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CONTENTS

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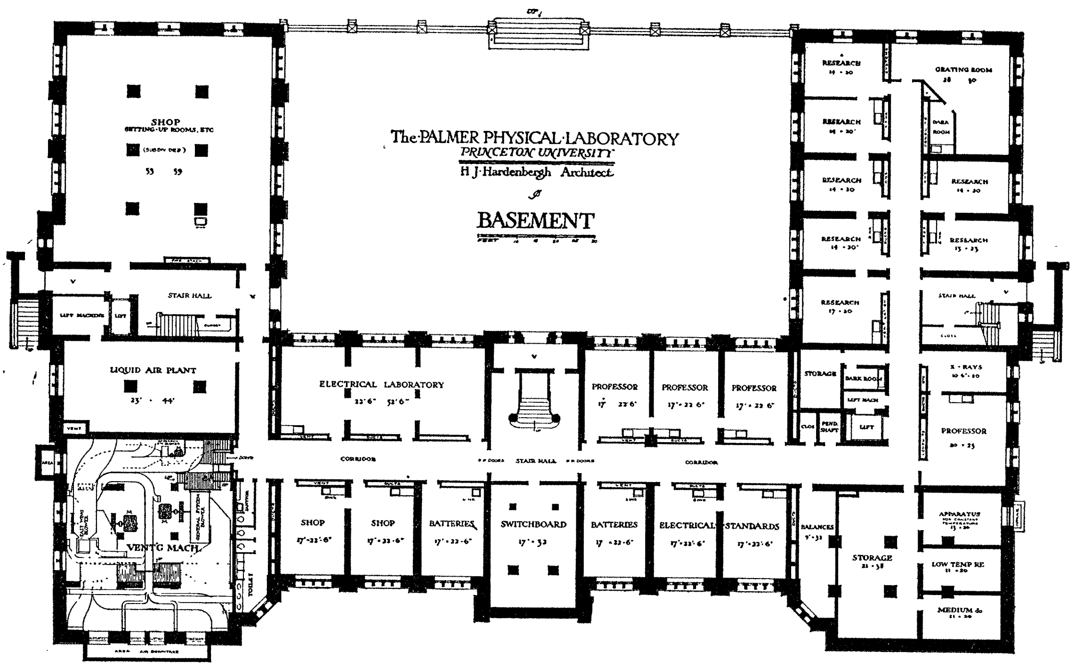
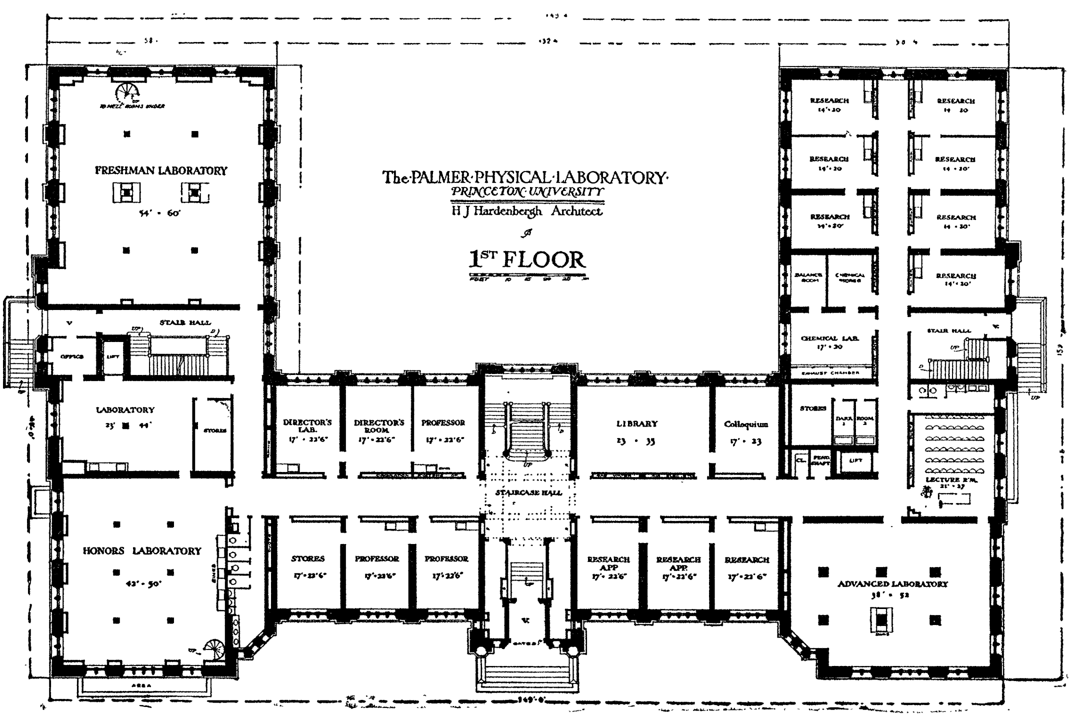
THE PALMER PHYSICAL LABORATORY

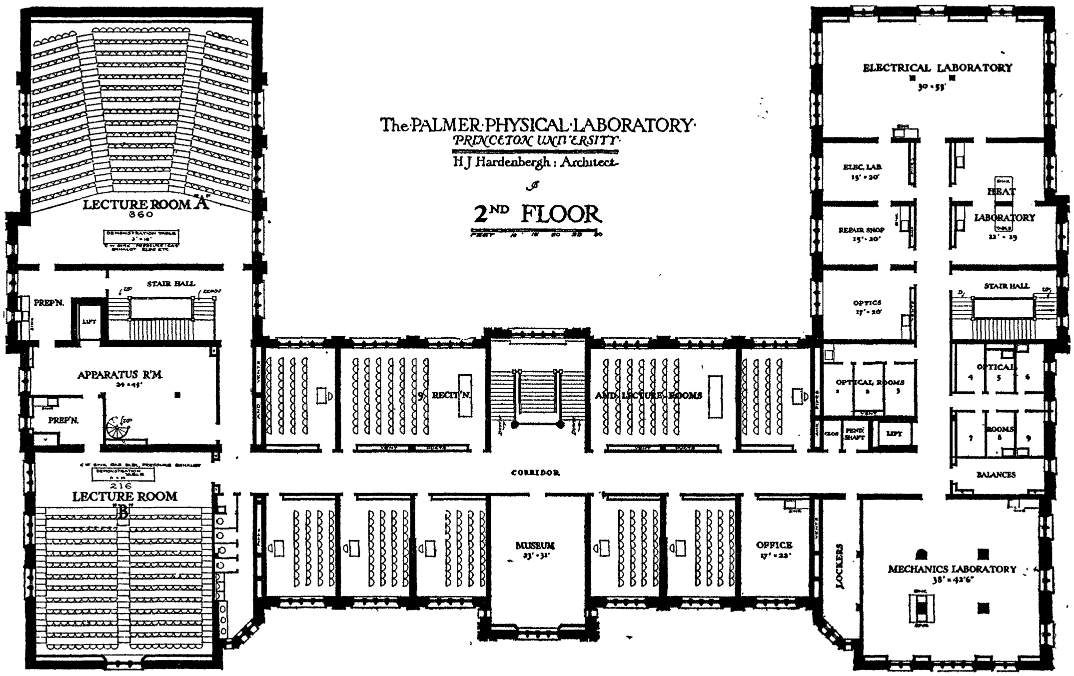
THE Palmer Physical Laboratory of Princeton University was erected and equipped by the generosity of Stephen S. Palmer, Esq., of Princeton, to meet the rapidly growing needs of the departments of physics and electrical engineering. The building is devoted entirely to the uses of the two departments. It is a two-story and basement structure of brick and Indiana limestone, and is a striking addition to the group of collegiate Gothic buildings which have been added to Princeton's equipment in recent years. Mr. H. J. Hardenbergh, of New York, was the architect.

The laboratory is, roughly, H-shaped, with the tongue of the H shifted laterally towards the front. The location of the building and the contour of the land are peculiarly favorable for an abundant supply of air and light to all parts of the building. The land slopes away rapidly toward the south, so that while but two stories show in front, the wings and the back have three full stories above ground level. The constant temperature, electrical standards and ventilating rooms are almost wholly under ground; yet the machine shops, electrical laboratories and professors' and private research rooms, which occupy the balance of the basement, are entirely above ground.

A double problem had to be solved in the planning of the building—provision had to be made for the accommodation of the very large amount of work necessitated by the required courses in physics, both theoretical and experimental, and by the con-


The PALMER PHYSICAL LABORATORY
PRINCETON UNIVERSITY
H J Hardenbergh Architect
BASEMENT
SHOP
SETTING-UP ROOMS, ETC
STAIR HALL
LIQUID AIR PLANT
23' × 44'
VENT'G MACH.
ELECTRICAL LABORATORY
22' 6" 52' 6"
PROFESSOR
17' 22' 6"
PROFESSOR
17' × 22' 6"
PROFESSOR
17' × 22' 6"
CORRIDOR
STAIR HALL
CORRIDOR
SHOP
17' × 22' 6"
SHOP
17' × 22' 6"
BATTERIES
17' × 22' 6"
SWITCHBOARD
17' × 32
BATTERIES
17' × 22' 6"
ELECTRICAL STANDARDS
17' × 22' 6"
17' × 22' 6"
BALANCES
STORAGE
LIFT
RESEARCH
GRATING ROOM
DARK ROOM
RESEARCH
RESEARCH
RESEARCH
RESEARCH
RESEARCH
RESEARCH
STAIR HALL
X-RAYS
PROFESSOR
20 × 25
APPARATUS
STORAGE
LOW TEMP RE
MEDIUM do


The PALMER PHYSICAL LABORATORY
PRINCETON UNIVERSITY
H J Hardenbergh Architect
1ST FLOOR
FRESHMAN LABORATORY
54' × 60'
STAIR HALL
OFFICE
LIFT
LABORATORY
23' × 44'
STORES
HONORS LABORATORY
42' × 50'
DIRECTOR'S LAB.
17' × 22' 6"
DIRECTOR'S ROOM
17' × 22' 6"
PROFESSOR
17' × 22' 6"
LIBRARY
23 × 35
Colloquium
17' × 23
STAIRCASE HALL
STORES
17' × 22' 6"
PROFESSOR
17' × 22' 6"
PROFESSOR
17' × 22' 6"
RESEARCH APP
17' × 22' 6"
RESEARCH APP
17' × 22' 6"
RESEARCH
17' × 22' 6"
RESEARCH
RESEARCH
RESEARCH
RESEARCH
RESEARCH
RESEARCH
RESEARCH
CHEMICAL LAB.
17' × 30
STORES
DARK ROOM
LIFT
STAIR HALL
LECTURE R'M.
ADVANCED LABORATORY
38' × 52



siderable number of elective courses in which experimental work is done. At the same time, rooms and equipment for the work of the students in electrical engineering and for the already large, and rapidly increasing, research work of the graduate students in physics had to be provided. The building may therefore be regarded as made up of two roughly equal portions. The upper floor and the east wing and other parts of the main floor are used mainly in undergraduate instruction. The basement and the balance of the main floor are given up to the rooms of the teaching staffs and of the advanced students. The facilities for the former include the following: four lecture rooms, one to seat 305, one to seat 176 and two with seats for 72 each; seven recitation rooms with 27 chairs each; and specially designed and equipped laboratories for the general courses, and for the special courses in the several branches of physics.

Twenty-eight research rooms have been equipped for members of the faculty and for other men carrying on experimental investigations. Constant temperature chambers, optical, photographic and photometric dark rooms, a balance room, a chemical laboratory, machine shops and an electrical standards room have been especially constructed and equipped for the use of any one carrying on work demanding such rooms and equipment.

The combined floor area of the three main stories is somewhat over 86,000 square feet. An additional area of 20,000 square feet in the attic is available, though not now utilized. This last space offers an unbroken stretch of 160 feet, and should prove invaluable for some types of experimental study.

The laboratory is a thoroughly fireproof structure and was planned to ensure the maximum of stability. It is of what may be termed the "wall-bearing" type as distinguished from the modern steel "office building" type. The walls are of very heavy masonry and bear the full weight. The floors are constructed of steel girders and vitrified brick arches, overlaid with nearly a foot of concrete, and the roof is made of steel framing, half-baked tiles and heavy, graduated slate. Tests have shown that there is little, if any, more vibration on the main floor than there is on a heavy pier especially constructed in the basement, on the undisturbed earth and without contact with the floor. One and a half years' occupancy of the building has proven the total lack of need of anti-vibration supports for apparatus sensitive to mechanical disturbances.

Apparatus is installed for either complete or partial artificial ventilation, as may be desired. The ventilating system is broken up into four separate units. One cares for the ventilation of the east wing in which are the big lecture halls and the laboratories for the general courses in physics. The second provides for the west wing, in which are placed the advanced laboratories and most of the research rooms. The third suffices for the main part of the building in which are the small lecture halls, the recitation rooms, the library, some private rooms and the administrative offices of the departments. The fourth section is connected with the chemical laboratory, all dark rooms and the storage battery rooms. The exhaust air from the battery rooms is carried off in lead ducts. Thus far it has been found necessary to install fans and motors in only the first and the last of the four parts of the system. The general ventilation is a marked success.

The ordinary ventilating ducts of a few of the research rooms have been supplemented by other ducts arranged to provide for special drying of all the air admitted to those rooms. Any desired humidity may be maintained in those rooms by means of this device, to aid in electrostatic studies and other lines of original work.

The heating of the building is controlled by a system of thermostats which enable the temperature of any one room to be controlled independently of every other room. This feature of the structural equipment has proven its worth in certain studies of solutions, during which deleterious changes of concentration with changes of temperature were prevented by the ability to keep the room temperature constant, within very narrow limits.

The ventilating ducts and steam and water and other pipes are distributed in a manner which makes them at once accessible and yet protected from injury. All the walls along the corridors are hollow walls, with a fifteen inch interspace. Air ducts and all pipes are carried in a pipe tunnel, under the basement corridor floor. Risers pass from this tunnel to the wall interspace, and lead to the various rooms. The space in the walls is sufficient to permit a man to enter it to make repairs, without damage to the walls, as has been done. At the same time, this space offers an easy means of running special pipes, or lines, from one floor to another, and from room to room.

A pendulum shaft, running from basement floor to roof has been specially designed for the reception of a Foucault pendulum for showing the rotation of the earth. The pendulum is now in course of construction. Its ball is a lead sphere weighing nearly 1,300 pounds. It will be supported by a steel wire from crossed knife edges. It is hoped by this arrangement to ensure a continuous plane vibration of thirty-six hours or more.

The main machine shop is fully equipped and stocked for either the production of the large amount of special apparatus required in research, or the repair of the even greater number of instruments broken in the general laboratory courses. Three machinists find themselves constantly busied in this work of production and repair.

Two smaller, fairly well equipped shops in different parts of the building are open to any one using the laboratory, for the rough repairs which often have to be made in an emergency.

The experimental equipment of the laboratory is most generous. In addition to the supply of the usual apparatus found in about all laboratories, the following, perhaps somewhat unusual, items of equipment have been installed and are in successful operation:

Refrigeration and Constant-temperature Rooms.—A four-ton ammonia refrigeration plant, driven by a ten-horse-power motor, provides for the cooling, or refrigeration, of two constant temperature rooms. These rooms, one 10 ft. $\times$ 10 ft. $\times$ 8 ft., the other 10 ft. $\times$ 20 ft. $\times$ 8 ft., are insulated by cork board of thickness sufficient to cut off practically all inflow of heat. On the test run these rooms were cooled simultaneously to $-7°$ F. and $+8°$ F., respectively. By means of a specially devised electrical thermostat, the temperature of the larger room has been held at 32° F. for twenty-four hours, with a variation of but one-twentieth of a degree during that time. By the use of the apparatus installed, the temperature of these rooms may be kept constant at any value between the lowest attainable in the room and the outside atmospheric temperature, the rooms being ventilated all the while.

Electrical Standards Room.—A room has been set apart and equipped for convenient and rapid comparison of the various electrical standards. Potentiometers, bridges and comparators are kept set up for use at any instant. The primary electrical standards of the laboratory are reserved exclusively for use in this room. It is provided also with a Callender recorder which can be connected by a special signal circuit to any room in the building, for registration of temperature or measurement of resistances.

Liquid Air Plant.—In the main machinery room, a two and a half liter liquid air plant, with Hampson liquefier and Whitehead compresser, is driven by belt from the motor of the main motor-generator set.

Pressure and Vacuum Systems.—Two systems of piping run from this main machinery room to all parts of the building, for supplying compressed air or vacuum as needed. To one system is connected an automatically controlled, motor-driven pressure pump, capable of producing a pressure of 100 lbs. per sq. in. By mere shifting of the stops on the controller, any pressure between that of the atmosphere and 100 lbs. per sq. in., with a variation of about one unit, can be supplied at any time, to any room where needed.

To the other system of piping a vacuum pump is coupled, which can produce a pressure of one half millimeter of mercury. This pump is not automatically controlled but can be started at any time by the throwing of a switch. By this machine a vacuum of the value named may be obtained in three or four minutes in almost any part of the laboratory.

But the most distinctive experimental feature of the laboratory is its electrical equipment. This is, the writer believes, unique in magnitude, and in the flexibility of the means of distribution of currents under widely different voltages.

Energy is received by means of 2-phase alternating currents from the central power plant of the university. These currents are utilized for lighting or for power, or are transformed by motor-generator sets into direct currents for battery charging and for any other work requiring direct currents.

The storage battery equipment consists of four batteries of 60 cells each, two having a capacity of 320 ampere hours each, and the other two a capacity of 120 ampere hours each. One of the two larger batteries is connected permanently in series. It is the general working battery and carries the direct-current load of the building. The other of the larger batteries is broken up into 12-volt units, 6 cells in series. These 12-volt sets may be joined in series, or in parallel, or in any series-parallel grouping.

The individual cells of the two smaller batteries, called the research batteries, are connected separately to the switchboard. They may all be thrown into series, into parallel or into any series-parallel arrangement. This arrangement of batteries permits one to obtain, for example, 2 volts with a current capacity of 7,200 amperes, or 12 volts with a current capacity of 2,800 amperes, or 660 volts with a current of 60 amperes. Any other values of voltage and current between these limiting values, may be obtained.

All currents are distributed from the main switchboard. At least four conductors run from this board to each room separately, to insure to that room electrical service free from variation of voltage and free from interruption. While, of course, the very heavy currents mentioned above may not be transmitted by the general wiring of the system, any of the voltages indicated can be made available in any research room, lecture room or laboratory, with current up to 50 amperes.

Alternating currents in one- or two-phase and at a voltage of 110, 220, 1,100 or 2,200 volts can be supplied as desired, and by the interconnection of the phase changers of the department of electrical engineering, polyphase currents of different epochs and voltages can be thrown upon any line.

An automatic telephone system with sixteen instruments connects the various central points of the building. And an interconnecting signal system renders it possible to establish, by a few contacts on, at most, two panels, private lines between one room and any other four rooms in the laboratory. These circuits are suited for low voltages only, but have been of the greatest convenience in providing connections for the Callender recorder, for time signaling and for private signal systems.

The motor load amounts to somewhat more than 85 horse-power. This equipment is required for ventilation, elevators, pumps, compressors and the running of the machine shops.

The following equipment of a research room is typical of all. In addition to the general means for lighting, heating and ventilating, water, compressed air, vacuum, seven gas outlets, four wall plugs supplying 110 volts direct current and four supplying 110 volts alternating currents are installed. The special experimental circuits just mentioned above run from the main switchboard to each room, and the special signal circuits come into each room. Finally, a special lighting circuit is run in a wooden moulding on the ceiling, 18 inches from the side walls, to enable a lamp and cord to be dropped at any point over the wall tables for the illumination of galvanometers, telescopes and similar apparatus.

The working libraries of the two departments are installed in a large room on the main floor. The scientific library of

Professor C. F. Brackett, for thirty-five years head of the department of physics and originator of the graduate department of electrical engineering, has been presented to the departments and forms the nucleus for their libraries. These are supplemented by any desired work on engineering or physics from the general library of the university. Three book funds are available for purchase of books and of periodicals for the Palmer Laboratory Library.

A notable feature of the exterior of the building is found in the two statues in marble of Benjamin Franklin and Professor Joseph Henry, and a portrait relief of Professor Brackett. These were executed under the supervision of Mr. Daniel C. French. The statues show Franklin in familiar colonial garb and Professor Henry in academic robe. The statues and the relief are most successful.

Through the generosity of Messrs. David B. Jones and Thomas D. Jones, of Chicago, loyal graduates of the university, a fund of $200,000 has been provided for endowment. The income of this fund, according to the terms of the deed of gift, may not be used for salaries for teachers, for janitor's services, for repairs or up-keep of the building, or for heat, light, gas, water or power. It may be used for the payment of scientific helpers and research assistants, for the purchase of apparatus and supplies, for accessions to the libraries, and for the satisfaction of the general scientific needs of the two departments of the university for which the Palmer Laboratory was erected.

HOWARD MCCLENAHAN

PRACTICAL NOMENCLATURE

SHOULD general acquiescence in the decisions of the Nomenclatural Commission of the International Zoological Congress bring about that stability of names for which we have been striving, to what shall we have attained when that goal has been reached? What, in view of past results and present methods, will our system of names be like? Will it be the simple comprehensible binomial system that Linnæus devised? Alas, no. It will be a vast jungle of names, through which no one can see more than a few paces from his own door. No one can comprehend it; no one thinks of trying to master it; it baffles and hinders and masters us.

Synonymy is far from being the greatest of our nomenclatural troubles. Let any one who doubts this examine the Great Book of Names, which now surpasses the unabridged dictionary, without a definition in it. Let him remember that this Great Book is reserved for the names of genera only, other names not being included in it. Let him, in the group that he knows best, compare the lists of genera that have been described from decade to decade, noting the ever-accelerated rate of increase, and let him think what future editions of the Great Book will be like. Then let him note how few names in the group—in any group—are called into question, and he will realize how little the burden of terminology would be lightened were these few names all adjusted to his complete satisfaction. Synonymy is but the last straw that, added to the appalling load, threatens to break the camel's back.

To be sure, we have added this last straw right boldly. We have made rules, and by them we have all but firmly established and made permanent the following wholly unnecessary evils:

1. We have adopted the mistakes in name construction made by ignorant or careless systematists as a permanent part of our biological literature, which all of us must continue to repeat.

2. We have committed ourselves, likewise, to all sorts of egregious blunders, in cases where names were inappropriately, mistakenly or malevolently assigned.

3. We have accepted the elimination or al-