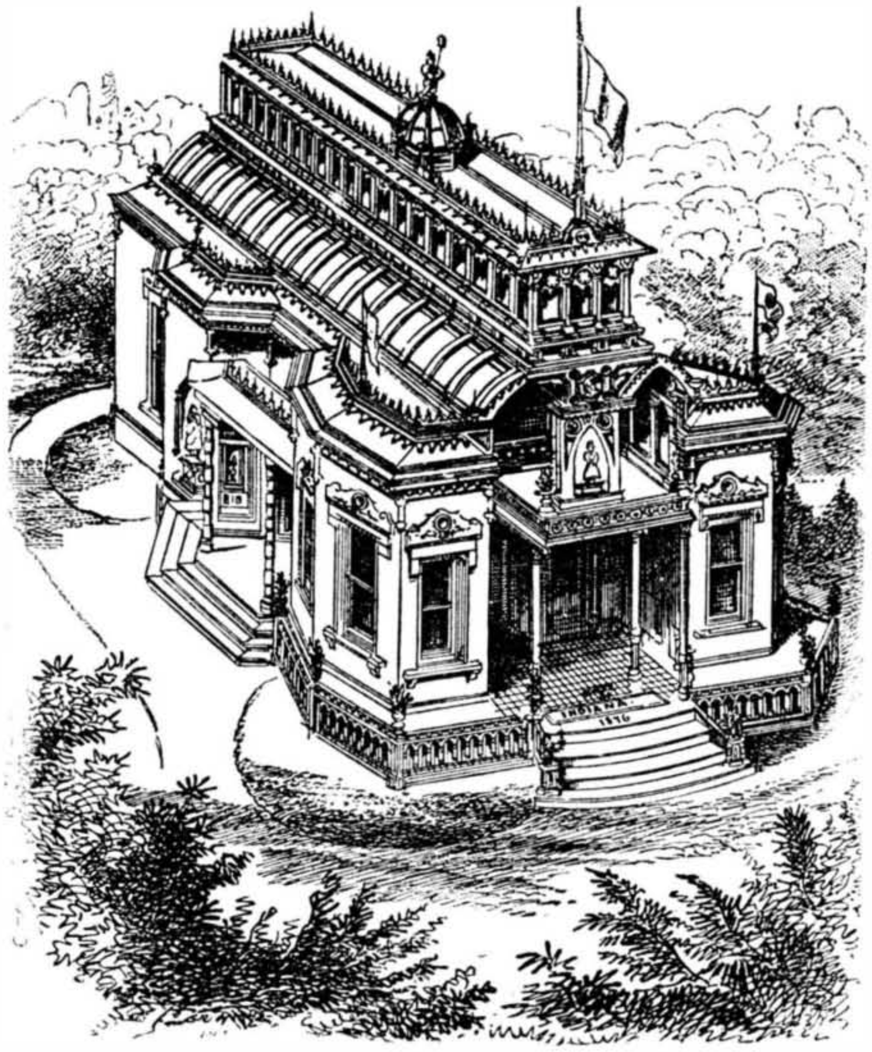
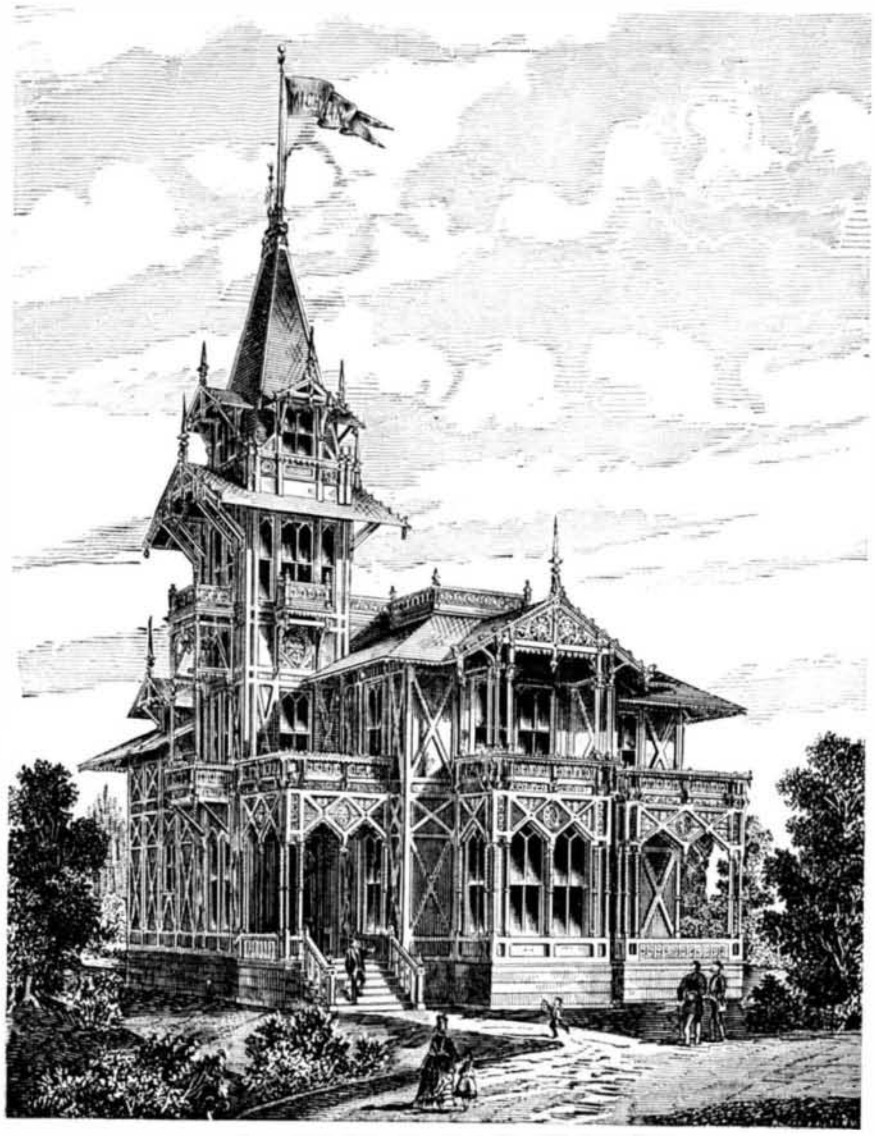


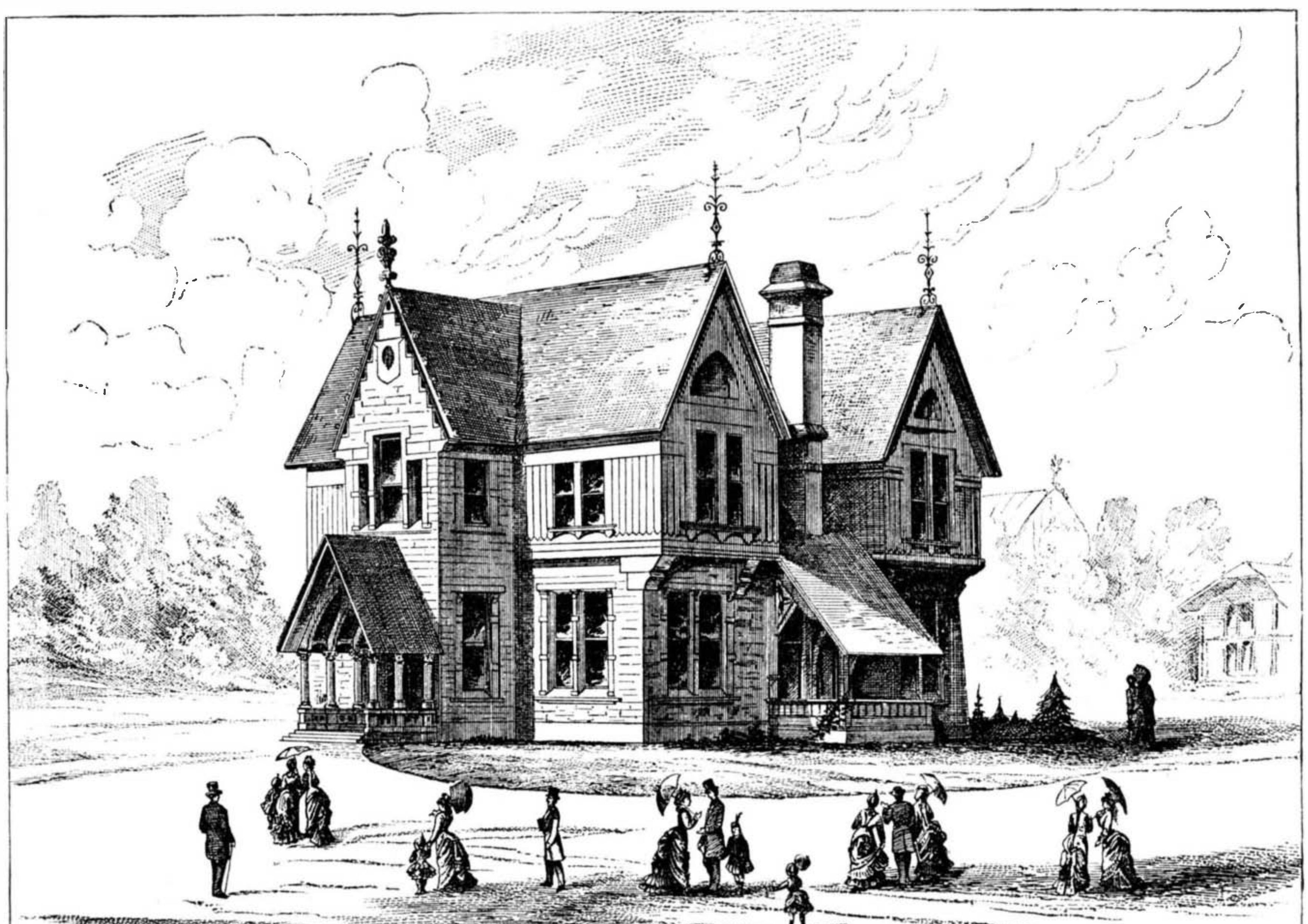
THE INDIANA STATE BUILDING.



THE MICHIGAN STATE BUILDING.

THE CENTENNIAL EXHIBITION.---THE STATE BUILDINGS.

As mentioned in the general description of the buildings, on the first page of this issue, many of the States have erected separate buildings for the convenience of their delegates and exhibitors. Some of these structures are highly ornamental, and they differ so widely in general design that altogether they contribute largely to the picturesque appearance of the grounds. The Indiana Building is intended by its architect to represent the characteristics of Indiana homes and productions. It is constructed of a combination of wood and other building materials, a frame of wood being the support of the building and roof, to which an outer wall of brick, stone, terra cotta, iron, and coal can be attached. There are three entrances by four broad steps to the front and side porches, and an open-roofed balcony extends from each side entrance to the front entrance. The assembly hall is designed to be a grand auditorium for miscellaneous gatherings. It is in the form of an irregular cross, 55 feet at its longest angle, and has about 1,400 feet of floor. From the level of the ceilings of the side rooms, it is spanned by a truss-arched roof at a hight of 24 feet above the center of the hall. It is lighted by the rotunda above, and an ornamental fountain plays in the center below. On the walls are 200 tablets, of which number 92 will be used by the counties of the State for the general statistics of each county, and the remainder will be given to individuals or firms. There will also be committee rooms, a ladies' parlor, invalids' room, post office, telegraph office, baggage room, and gentlemen's parlor; and the building will be a place where any citizen of the State can be at home, to entertain friends and



THE OHIO STATE BUILDING.

dispatch business. The whole will be surmounted by a handsome truss roof, from the top of whose arches a lighted open rotunda of glass and wood rises, crested with metallic ornaments and statues. The entire cost of the building will not exceed $10,000.

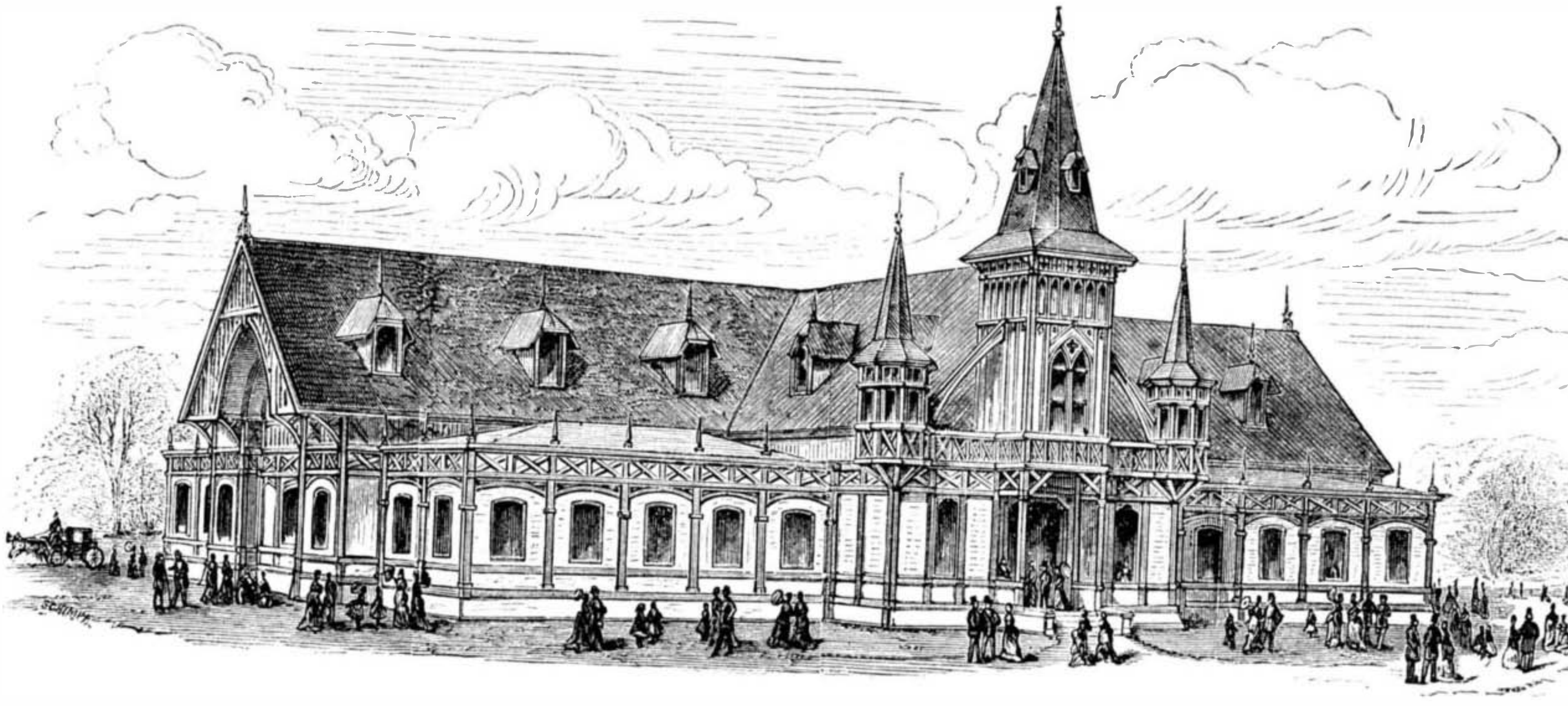
Our next engraving shows the Michigan Building, which stands about 1,000 feet north of and facing the Main Building. The narrow gage passenger railway which runs around the entire Centennial grounds passes in front of the Michigan building. The site is elevated, and commands a fine view of the surrounding grounds. The building is of the Swiss style of architecture. Its outline is very graceful, and the exterior is elaborate and ornamental. The ground plan shows an area of about 50 x 65 feet in size. The foundation is of stone, with exterior facing above ground of Lake Superior sandstone. This building is constructed entirely from Michigan material and of Michigan workmanship. It is designed to show the resources of the State in respect to building material. The brown stone foundation is from Marquette; the slate of the roof is from Huron Bay. The entire interior finish is of native woods, marble, and alabaster, and is highly polished. The floors are laid with hard wood of various kinds and colors, and in fancy patterns. The doors are of solid walnut, elaborately carved; the main staircase is a marvel of beauty and skill. The wainscoting n all the rooms is paneled in beautiful designs of various woods or other material. That in the reception room is of highly polished alabaster from the quarries at Grand Rapids; that in the Governor's office, as well as the mantel in the same room, is of marble. The furniture is of the very finest character, made of Michigan material and of Michigan workmanship, and contributed by manufacturers in different parts of the State. The walls will be ornamented with pictures by Michigan artists The large painting by Robert Hopkin, entitled "Off Sleeping Bear Point, Lake Michigan," will occupy a prominent position in one of the rooms.

Our next illustration shows the Ohio State Building, which is an admirable specimen of villa architecture. In addition to the usual purposes for which these buildings have been erected, the Ohio Building is to contain a very interesting archæological display. No State in the Union is more fertile of relics of bygone ages and races; and the Archæological Association of the State has done much to preserve these evidences and to foster a taste for this interesting study. The exhibits will comprise all articles fabricated by the Mound Builders or Indians, whether in stone, flint, bone, shell, or copper, such as hammers, mauls, axes, wedges, tubes, perforated balls, rollers, beads, ornaments, arrow points, spear heads, pestles, and every ancient thing that is clearly artificial. The proper arrangement and care of this Department has been entrusted to Professor M. C. Read, of Hudson, Ohio.

Our next subject is the building erected by the wealthy State of Pennsylvania. It is located on Belmont Avenue, near the United States Government Building. The State appropriated $15,000 for its erection, and it is to be the headquarters of the Pennsylvania State Commission. It is a Gothic building, built of wood, and is 98 x 55 feet. It is surrounded by a tasteful piazza, six feet wide, and is ornamented with a central tower, flanked on each side by two smaller octagonal towers. The hight to the eaves is 22 feet, to the peak of the roof 39 feet, and to the top of the central tower 65 feet. The main hall is 30 x 50 feet, on the right of which are two rooms 20 x 20 feet each, intended for ladies' and gentlemen's parlors, beautifully fitted up, and having dressing rooms and other conveniences attached. On the left are two committee rooms, 20 x 27 feet.

Our last illustration in this series shows the Women's Pavilion, erected by the exertions and under the supervision of the Women's Centennial Committee; and it is intended to be a place for the exhibition of all articles made or invented by women, and is expected to be, in fact, an epitome of the whole Exposition. It is located on Belmont Avenue, near the horticultural grounds; it covers an area of 30,000 square feet, and is formed by two naves intersecting each other, each 64 feet wide by 192 feet long. At the end of these there is a porch, 8 x 32 feet. The corners, formed by the two naves, are filled out by four pavilions, each 48 feet square. The whole structure is in modern wood architecture, roofed over by segmental trusses. The centre of the edifice is raised 25 feet higher than the rest of the building, and is surmounted by an observatory, with a cupola on the top of the same, making the entire hight of the building 90 feet. The interior of the building presents a very attractive appearance, but four columns obstructing the view, the main support of the roof being furnished by trusses resting on the outside walls. The panels are beautifully decorated with allegorical groups representing Faith, Hope, Charity, Art, Labor, Instruction, Religion, and the Family, from designs by Camille Pitou, an artist who has done much towards the embellishment of the buildings on the Centennial grounds.

For illustrations and descriptions of some of the buildings erected for the separate industries, see pages 326 and 327 of this issue.



THE PENNSYLVANIA STATE BUILDING.

The Solvay Soda Process.

The ammonia-soda process of Solvay has been so greatly improved that the German soda ash manufacturers fear they will no longer be able to compete with him. Solvay is now on the point of erecting a factory, says a German contemporary, large enough to supply the demand of all the consumers on the Rhine.

1776. WOMEN'S PAVILION. 1876.

A Microscopical Exhibition.

Mr. D. S. Holman, the Actuary of the Franklin Institute, recently gave a very interesting microscopical exhibition in Philadelphia. The method he adopted of giving ever person in the audience a good view of the image was a novel one. An assistant carried a white screen some 18 inches square to different parts of the room, and all in its immediate vicinity had thus an opportunity to examine the details of the object. Mr. Holman has invented a number of very ingenious appliances for exhibitions of this kind. Perhaps the most noteworthy is a slide by which a small animal, like a salamander, may be kept alive in water, and quiet enough to show the circulation of its blood. The fish is laid in the groove of the glass slide, through which a current of water is kept flowing. A thin portion of the body is selected for examination, which, by the powerful light, is made transparent, and this portion is firmly held by the pressure of the very thin sheet of glass above the fish. A lens magnifying about 800 diameters is used, and a small artery invisible to the naked eye is made to appear on the screen as large as the finger; and the blood, which has been resolved into its component globules, or, as they are called, corpuscles, is seen coursing along, each heart beat accelerating its motion. It may be remarked that the frequency of these beats corresponds almost exactly with those of the human subject. These corpuscles vary in shape with the species of animal, and it is upon this fact that the expert testimony introduced latterly in murder trials is based.

In the salamader it is shaped much like a boy's torpedo or a pegtop. There are two varieties in all blood, the red and white, of which the former are much the more numerous; the red appears to be inert, but the white has apparently an individual motion, and may be said to be endowed with a certain kind of intelligence. These corpuscles are suspended in a transparent fluid which, of course, the microscope does not analyze.

At a private exhibition at the Institute, Mr. Holman, by a lens of his table microscope magnifying 1,200 diameters, showed the circulation of the sap in the leaves of plants. What does 1,200 diameters mean? Simply that the surface appears 1,440,000 times as large as it really is. To furnish a basis for comparison, he pricked a hole in a piece of paper with a fine cambric needle point, and found, when put in the field of the microscope, that the hole was nearly four times as large as the field. A small portion of a leaf of the *anarcharsis alsinastrum*, a water plant, was then shown under the lens, and the cellular structure of the leaf was seen. The cells appear like bricks laid in a wall, about forty appearing in the field, each overlapping its neighbor, and of about the same proportions as a brick.

Within each cell were little globules, which kept up a ceaseless movement round about the edges of their prison, like little mice chasing each other around a room. In all the cells the movement was in the same direction and at the same speed. That infinitesimal point could be studied with interest and profit for hours.

That motion is an attribute of all matter is very nicely shown by Mr. Holman in a slide which illustrates what microscopists term the dance of the atoms. Gamboge is pulverized and thrown into water, which is slightly colored by it. With a lens magnifying 2,000 diameters, the particles are seen in a rapid, cycloidic motion, which never ceases and is perfectly uniform, resembling very much a swarm of midges in the warm days of October.

Progress of Torpedo Improvements.

An experimental trial of a new torpedo boat, embodying the most recent improvements of the Lay system, was recently tried near the Navy Yard, Washington, D. C. The boat, of cigar shape, 16 feet long, 19 inches in diameter, is made of iron. It is propelled by liquid carbonic acid, carried in a reservoir within the shell, the liquid being allowed to expand into gas, which operates an engine and propeller. The boat is steered and the speed and direction of the engine governed by electricity, the circuit being opened and closed by means of a cable, which is wound or unwound, as desired, from a reel carried in the boat: the boat's direction and motions being governed by electric keys, located at the station or on the vessel whence the torpedo boat is sent out. The boat carries an explosive magazine which is discharged by electricity.

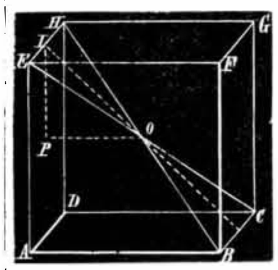
Mr. Lay's invention is calculated to revolutionize the entire system of naval warfare, particularly that branch pertaining to harbor defences and protection of fortifications, as well as open combat between floating navies. So fast as shipbuilders have been able to construct the thickest metallic defences for naval vessels, so fast have manufacturers of guns been able to invent projectiles that will pierce them. The submerged torpedo is impregnable to attack. With its explosion it carries far wider destruction than the most terrific storm of shot and shell, and the loss of life inevitable upon a close naval conflict is entirely avoided. The advantages of the movable torpedo over fixed mines and the spar torpedo are so apparent that it is not necessary to enumerate them. The torpedo boat is calculated to be used in a most efficient manner for offensive warfare. It can be used as a towing boat to effect an entrance to the harbor of an enemy or approach his fortifications, even if they are protected with fixed mines or torpedoes in the channel. To the Lay torpedo boat may be attached a line of floating explosive mines, connected with the operator's station, as is the torpedo itself, by electric cable. The torpedo boat may be despatched with these floating mines in tow to open the channel. The mines can be detached from the boat at any given point and sunk in position by an arrangement peculiar to their construction, still retaining their electric cable connection with the operator's station. They may be fixed at will. Mr. Lay has invented a submarine torpedo battery for harbor and coast defence. It is similar to the ship floating torpedo.

Correspondence.

The Largest Cube in a Ball.

To the Editor of the Scientific American:

There is an error in the reply of L. S. W. to J. C. W., No. 58, page 267, in regard to the largest cube which can be cut out from a ball; this error has been pointed out by others of your correspondents. L. S. W.'s assertion is strangely wide of the mark, as the great circle of a sphere passes always through its center, and the square inscribed in the same must therefore also pass through the center; but the sides of the cube are of course beyond the center, and are squares inscribed in circles situated at a distance from the center, and consequently much smaller. The annexed figure makes this clear: the globe which may be circumscribed on the cube is here represented, and its surface passes through the eight angles; and it has none of the surfaces for its large circle, but the larger circle will have for its diameter the diagonal, E C, passing from one angle to the diagonally opposite one, through the center, O, of the sphere and cube. This diagonal is considerably longer than the diagonal of one of the sides of the cube.



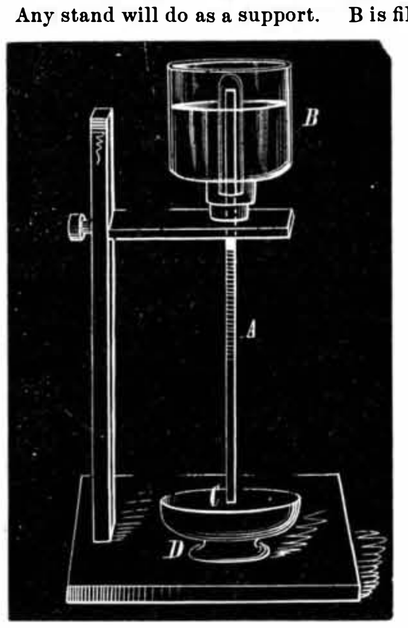
To find the relation between the globe and inscribed cube, we draw the perpendiculars, P O and I P, and the line, O T. Then we have P O = P I, and E I = ½ E H = half the side of the cube, which we will call s. Further: $IO^2 = OP^2 + PI^2 = s^2 + s^2 = 2s^2$. Further: $HO^2 = IO^2 + sH^2 = 2s^2 + s^2 = 3s^2$; but H O is the radius of the ball, and so, if we call this r, we have $r^2 = 3s^2$, and $s^2 = \frac{1}{3} r^2$, or $s = r\sqrt{\frac{1}{3}}$. If we call the whole side of the square x, and the diameter d, we have, for the same reason, $x = d\sqrt{\frac{1}{3}}$; so that, if the diameter is 12 inches, we have $x = 12\sqrt{\frac{1}{3}} = 6{\cdot}94$ inches, and the volume of the cube $576\sqrt{\frac{1}{3}} = 332{\cdot}95$, considerably less than that found by L. S. W. in applying his erroneous proposition.

New York city. P. H. VANDER WEYDE.

Liquids under Atmospheric Pressure.

To the Editor of the Scientific American:

The accompanying engraving shows a very simple and cheaply constructed apparatus for illustrating the flow of liquids under atmospheric pressure, which might be called an interrupted siphon. It consists of a long glass tube, A, passing through a cork fitted in the neck of an open-mouthed bell glass, or a bottle with the bottom cut off, B, and a large test tube. Any stand will do as a support. B is filled with



water to the upper opening of A. The opening, C, is closed with the index finger of the left hand, and the test tube, previously let down over the tube, A, is gently raised. The elasticity of the air confined in A is diminished, and the normal pressure upon the surface of the water, in B, forces the water up in the test tube and into A. So soon as the column of water in A is greater than the depth of water in B, the finger may be removed from C, and the vessel, B, is emptied. Of course, if C is already under the surface of the water previously placed in D, it is not necessary to apply the finger to C. By holding the test tube quite high, a small quantity of air may be kept in the top of the test tube, and thus the difference of atmospheric pressure is very prettily shown.

Baltimore City College, Md. C.

Corn Sugar.

The Davenport (Iowa) *Gazette* claims for that city the first manufactory of pure glucose in this country. The demand for the article by confectioners alone, in the United States, is immense. The sources of supply heretofore have been France and Germany, where glucose is made from potatoes. Here it is the product of corn wholly. It is as pleasing to the taste as honey. The production of grape sugar and glucose opens a new department for Iowa corn. The capacity of the works at Davenport is 500 bushels per day. This branch of manufacture bids fair to become of immense importance to the State and country

Preserving Wet Plates.

At a recent meeting of the Belgian Photographic Society, a paper was read by M. Watrigant, who was of opinion that none of the dry plate processes in vogue at the present day were capable of giving pictures equal to those from wet plates. M. Watrigant proposed a method for maintaining the moist film in a wet condition for many hours, so that it would be possible, for tourists and others occupied in photography, to employ wet plates without having the trouble of carrying about with them a lot of solutions necessary under ordinary circumstances.

M. Watrigant's plan is to take the plate as it comes from the dipping bath, and to put round its margin an india rubber ring, in such a way that the rubber laps over on each side. Upon this sensitized plate he now places a second one, similarly prepared, the two collodion films towards each other. The two are tightly fastened together in any way that might suggest itself, by string or some other means, and then one is in possession of a couple of prepared films sealed hermetically. No injury can arise from the two plates pressing against one another, as the rubber ring forms a suitable buffer. M. Watrigant says that plates may be kept in a moist condition in this state for a period of forty-eight hours.

If it is considered undesirable to have a dark tent in which to separate the films before exposure, then M. Watrigant suggests that only the sensitive film should be sealed in like manner against an ordinary glass plate, and then an exposure may be made in the camera without inconvenience, due regard being paid to the thickness of the plates in the dark slide. The result in this case is not, however, so good as that secured when two prepared films are fastened together.

The landscape photographer, by adopting the Watrigant method, may spare himself the trouble of carrying collodion, silver bath, developer, and other solutions, and this is the object which the author desired to obtain.

Zuccato's Papyrograph.

This is a useful invention for the speedy reproduction of circulars, price lists, diagrams, maps, examination papers, music, etc., upon any description of dry and unprepared paper. The writing or drawing to be multiplied must be executed with a steel pen, by means of special ink, upon a sheet of prepared waterproof paper. The ink passes through the fibers of the paper without injuring them, and attacks or corrodes the waterproofing beneath. The corroded parts are then removed by placing the waterproof paper upon a piece of thoroughly wet calico. The moisture from this dissolves the corroded lines, ascends through them to the surface of the paper, and, loosening the ink, enables it to be entirely removed by blotting paper. The result is a porous paper stencil, held together by its fibers, which presents in facsimile the delineations that have been made upon it with the ink. The stencil is then lightly painted upon the written side with papyrographic color. It is next placed upon a pad of velvet, painted side downwards, and, upon being pressed, color is forced through the lines of the matrix and brought in contact with the paper employed for printing, upon which is formed a perfect facsimile of the writing. A like result is attained, without repeating any of the before mentioned operations, as often as a new sheet of paper is laid upon the stencil and submitted to light pressure by means of a copying press. A proof impression can be taken in a few minutes, and afterwards quickly multiplied. It is said that 500 copies can be produced from one sheet of the specially prepared paper at an infinitesimal cost.

Photo Plates under the Microscope.

M. Jules Girard, who has published several valuable works upon the application of photography to the microscope, has just communicated to the Academy of Sciences the results of his interesting researches upon the transformation of collodion in photographic operations. A microscopic examination of collodion permits one to discover the texture of the film, and to follow the reactions which take place in the production of the luminous impression. When of good quality, the collodion plate is translucid and colorless in the event in the collodion being perfectly dissolved; but its composition, age, and the actions which constitute sensitizing change its texture. The photo-micrographs which M. Girard presents to the Academy, representing enlargements to 50 diameters, demonstrated several phenomena. Old collodion which gives very fine images, but the rapidity of which leaves much to be desired, is shown to contain liquid bubbles holding unchanged ether. If the collodion contains alcohol, it has the appearance of a cellular tissue; and if there is much water in the collodion, the fibers of cotton become apparent in the form of flocculent matter. Collodion which is too thick gives intensity, but is not rapid; it has the appearance of an undulated cellulo-vascular tissue. The irregularity of the film militates against the clearness of the image. Two indications or proofs are at hand of the time during which the action of sensitizing in the nitrate of silver bath is still incomplete, and of the moment when the operation has terminated. In the first case, the greasy marks, which are an indication of the sensitizing being still incomplete, are full of streaks and groups of crystals, some in the form of needles and some amorphous. It seems as if the crystals of iodide of silver, which were in course of formation, have been arrested in the midst of their development.

In the second case, when the operation of sensitizing is complete, the texture of the film is homogeneous and compact. It is covered with a uniform network, rendered the more evident by those portions which are free from crystals