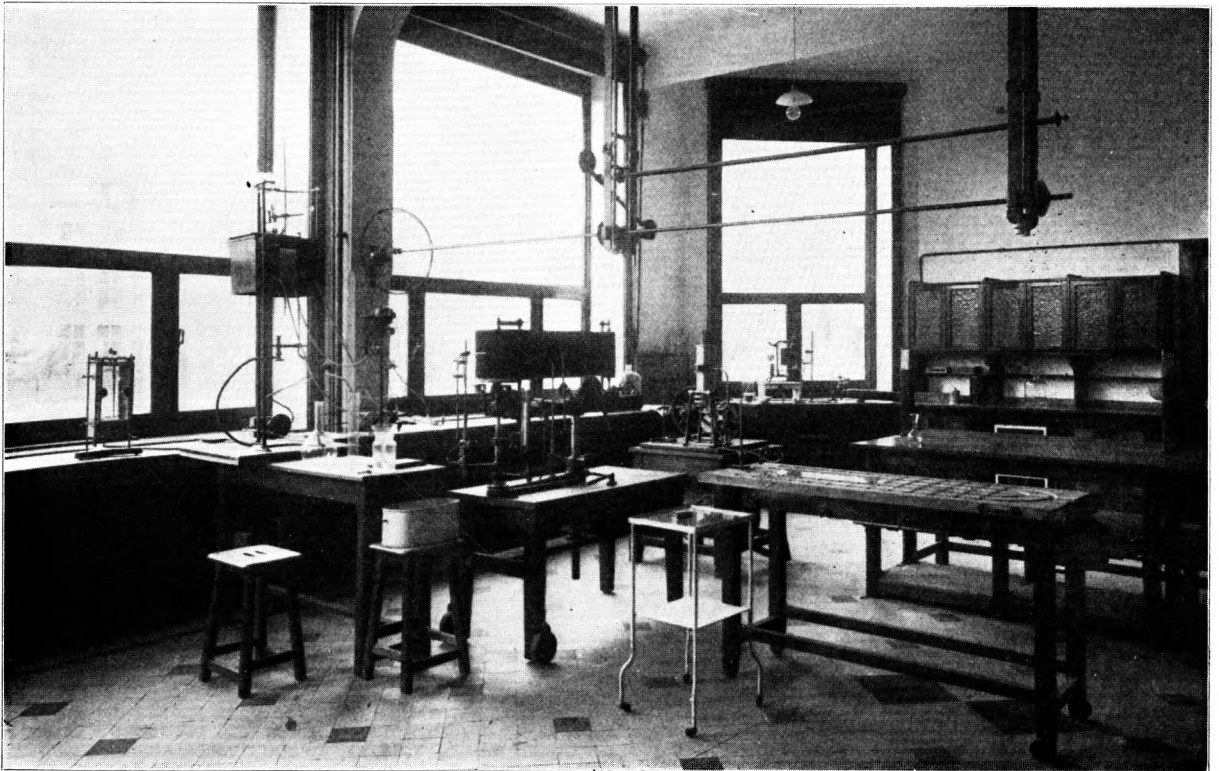


FIG. 7.—SPECTATORIUM

iron beams, concrete between iron beams, etc. being alternated in the construction of each floor. The direction of the beams is changed for every room. In this way a very remarkable interference of wave-sounds is obtained, so that the transmission of noise from one part of the building to the other is reduced to a minimum. This is very important in the different experiments on man and animal to protect them from undesirable acoustical excitation, a source of experimental error too often neglected.

There are casement windows, which occupy the maximum amount of wall space, consisting of an upper and a lower central casement, each flanked on both sides by smaller lateral casements. The lateral sashes open inwards, so that all panes may be cleaned from the room itself. The upper lateral divisions are movable to provide for ventilation.

On the walls of different rooms are placed wooden moldings for hanging pictures. There are small tables for supporting apparatus.

The floors of the basement, of the ground story, and those of a part of the first and second story are of tile; the others are in planking. On the second floor the department for aseptical operations and the animal hospital also have tiled floors which can easily be cleaned.

## THE ENGINEERING INSTALLATIONS

### VENTILATING

The engineering installations had to be made at a minimum expense. A central ventilating system would have been preferable, but it would have been too costly. Under these circumstances the ventilation was planned in such a way that the system could eventually be transformed into a central ventilating suction system. Each window has under its threshold a fresh air intake and each room has in its wall one or two canalizations that end in a chimney on the roof. In the garret of the building these chimneys are visible and each of them has a trap that by closing these chimneys upwards and by connecting them with a large central suction tube, we can eventually arrange a large aspirating fan to exhaust the vitiated air from the different rooms of the whole Institute.

When, under the present conditions, we have to purify the air in one room or another, we can apply the same exhausting system on a more moderate scale by placing a small electrically driven fan in the corresponding chimney near the roof. To supply a large quantity of air the lower lateral parts of all the windows can be opened. The upper parts are all provided with special ventilating apparatus. All fume cupboards have special ventilating chimneys whose current is facilitated by a simple gas flame.

### HEATING

Heat is provided by a central apparatus that supplies both the Institute of Physiology and the Institute of Commerce which is nearby. Between the two buildings is situated a large cellar 12 meters long and 8.15 meters wide, which contains two boilers of different dimensions, so that different degrees of heating are obtained by lighting one or two boilers. A low pressure system is employed for heating. The Institute of Physiology is united with the heating cellar by a tunnel through which pass the heating and the return pipes.

The supply pipe entering the Institute goes through the central corridor of the basement. Two columns, one for each wing of the building, carry the steam to the garret, where it is distributed in a main tube which surrounds the whole garret. This main pipe is tapped by numerous secondary pipes, going down to the various rooms on the different floors. In this way the condensed water is driven back by the pressure of steam so that all the noise caused by the resistance of water to the arriving steam is eliminated. This is of the greatest importance for silent laboratory work and is also the most reasonable system because we have heat there, where cold penetrates into the building. Some rooms such as the calorimetric room, the room for metabolic research by gas analysis, the spectatorium, and the aseptic operation room can be heated to a high temperature by means of large radiators.

### WATER AND GAS

The Institute is supplied with water, gas, and electricity from the works of the city of Louvain. Consequently all the installations in connection with the works have had to be placed in accordance with the elaborate regulations issued on these matters. In the center at the top of the building under the roof is a large cistern which serves as a supply for constant pressure. The water supply of this tank is automatically regulated. In laying the pipes special care has been taken to make the whole system as conspicuous and as easily accessible for repairs as possible. All pipes are therefore laid clear of walls and ceilings. The main conducts for heating, gas, water, and electricity are all placed in the central corridor of the basement.

### ELECTRICITY

Because the Institute is situated just at the intersection of the center and the edge of the town we have at our disposal continuous as well as alternating current. We have continuous current from our own battery of 120 volts, charged by a motorgenerator, continuous current of 440 volts tension from the electrical town works, continuous current of 220 volts from the same

works, one wire as neutral and the other as positive or negative 220 volts, a triphasic alternating current of 250 volts, and one phase of the alternating current of 125 volts.

The main electric wires are all placed in the central corridor of the basement on isolators embedded in wooden layers, which are fixed in the walls. It is very easy to direct the desired current to one room or another by making a connection with the main wire and passing it through a hole in the wall. In each of several rooms there has been arranged a switchboard with different currents. All places are provided with plug contacts.

Besides the motors used for working air fans, power-transmission shafts, machines, centrifuges, etc., we have several transportable small motors varying from 1/16 to 1 H.P. Nearly all these motors are equipped for a continuous current of 220 volts.

The lighting comes from a 220-volt continuous current, with the exception of the lighting of two staircases where we applied alternating current, in order to have light always in case of accident.

#### SEWERAGE SYSTEM

The sewerage system is connected with that of the public sewer in three places. There are two main sewers in the building, one leading the water from the end of the teaching wing and passing under the floor of the central corridor of this wing, and the other receiving the water from the main building and passing under the floor of the central corridor of the building. In each room of the basement there are lateral sewers going from the outer wall to one of the main central sewers. The secondary sewers receive the used water of the upper floors by vertical conducts. The third main sewer collects the used water of the stables and of the house of the attendant to lead it to the public sewer. In different places are peep holes for controlling the sewerage system. All the main, vertical, and secondary sewers are made of glazed, gray stone, and have a large diameter.

#### DESCRIPTION OF SPECIAL ROOMS

All the rooms of the basement are 3.30 meters high; those of the ground floor with the exception of the

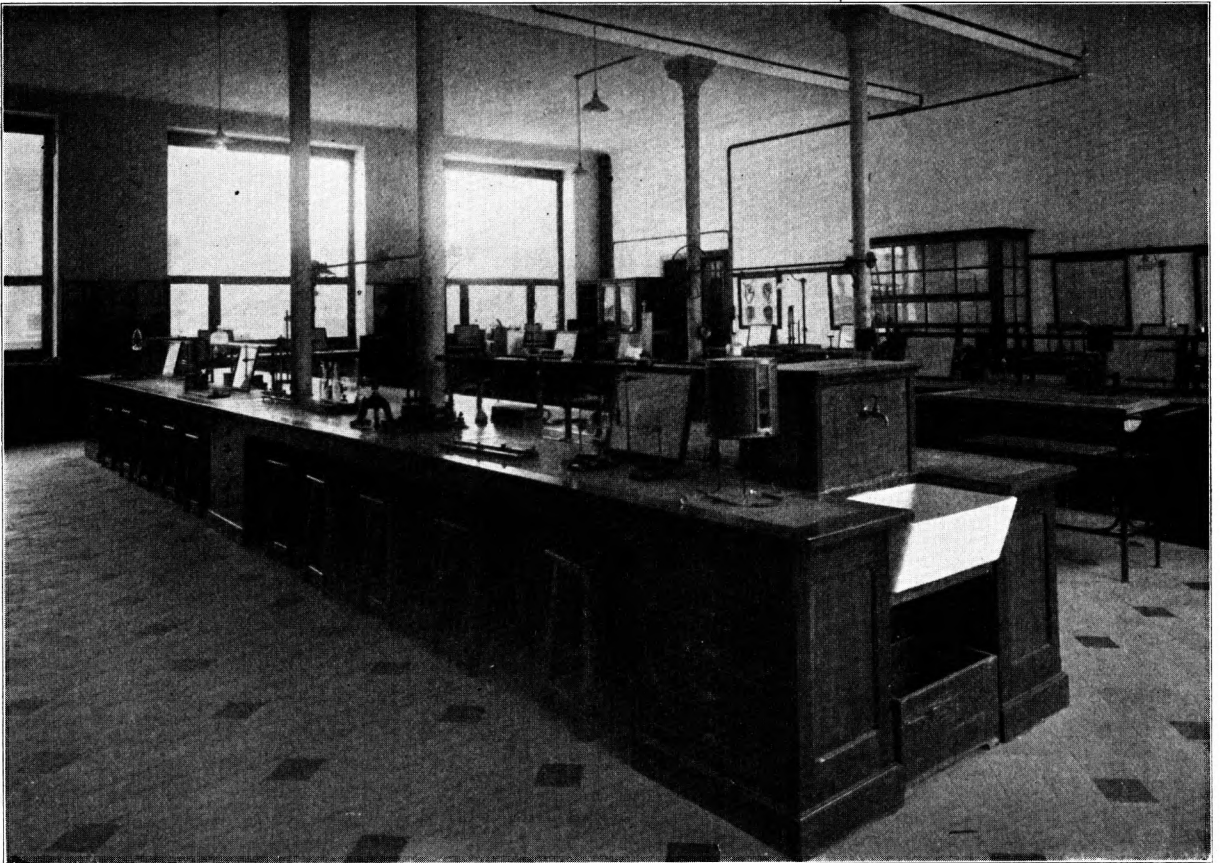


FIG. 8.—STUDENTS' LABORATORY FOR EXPERIMENTAL PHYSIOLOGY

lecture-room are 4.50 meters high; and those of the first floor are 4.10 meters, while those of the second floor measure 4.40 meters.

The lecture-room (Fig. 6) is 14 meters wide, 13.50 meters deep, and 7 meters high, having seats for 226 students, but by adding small portable stools, 300 students can be seated easily. The seats are arranged in the form of a theater and the inclination is such that everyone can observe what is happening on the demonstration table and can see the blackboard.

The demonstration table is placed on a platform 34 centimeters high. The wall behind the table has a blackboard 4 meters long. On both sides of the blackboard are fixed wall demonstration apparatus for pictures; the apparatus consists of a curtain made of three linen strings supporting horizontal strips of wood for attaching the pictures. The pictures can be suspended in this way at different heights. Between the demonstration table and the first row of seats is sufficient place to give demonstrations of animals, apparatus, etc. By opening a section of the top of the table we have at our disposal different electrical currents: battery, 120 volts; continuous current, 220 volts; alternating current, 125 and 250 volts.

In the middle of the theater, partly hidden in the bleachers, is reserved a small room for projection purposes. In this room on one side is placed a Zeiss apparatus for microscopical projection, on the other side a Leitz epidiascope. A movable screen for projection has been hung before the projection apparatus so that it can receive both projections, being placed against the wall for the projection of slides or at a nearer distance for epidiascopical use. The screen which is of linen fixed in an iron frame, is suspended by means of rolls on a pendent bridge balanced by counterweights. The bridge can move around two axes, fixed in the middle of the arms of the bridge and reposing on two supports attached to the ceiling and the wall. One axis of the bridge has a cog-wheel, provided with a chain, which passes by another in contact with a horizontal one which reverses the direction. The axis of the horizontal cog-wheel has been prolonged and can be moved by a handle at its lower end.

The place beneath the theater is partly utilized as a storeroom for pictures used in connection with the teaching. Further on there remains sufficient place for a long room, which can be employed as a large dark room. Two corridors and the projecting room lead to this place. In these corridors are placed in recesses the heating radiators which receive the outdoor air directly penetrating through ventilating openings behind. The heated air goes through the theater to leave it as vitiated air by ventilating openings near the ceiling. A regular ventilating current is obtained in this way.

The light enters the lecture-room by six windows, three on each side. The curtains for each side are

fixed on the same axis; the darkening is accomplished electrically. The acoustical conditions of the theater are excellent and may be considered as the application of certain rational theoretical principles of acoustics. Those excellent conditions are obtained by stabilizing the walls and the ceiling without charging them too much. The walls are very thick and on the outside stabilized by large supports. The ceiling is a rather thin plate of reinforced concrete receiving sufficient strength through different beams of the same material. There are two large principal beams, of a trapezoid form, one meter high and one meter wide on the upper surface, and further transversal beams, one meter wide and 0.40 meter high, at a right angle to the large beams. The space between the beams is filled up with coke and sand, and covered above with a tiled floor. In this way we have obtained a ceiling which is very strong without marked elastic traction which is liable to produce resonance.

The spectatorium (Fig. 7), or demonstration room, 12 meters wide and 8 meters deep, lighted in front and partly on both sides, is situated between the lecture-room and the laboratory for practical work of students, so that it forms a real part of both. During the lecture the illustrating experiment can be prepared so that at the same time or at the end of the lecture a demonstration can be given. This room can be darkened for special purposes. The spectatorium also renders great service as a part of the room for practical student work, not only by increasing the available space, but especially by offering occasion to demonstrate more complicated experiments for the students during their practical work.

In the middle of the room is placed an operating table. The top of the table has a copper plate supporting the animal and heated by electric lamps. There is further a large Palmer kymograph, and a respiration pump with electromotor (pattern Hans Meyer, made by Rinck). Air under pressure is always at our disposal to make "insufflation" according to Meltzer.

Two large tables of a special form, serving normally as work tables, can be transformed in a very simple way into theaters to allow a great number of students to observe the demonstration of operations on animals. The tables have not four but six legs fixed solidly in a wooden base. The top of the table, like that of a folding table, is composed of two parts forming wings, which can be turned up around an axis supported by the central legs. The two anterior legs have on the outside at a distance of 45 centimeters from the floor a movable shelf, turning round an axis. This can be used as a seat for a row of six students. Between the anterior and the central legs another row of six persons finds place by standing. At a distance of 40 centimeters from the base is fixed a platform between the central and the posterior legs. On this platform there is room

for eight or ten students. In this way each table can be made to accommodate twenty-two persons. These theaters are very comfortable and do not disturb the other work in the room.

In the two lateral angles of the room are constructed two cabinets for otorhinolaryngoscopy and for spectroscopy. The same cabinets can be used as dressing rooms for people, who undergo auscultation and registration of heart and respiration movements. It is in this place that apparatus is arranged for the survival of heart, intestines, etc. of mammals. We have at our disposal two types of apparatus for heart-survival of cats, dogs, and rabbits. One is a rather large apparatus which is used for normal work where we obtain constant temperature, oxygen and pressure, the other where the whole apparatus can be sterilized. This apparatus is very useful for a prolonged perfusion and for studying the consumption of foodstuffs of living tissues.

#### STUDENTS' LABORATORY

The students' laboratory is a room 12.50 meters deep by 15.80 meters wide, brilliantly lighted by three large windows on each of the two opposite sides. The room has in the middle two large tables 10 meters long and 1.60 meters wide; in front of the windows and along

the walls are additional tables, so that we have a table length of 75 meters available for practical student work. All the tables are fitted with lockers and drawers as well as with water, gas, and electricity. Cupboards for the instruments, pictures on the wall explaining the most usual experiments, a large blackboard, and some fume cupboards complete the furnishing of the room.

The two tables in the middle are provided with shafting driven by an electromotor, and fitted with stepped pullies, so that a great number of students can work at the same moment with kymographs. We can put at their disposal for all kinds of electric work an accumulator of 2 volts, the direct current of 120 volts, and alternating current of 125 volts. In the middle of the tables there are two central points for distributing the different currents.

The practical course of experimental physiology is so arranged that two students are always working together. They find on a determined place a picture with a description of the enumerated experiments, and further all the apparatus and supplies necessary. Every student has a card on which is written the date and number of the experiment, following a certain program. He is not allowed to advance to another experiment without receiving upon his card the



FIG. 9.—PRIVATE LABORATORY OF THE PROFESSOR OF PHYSIOLOGY

approval of one of the assistants. At the end of the year each student has to deliver a report concerning the experiments performed during the year.

#### GENERAL RESEARCH LABORATORY

The general research laboratory, 12 meters by 9 meters, is situated at the intersection of the two wings of the building and is designed for work of a more general character. It is here that young workers commence their research work. They can have at every moment the help of the assistants and can be controlled very easily.

A large table 4.5 by 1.5 meters in the middle of the room, with shafting driven by an electromotor, and drawers with all kind of clamps, rods, glass, corks, and other supplies has a switchboard with different electric currents. Other free tables and fixed tables in front of the windows offer plenty of place to arrange all kinds of experiments.

Cupboards for instruments of general use, a blackboard, a fume cupboard, sinks, and benches form the furniture of the room, which is lighted abundantly on two sides. Balances of different sensitivities are placed upon stone plates fixed in the wall.

This laboratory is surrounded by a ring of other rooms designed for work in relation to general research. These consist of a room for physicochemical work, a dark room, a room with incubators, and a room for the histological research work necessitated by physiological experiments. The room for physicochemical work is situated on the north to avoid as much as possible temperature changes during the day.

On cement blocks is placed a large centrifuge of Boultite running without noise 3,000 revolutions a minute and with a capacity of 300 cc. There are different cupboards for instruments and chemicals. The space between two cupboards is arranged as a titration table.

#### DIRECTOR'S DEPARTMENT

The director of the laboratory has at his disposal two rooms, an office and a private laboratory. In the office is a cupboard for fine and precious instruments and a large cupboard with a great number of drawers, containing the private collection of reprints of the director. This collection is classed following the subject so that it is very useful and easily consulted. A desk is in the middle of the room. The private laboratory 10.45 by 8 meters is employed for the private work of the director and for strangers who come to work in the Institute.

For furniture we have fixed tables with sinks in front of the windows, two free tables in the middle of the room, and at a distance of 1.20 meters of the main wall, a large piece of furniture which is composed on

the front side of three cupboards united by shelves and a large table so that it can be utilized as a titration table and may be employed for preparing all kinds of experiments. The upper part of the cupboards has lockers, the lower part, drawers of different size.

The space between this piece of furniture and the wall has been fitted up as a dark room by covering it above and closing it on both sides by doors. Small trap-doors between the dark room and table outside allow connections to be made with galvanometers in the dark room. Here there are also small tables with sinks for all kind of work such as polarimetry, etc.

#### LIBRARY AND MUSEUM

The library 5.45 meters deep by 10.45 meters wide has light from two adjacent sides. Before the windows of one of these sides are placed fixed tables. Two other tables serve as reading-tables in the middle of the room. The sides opposite the light are completely covered with cupboards. A platform has been supplied at a distance of half the height of the room so that we obtain two ranges of cupboards. Those on the level of the room serve for receiving the collection of instruments, the upper range is used for bookcases for the special books and periodicals. The books that are in general use are placed beneath the tables in special cupboards near the windows.

Between the windows is a cupboard containing the card index of the reprints of the private collection of the director and of the Institute. The system provides a special way for marking the most important articles on different physiological problems. There is a special cupboard on the ground level for the current numbers of books and periodicals that are not yet bound.

#### DEPARTMENT OF ELECTROPHYSIOLOGY

The Department of Electrophysiology is situated in a quiet corner of the basement of the building, far from all noise and in so far as possible free from vibration which has been reduced to a minimum by separating the building from the street and by making pillars of masonry on the bottom, which do not touch the floor and which support the very sensitive instruments. The earth, dug out on the front and on the two sides of the building, has been added at the rear of the building.

The pillars are stone tables with a thick top of free-stone measuring 2 by 1 meters. These tables are very practical because all instruments placed on them remain in an unaltered position. On one of these tables is placed the electrocardiograph with all the accompanying instruments.

The electrocardiograph is of the Wertheim Salomonson design; we have added a water cooling apparatus so that we can have an electromagnetic field between

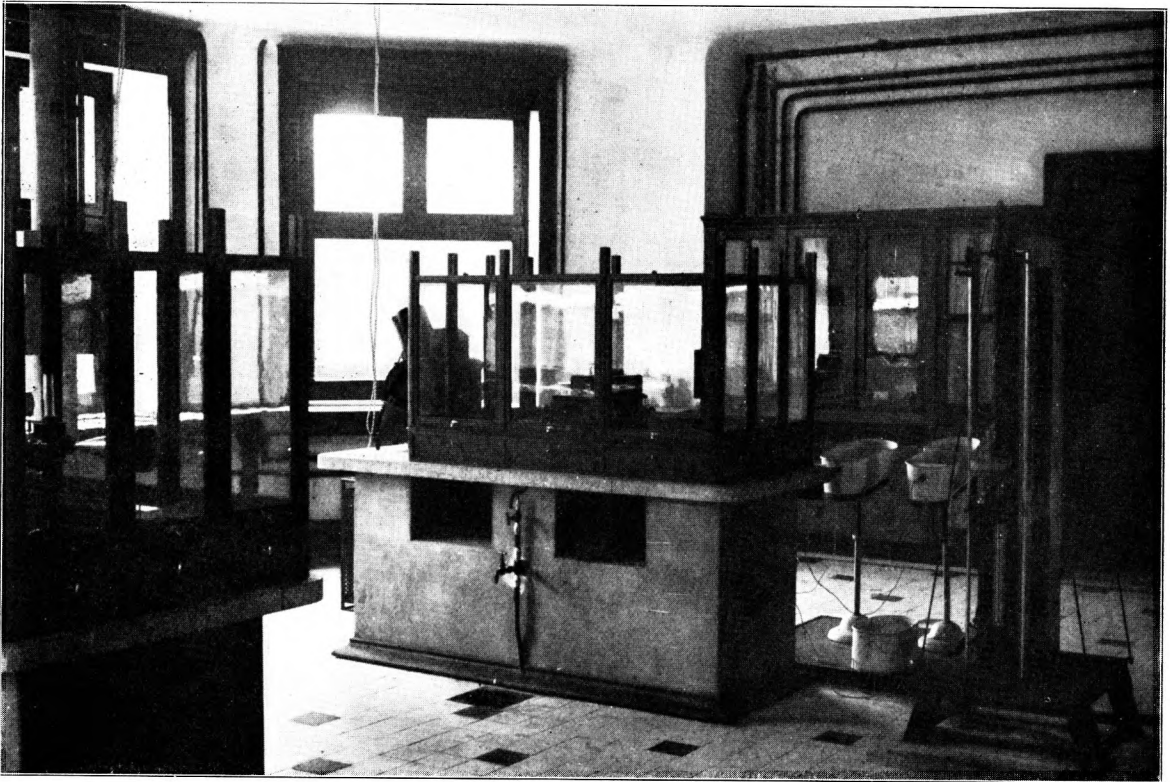


FIG. 10.—GALVANOMETER ROOM

the poles of 30,000 gauss. For normal electrocardiograph work we do not need such a strong field, but it is very useful for all kinds of finer work. A small Edelmann electrocardiograph with a double permanent magnet is employed for different electrocardiographic work upon cold-blooded animals.

The department comprises further two rooms where all other kinds of electrophysiological work can be done. Here we arranged apparatus to determine the chronaxia of tissues and organs. Special mention should be made of a chronaximeter of our design that allows control for a very short duration of time ( $1/200,000$  of a second) necessary for excitation. A falling weight breaks successively a shunt and a main current is employed for the excitation of tissue. The excitation-time between those two events is controlled by measuring by means of a ballistic galvanometer the remaining charge on a condenser of which are broken successively the feeding current and the shunt.

Another room has been reserved for spectrographic work. Absorption spectra of liquids are made by photographing through a layer of the liquid a source of ultraviolet light by means of a quartz-spectrograph of Hilger. The absorption spectrum obtained in this manner is analyzed and transformed in a curve. Light condensed on the photographic plate containing

the spectrum falls upon a series of very fine thermocouples and develops an electric current which is registered by means of a galvanometer upon photographic paper fixed upon a drum. The movements of the plate and use of the drum are coupled. Each ray or each darkening of the photographic plate will change the height of the curve, so that the changes produced by absorption are immediately visible in the curve.

#### DEPARTMENT FOR RESEARCH UPON COLD-BLOODED ANIMALS

On the north, close to the refrigerating room on the other side of the corridor is situated the department for research on cold-blooded animals. This place has been chosen because it is very cool in summer and not too cold in winter so that the daily variation of temperature in both seasons is reduced and rather small.

One room is fitted out as a more special laboratory with cupboards, and with free and fixed tables before the windows. The other room contains the large basin for winter quarters of frogs (2 by 2 meters) and a large aquarium (2.10 by 1.35 meters and 0.85 meters deep) for fishes. Both are supplied by a constant stream of water.

### DEPARTMENT OF METABOLIC RESEARCH

Exposed to the north, so that the daily variations of temperature are reduced to a minimum, is situated the department of metabolic research where are employed different methods of a gas-analytic or gas-volumetric nature. It is here that a great deal of work is done on basal metabolism. For this reason the laboratory is quiet. The department comprises two rooms, one of which has three boxes, separated by curtains so that the patient on the bed cannot see what is happening outside the box, where the recording apparatus is placed.

We have here at our disposal (*a*) an apparatus for the determination of basal metabolism according to Krogh, measuring the consumption of oxygen; (*b*) a Tissot spirometer with recording apparatus, allowing us to determine CO<sub>2</sub> production, O<sub>2</sub> consumption, and the value of the respiration quotient after air analysis; (*c*) and the following apparatus for analysis: an analytic apparatus of Haldane, small pattern; an analytic apparatus of Haldane, large pattern; an analytic apparatus of Gräve; a diaferometer of Noyons, and an interferometer of Zeiss.

Outdoor air is conducted to the different apparatus through a large main tube with different lateral tubes. The heating system in the room can be varied on a large scale in order to study the influence of temperature on the organic combustion of living beings.

### TECHNICAL DEPARTMENT

The technical department of the laboratory comprises the following rooms: (*a*) A mechanical workshop (No. 15) furnished with: a lathe of moderate size, a small lathe for precision work, such as is employed by watchmakers, a vertical and horizontal fraising-machine, a very small fraising-apparatus, a bore machine, an automatic metal-saw, and a nickel-bath. All instruments are driven by a central axis. (*b*) A workshop for glass-making (No. 16) with bellows and with a smoothing machine. (*c*) A storeroom for different materials. (No. 17). (*d*) A testing room, (No. 14) where is also placed the apparatus for vacuum and pressure.

There are two reservoirs for pressure, each with a capacity of 1,800 liters and also two reservoirs for vacuum each of 1,500 liters capacity. We employ for vacuum and pressure the same horizontal pump, driven by a motor of 3.5 h.p. This pump gives 27 cubic meters an hour and 5.4 cubic meters on a pressure of four atmospheres.

A system of valves and a big three-way stop-cock moved by a handle allows the employment of the pump as a pressure or a vacuum pump. (*e*) A room (No. 13) designed for the distribution of different currents and for the transformation of triphasic alternating current by means of a motor-generator of

the Electric Works of Charleroi (the three phasic current after transformation supplies the storage-battery, which is placed in the next room). (*f*) A battery-room (No. 12), where is placed a battery Tudor of 60 elements of 150 ampere-hours. In the same place are charged the smaller accumulators used everywhere in the laboratory. (*g*) The refrigerating room contains a Brown-Boveri refrigerating apparatus with a small refrigerator box and small refrigerator room of the following interior dimensions, 2 meters deep, 1.80 meters wide, and 2.40 meters high, with insulated double walls, the space between the walls being filled with sawdust. The room is cooled by a circulating stream of brine which is cooled in turn by the refrigerating apparatus.

### DEPARTMENT OF CALORIMETRIC RESEARCH

In the basement of the Institute the end of the southern wing has been reserved for calorimetric research.

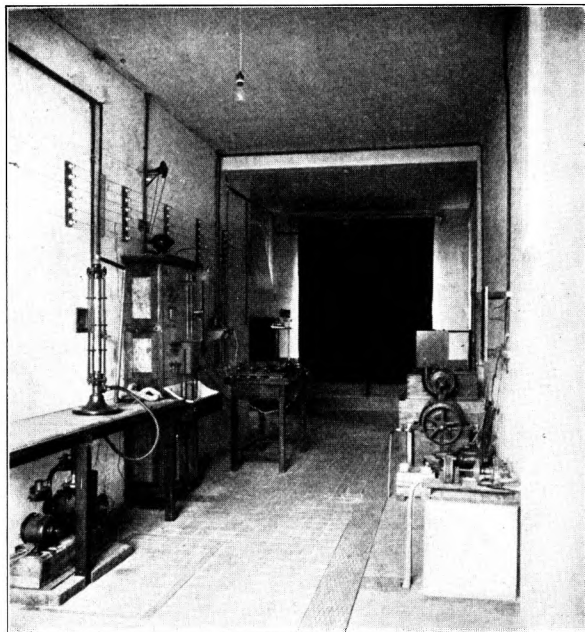


FIG. 11.—CALORIMETER ROOM

We have there a large space 13 by 13.25 meters divided by a wall into two parts of the same breadth but of different depth. The wall protects the interior part which is 10 by 13.25 meters, against direct radiation of sunlight. The smaller room, which is 2.69 by 13.25 meters, is designed for analytic work in relation to calorimetric research; the large room contains our different types of calorimeters.

We elaborated three types for our research work, all based on a differential principle: (*a*) a small calorimeter for small animals such as guinea-pigs, pigeons,

mice, and rats; (b) a middle calorimeter for dogs, cats, and rabbits; (c) a calorimeter for man and large animals. The principle of these three types is that we calculate the heat given off by the living being by determining how many calories must be developed by a heated wire in another room in order to have an equivalent caloric output between both the sources of heat. The latent heat required by the living being for the transformation of water into water vapor is counterbalanced by producing an equal quantity of latent heat in the other room.

This double differential principle is realized for man in the following manner by constructing two adiabatic thermostats. Two small rooms, 1.70 by 2.40 by 2.20 meters separated by a central corridor are surrounded by different insulating materials, air, wood, paper, cork, and masonry. One of the rooms is designed for receiving a living being; the other contains an electric resistance which can be heated by a variable electric current from the outside. The amount of the compensation heating current is read on an amperometer. To take away the developed calories, both rooms are cooled by water currents circulating in serpentine, which cover the walls and the ceilings. This water is measured upon its absolute temperature by thermometers sensitive to one one-thousandth of a degree, Celsius. The equivalent of temperature in the rooms can be determined by comparing the temperature of the water currents or better by bolometric wire systems, spread out in the interior of the calorimetric rooms and forming two arms of a Wheatstone bridge with a sensitive galvanometer as an indicator. Screens of fine copper gauze contribute for equal repartition of heat, and large fans of a special pattern are distributing and mixing the air to secure the same degree of temperature and humidity everywhere.

We determine the total caloric output by calculating the equivalent of heat given off by the electrical resistance. The equivalent of latent heat is determined by the equivalent of humidity measured in the two rooms by means of dry and wet thermopiles placed in air currents withdrawn from the two rooms. The amount of humidity needed is obtained by evaporating water of a spray which is regulable from the outside.

The calorimeter is employed with very good results for all metabolic research, but especially for the basal metabolism of man, where we can follow the caloric output from the moment of entrance until the moment of minimal deperdition.

#### DEPARTMENT OF SPECIAL SENSES

The western part of the first floor of the main wing is occupied by rooms which form the Department of the Physiology for the special senses. This department comprises two pairs of rooms separated by a

large dark room, No. 49. There are openings in the wall between the dark room and the adjacent room to make it possible to register photographically experiments that are running in the adjacent rooms. The two southern rooms, No. 50 and 51, are arranged for different optical work; there is accommodation to employ direct sunlight for different purposes. The northern pair of rooms, No. 47 and 48, constitute the laboratory for acoustics, containing a special laboratory for phonetics.

The laboratory of phonetics (Fig. 12) is directed by a

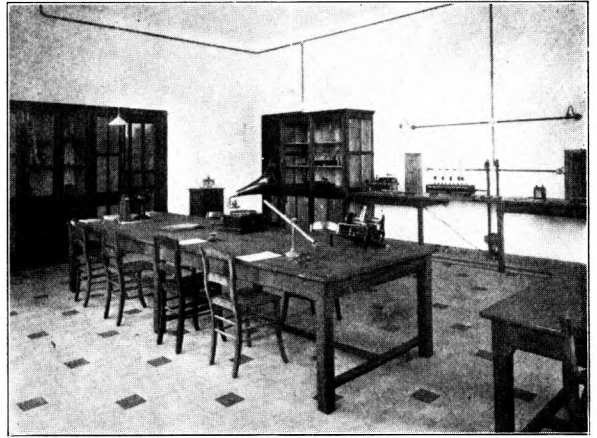


FIG. 12.—DEPARTMENT OF PHONETICS

philologist who can appeal to experimental physiology for his experimental work. The director with his students is occupied with researches concerning the repartition of dialects spoken in Belgium. This study is particularly interesting because Belgium represents a meeting place of the Germanic and Latin languages.

#### ASEPTIC DEPARTMENT

The Aseptic Department, suggested by the ideas and the experience of the Russian physiologist Pavlov, comprises:

(a) A sterilization and preparation room (No. 74) provided with a steam sterilizer and the necessary arrangements for the sterilization of instruments by boiling. There are additional wash basins with hot and cold water supply and a cupboard with instruments.

(b) An operating room (No. 75) having daylight from three sides and a strong electric lamp of 400 candle power, fixed on the ceiling. This room separated from the rest of the department has a large interior heating surface secured by means of radiators, and ventilating openings near the ceiling. The operating table which is heated by electric lamps closed up in a

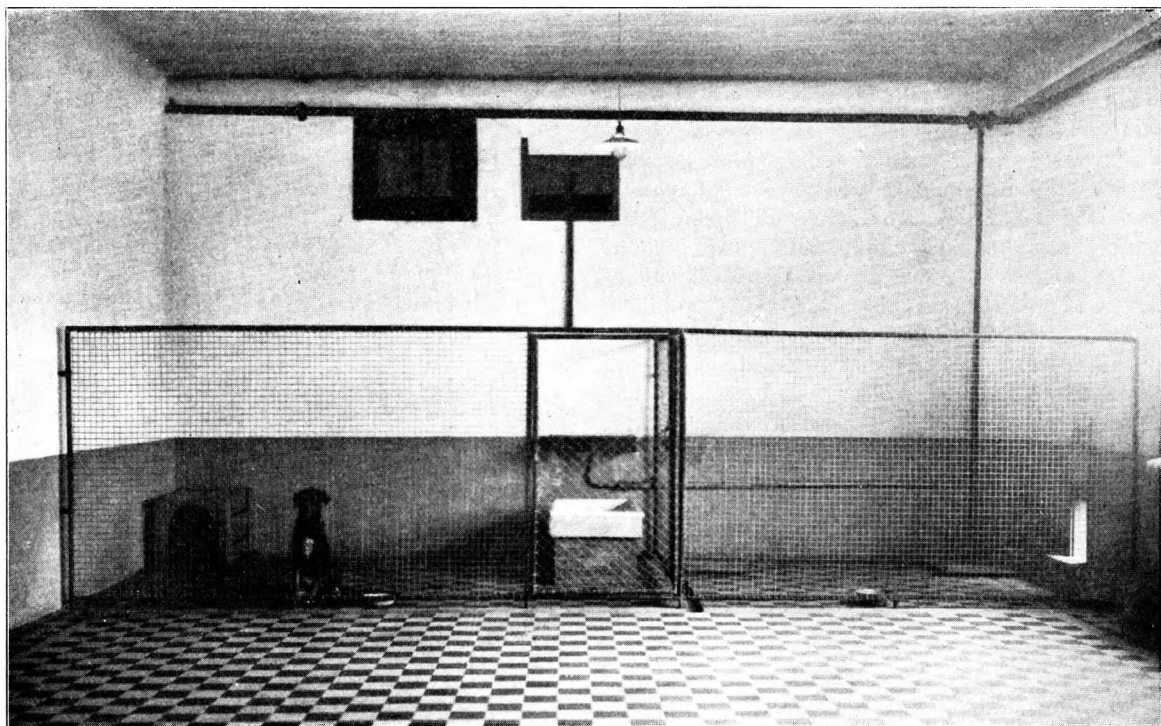


FIG. 13.—ANIMAL HOSPITAL

box can be moved in different directions, so that the animal can be operated on in different positions.

(c) The animal hospital (No. 72), excellently lighted and ventilated from the ceiling, contains three large kennels with sleeping cages for animals that have been operated upon. Openings in the wall give communication from the kennel to a platform outside where the animals can stay during good weather. This opening can be shut by a trap-door, when it is cold. A bath is provided for cleaning the animals. There still remains sufficient place in the room for cages for other animals. The animals are nursed in the hospital after operation and stay there under observation returning to the stable only at the end of the whole experiment.

#### DEPARTMENT OF PHYSIOLOGICAL CHEMISTRY

The Department of Physiological Chemistry comprises an office of the professor (No. 63), a balance-room (No. 62), a private laboratory (No. 61), a research laboratory for special workers (No. 60), a students' laboratory (No. 58) where the practical course of physiological chemistry is given, two assistants' rooms (No. 53 and 54), and a distillation department (No. 22 and 23) in the basement where the rougher work is done. In the research laboratory there is accommodation for microbiological work and one finds there also a big Büchner press for enzymatic preparation.

The students' laboratory, 14 meters long by 13.50 meters wide and 4 meters high has a complete equipment of cupboards, fume cupboards, sinks and baths, and six large laboratory benches. Each bench is 4.15 meters long, 1.60 meters wide and 0.75 meters high, with a top of asbestos, drawers and cupboards, sinks at the two ends, and small leaden funnels for waste water in the middle of the bench. Each bench suitable for normal biochemistry work is arranged for eight students, so there is accommodation for about fifty students in all.

#### DEPARTMENT OF PHARMACOLOGY

The Department of Pharmacology comprises an office of the professor (No. 57), a private laboratory (No. 56), a research laboratory for special workers (No. 55), a dark room (No. 54), and a small incubator-room, arranged and used for fermentation purposes especially in connection with research work upon bios, which was discovered in the laboratory under the direction of the chief of the Department of Pharmacology.

#### ANIMAL SHEDS

In the yard, parallel to the teaching wing of the laboratory is a building at an average of 6 meters deep and 25 meters long containing accommodation for small animals. It is subdivided into a number of

special rooms including a room for preparing food (No. 84) with staircase leading to the cellar and to the garret where hay, straw, and dried food for the animals are stored. The rooms for rabbits and guinea-pigs also have cages outside that are in communication with a trap-door, which is closed during winter.

The sheds are heated by radiators receiving the vapor by a subterranean conducting tube connected with the general heating plant.

At the end of the yard are two places, (No. 79 and 80) offering accommodation for large animals such as horses, cows, and calves. In the garden there is a frog pond, comprising three basins, molded in reinforced concrete. These basins, normally supplied by rain water from the roofs of the buildings, are surrounded by a large border with grass and plants. The basins have an overflow for emptying in the sewer and for maintaining the water at a constant level. The cleaning of the basins is facilitated by an opening in the floor. The largest basin has a central part which is 2 meters deep and two lateral wings with floors built on an incline so that the frogs can easily leave the water. The central part serves in winter for the retreat of the frogs. Treads lead from the floor of the wings

to the bottom of the central part. The pond with borders and plants is railed in and covered by a net of metal wire for protection against cats. The openings of the railing are so small that insects can enter the pond freely but frogs of normal size cannot leave it.

In the basement of the building there is also a large basin employed as winter quarters for the frogs, which must be at a room temperature or which must be employed regularly for the experiments of students.

The laboratory has been so conceived and equipped that it can be used for all kinds of physiological research work and for experiments illustrating the principles of physiology for teaching purposes, but it can easily be understood that not all branches of physiology have reached the same degree of development. In general we were studious in applying physical methods of measuring the different physiological phenomena to facilitate comparison. It is also an accepted rule that progress in physiology advances by help of a meter and a weight.

A great many of our instruments have a general character, so that we can get up impromptu experiments. We have avoided as far as possible spending

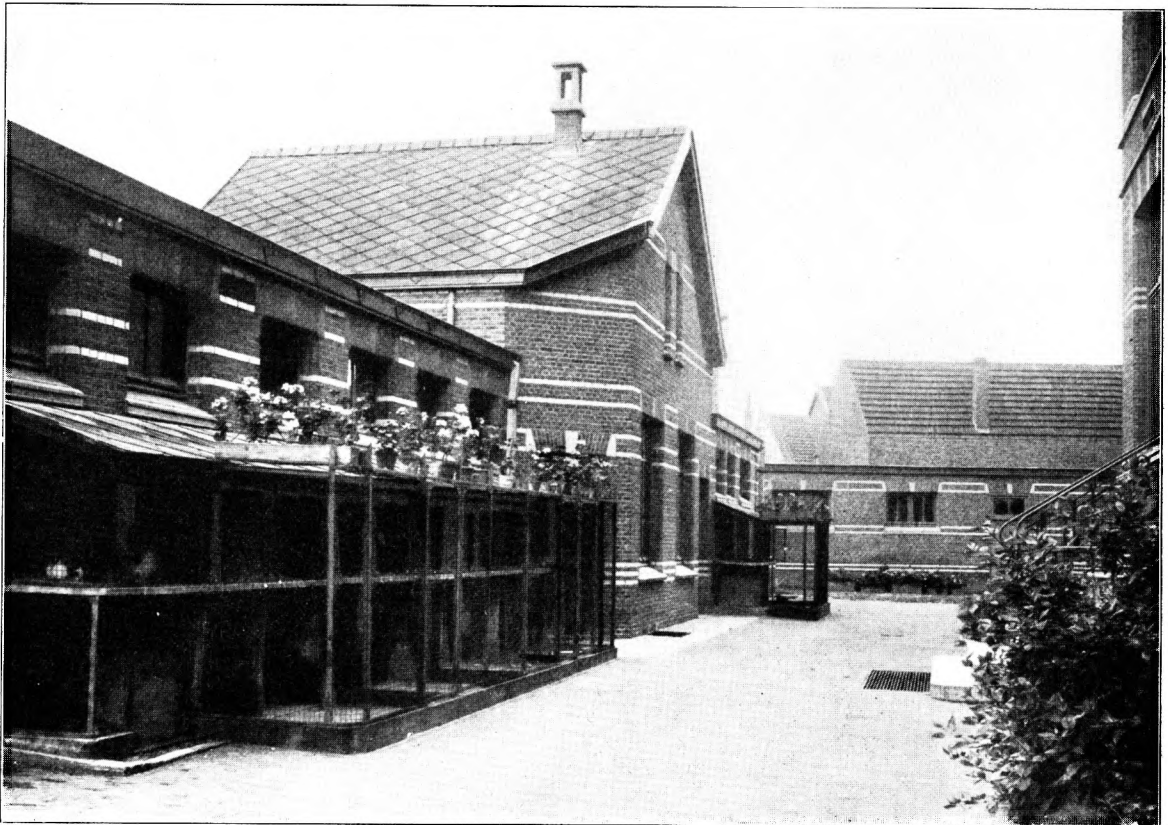


FIG. 14.—ANIMAL SHEDS

our money for complicated apparatus employed only for demonstration of one or another special phenomenon. Our method of direct differential calorimetry made it possible for us to control the basal metabolism of a great number of patients with a normal internal secretion. In this way the laboratory is steadily in contact with the clinics.

### STAFF

#### DEPARTMENT OF EXPERIMENTAL PHYSIOLOGY

##### *Professional Staff*

Dr. A. K. Noyons. Ordinary professor of experimental physiology.

Dr. J. P. Bouckert. Leader of the practical students work.

The second assistant.

The third assistant.

Dr. Groutaers. Philologist, chief of the phonetical department.

##### *Technical Staff*

One mechanic to make and mend apparatus, one attendant, and one servant.

#### DEPARTMENT OF PHYSIOLOGICAL CHEMISTRY

Dr. F. Malengreau: Ordinary professor of physiological chemistry. A first and second assistant.

#### DEPARTMENT OF PHARMACOLOGY

Dr. M. Ide. Ordinary professor of pharmacology. One servant.

The first assistants have free lodging, heating, and light in the Institute thus reducing the cost of living for them without increasing directly the expenses of the Institute.

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RECEIVED FOR PUBLICATION AUGUST 27, 1925