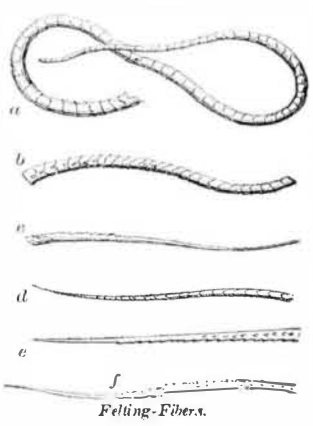
In Fig. 4 are represented several

FELTING FIBERS

as seen under the microscope. *a* is a fiber of Saxony wool, somewhat less than $\frac{1}{1000}$ of an inch in diameter. *f* is rabbit hair, and *b* beaver down, which has a diameter of about $\frac{1}{2000}$ of an inch. *c*, *d*, and *e* are muskrat, nutria, and hare fur. They all show the jagged edges which confer upon them the characteristic felting quality.

Fig. 4.



Felting-Fibers.

M. Du Chaillu, the well known African explorer, describes a

PRIMITIVE EASY CHAIR,

devised by Obindji, a chieftain of a tribe living in the Gaboon country. This dusky potentate is represented, enjoying a *siesta* in the offspring of his inventive genius, in Fig. 5. The chair is nothing more than a slab of wood which rests on an inclined four-legged frame, and is held from sliding by blocks at its lower end.

Fig 5.

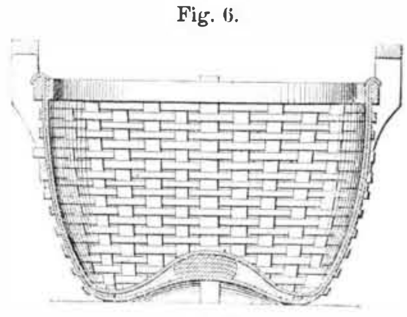
Obindji in his Easy-Chair; Gaboon, Africa, A. D. 1872.

Figs. 6 and 7 relate to

BASKET MAKING.

For the finer kinds of baskets, osier is the material most commonly used, but for a coarser article strips of split hickory, oak, or black ash, are frequently employed (Fig. 6.)

Fig. 6.



Splint Basket.

Osiers are prepared by soaking in water, after which they are split, cleaned, and bleached in the sun. A number of rows are laid crosswise to begin the bottom of the basket, and are woven together by a spiral weft of wands, which pass alternately over and under the radial wands, to which others are added as the size increases. The wands are bent up to form the sides, and other rods are woven in and out between them, until the basket is made of the required hight. The edge or brim is finished by turning down the projecting ends of the ribs, whereby the whole is firmly and compactly united. Handles are formed by forcing two or three osiers, sharpened at the ends and cut to the proper length, down the weaving of the sides and close together. They are pinned fast near the edge and afterwards bound or plaited.

Fig. 7.

Basket Making.

Hydrophobia and Intemperance.

Mr. L. N. Noyes, of Boston, Mass., sends us the following, from the Brooklyn *Argus*:

"Hydrophobia, in the dog, I am satisfied, is the result of the animal having been inoculated by biting some person suffering from the disease of intoxication. Startling as this theory may appear, there is not the least question but that the facts will bear it out. First, hydrophobia and *mania a potu* are identical in most physical conditions—subjects dead of either disease presenting nearly the same autopsy. Second, the saliva of a man dying of delirium tremens, and that of a dog suffering from rabies, bear the same chemical analysis. Third, the entire system of the patient suffering from alcoholic madness is so poisoned that rapid inoculation will follow any contact with the virus of the blood. Fourth, the bite of a man in an alcoholic fit has been known to result in hydrophobia. As to the application of these facts: First, with the canine race, hydrophobia is never spontaneous; with man, the disease is known to be. Second, there is not a case on record of a dog having died of hydrophobia that will not admit of proof—if the facts can be ascertained—that the dog had previously bitten an intoxicated person, or had been attacked by some other animal suffering from a like inoculation.

GEORGE WILL. JOHNSTON, Superintendent
Brooklyn Society for Prevention of Cruelty to Animals."

We think the statements here made are without foundation: In regard to the first assertion, that hydrophobia and *mania a potu* are identical, by which we presume the writer means that similar symptoms are developed in both, we would refer him to the works of the best authorities, in which he will find that they differ in the most important respects. That the autopsy in both cases is similar is quite natural, since there are no well marked anatomical lesions in either; nor are there in hydrocyanic acid poisoning, *tetanus*, etc. Secondly, as to the saliva of a man dying of *delirium tremens*, etc.: we do not fully understand what the writer means. If it is that the same abnormal principles are found in the saliva of both cases, such as would produce hydrophobia if introduced into the healthy circulation, we can only reply that this could only be proved by a number of experiments, which have not, as far as we are aware, ever been made. We almost daily hear of cases where a nose, an ear, a cheek, or a finger is bitten off in a drunken broil, without hydrophobia resulting. Thirdly, there is no virus of the blood in alcoholism. According to Flint, Sr., Minuyer, Watson, Reynolds, Dunglison, and many others, the etiology of hydrophobia is not known; while it never appears in the human subject without inoculation in the correct sense of the word, and not as Mr. Johnston uses it. The last deduction is too absurd to demand attention.

Correspondence.

The Centennial Trial of Steam Fire Engines.

To the Editor of the Scientific American

Will you please correct an error in your otherwise admirable account of the trial of steam fire engines at the Centennial?

The judges were assisted by Mr. Wellington Lee, as expert, not by a Mr. Wellington as you printed it. Mr. Lee is well known as a member of the firm of Lee & Larned, who, after Latta of Cincinnati, were the pioneers in steam fire engines, and first made them an established success. He is on all accounts the most competent man living to fill the exceedingly difficult position of expert assistant to the judges.

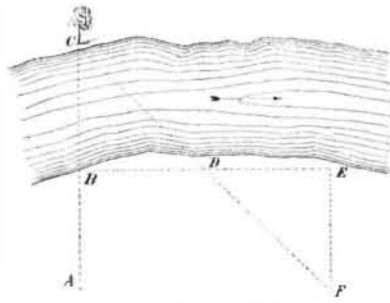
Newark, N. J. CHARLES T. PORTER.

To Measure the Width of a River.

To the Editor of the Scientific American:

Let A B represent the line of survey (the course being at any point of the compass), striking the river bank at B. Mark a tree or bush on the opposite bank, in line with A B. Then lay off 25, 40, 50, or any number of feet from B to D, at right angles with the line A B; from D to E lay off the same distance as from B to D; then from E, walk, at right angles to B E and parallel to line A B, until you reach point F, which is in line with points C and D. Then measure from E to F, which will be the same distance as from B to C, or the width of the stream. A. S. LEHMAN.

Fort Cameron, Utah Ter.



[For the Scientific American.]

A LESSON FROM THE MACHINE TOOLS AT THE CENTENNIAL.

It is somewhat remarkable that, while the exhibits in Machinery Hall show the advancement in special manufactures and processes, yet, in the tools and appliances for producing the machinery, but little progress seems to have been made during the last thirty years. If we examine the loom, the printing press, and the woodworking machinery, our advance is marked by complete and successful applications of new and original principles. But if we turn to the lathe and the planing, drilling and slotting machines, in fact to any of the tools used in the construction of machines, we shall find that we have reach a platform where we may "rest and be thankful," but beyond which we have apparently but a small prospect of further progress. If we examine the lathe, and ask ourselves in what broad particular we have improved upon the old Smith, Beacock, and Tannett lathe of thirty or forty years ago, we shall not readily find an answer. We have the same bed, the same cone mandril, the same gear, screw-cutting, and independent feeds, the same cross feed, the same compound rest, the same tail stock, in fact, the same design and general arrangement all through; and with the exception of the introduction of the universal chuck, our chucking devices are identical. If we turn to the lathe cutting tools, we shall find that our practice has been stationary. In planing machines, we have adhered to a like general arrangement of parts; and the departures from old practice are not worth mention. The slight modifications consist in arrangements for a quick return motion by means of an extra pulley and belt instead of differential gearing, and in the application of an independent rest attached to the uprights for planing vertical faces. In planing machine cutting tools, we have made no innovation; and the only departure from the old time practice has been in the modern plan of taking a finishing cut on cast iron with a broad, flat-nosed tool with a very coarse lateral tool feed. In shaping machines, we have made some departures in the entire design, giving to one machine capacity for a much wider range of work. The sliding head has been made movable upon the bed, and various attachments for the table have been introduced. But the machines built by Maclear and March, a generation since, had a quick return motion, cone mandrils for circular work, and a vise chuck (as good as any we remember to have seen, except that lately introduced by Thomas & Co., of this city); whereas we do not know of a modern shaping machine equal in capacity to the Nasmyth "puff and dart" machine of thirty years ago. That machine, which is still extensively used in England upon the edges of armor plates, had a stroke of five inches and made 160 cutting strokes per minute. Referring again to the various attachments for the table, but very few of them are used for general work. In cutting tools for shaping machines, we have no modern innovations whatever. In drilling machines, our progress has been confined to the introduction of multiple machines, adapted to special work, and in various forms of radial drilling machines, constituting a more marked improvement than in the machines above mentioned; but in the drilling machine pure and simple we have made no substantial progress, except it be in the introduction of the twist drill, which is decidedly a step forward in drilling fine work. The Maclear and March drilling machines above mentioned were as substantial in their framing, and were provided with self-acting change feed as well as hand feed; for light work a treadle feed was employed, leaving both hands free to manipulate the work. In screwing machines, we may justly lay claim to advancement in the introduction of solid dies, and in the use now common of segmental dies fitted to adjustable chucks; so that, while the dies cut the whole thread at one cut, they thus avoid the strain on the sides of the thread, which is inherent in those dies which are adjustable and require to take more than one cut to make a full thread. Another modern improvement is in the dies, which are made to throw open when the thread to be cut is finished, so that the dies do not require to travel back over the thread, a movement which abrades the cutting edges of the die teeth, and also entails a loss of time. We have also added pumps for supplying a more copious stream of oil to the dies; so that, taken altogether, we have made satisfactory progress, notwithstanding that the tap has maintained its original form, except it be in our having adopted a standard angle and pitch.

Our greatest degree of progress has been in the milling machine, which has been given a very wide range of useful application during the last thirty years. But milling machines and milling cutters, of the same shape as those at present used, and with self-acting feeds, were employed years ago; but their field of employment was then comparatively limited. In the slotting machine, we know of no substantial improvement made during the last twenty-five years, and but little indeed in a much longer period. The slotter introduced by Sharp, Stewart, and Co., of Manchester, England, about the year 1855, had a box frame, and as complete an arrangement of change speeds and table movements as any exhibited at the Centennial. In boring machines, we have made considerable improvement, especially in the introduction of those of the horizontal type.

In none of these machines, however, have we succeeded in attaining higher rates of cutting speed and feed than were formerly used. It is only when we turn to special machines that the march of modern progress becomes visible. The Monitor lathe, for example, will produce infinitely more small work than was formerly attainable by any machine worked by one operative. It is, however, scarcely just to term it a lathe, since it is more properly a special machine having definite limits of useful application. The introduction of solid emery wheels is another modern improvement, greatly facilitating our operations upon hard metals requiring to be very true, but in no way advancing us in the practice of polishing, for which purpose the wooden wheel, covered with leather and coated with emery, still holds its own. So likewise for many purposes the quick running grindstone has not been displaced by the emery wheel. In polishing processes our progress has been but little, the greatest innovation being in the employment of rag wheels.

In many of our special machines, we have merely enabled the ordinary mechanic to produce as much and as good work as the most expert workman did formerly: and we have lowered the standard of capability of our mechanics in a proportionate degree. This, however, is not in the main to be regretted, since, having the improved machines, we do not as a rule require the expert workmen. The only attendant evil lies in that, though we have greatly enhanced our ability to produce new machines, we have in a partial degree produced a less skillful class of workmen to repair them. It is true that worn out parts may be duplicated, but that is not sufficient, for the reason that the new part is of the original size, whereas the repaired part requires in a majority of cases to be made sufficiently larger to compensate for the wear in the part to which it is attached. Thus, if a hole is worn larger and the bolt smaller, a new bolt of the original size will not fit the enlarged hole. There are, furthermore, many classes of work which a skillful workman can fit together more quickly or economically with the hammer, chisel, and file than can be done by the aid of machine work; but to be sufficiently expert to do this, the mechanic requires to be vastly more skillful than our modern practice enables him to become.

The United States has undoubtedly taken the lead in the application of special machinery for special purposes, and hence possesses the largest proportion of special workmen, that is to say, men having more knowledge as to how a piece of work should be done than they have manual or manipulative skill to do it; and it is mainly from this class of men that our inventors are drawn. The workman who does not find it difficult to handle and manipulate his work becomes satisfied with and wedded to the process or means by which it is made or manufactured; while he who finds the existing means of production difficult and tedious begins at once to think out some better means of producing the same result. And though the difficulties to be overcome may preclude his entire success, he generally attains it in some degree; while others, taking up that part in which his object was attained and profiting by his failures, search in a new direction to overcome the obstacles which proved to him almost insuperable. It is from thesecauses that our triumphs in mechanics have been almost invariably practical. It is a common ideathat it is the cost of labor to which we owe the greater part of our inventive progress; but there can be no doubt but that, to the causes here pointed out, we are much more large indebted.

Had it been the undue cost of labor, we should have undoubtedly expected to look to theoretical men and capitalists for the innovations; whereas our inventions have been the productions of practical men, with only a partial manipulative and mechanical education: of those men, in fact, who, experiencing the practical difficulties, set about to avoid them by machine manipulation, leaving it to the theorists to follow, and so cover the principles governing the action of the machine. With the diagrams, formulas, and laws that they produce, the inventor is very frequently lost in astonishment at beholding the cloud of theoretical considerations enveloping his successful productions, and innocently, though naturally, wonders how he came to devise so simple a machine involving such learned considerations, of which he had not the slightest knowledge. The American mechanic, in fact, not satisfied with the capacity of the ordinary machine tool, and not having had sufficient experience to wed him to a precise method of operation, sets about to first make those tools as perfect as possible, and next to supplant them, whenever practicable, by taking the processes in detail and designing new tools, bringing the appliances for planing, turning, grinding, polishing, and screw cutting together in one machine, if necessary; and steadily pursuing his end, adopting new ideas wherever he could find them, profiting by others' failures, and substituting for them his own ideas, which might be successful or otherwise, the latter case merely showing the necessity for further experiment. Thus every failure becomes a success, inasmuch as it is a sign post to a road that was not to be taken, besides being a notice to search in other directions. How far we have profited by this practical process will be shown on a future occasion. J. R.

PRACTICAL MECHANISM.

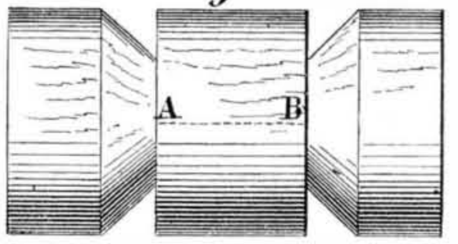
BY JOSHUA ROSE.

SECOND SERIES—Number XIII.

To resume, then, having sawn out our piece of wood for the flange, we plane up one side, and set a pair of compasses to the radius of the required flange, and mark a circle upon the piece of wood, and then saw off the corners nearly to the circle. We then true up a facing chuck in the lathe, and fix the flange to it by screws passing through the chuck from the back, placing them far enough from the center to avoid their coming into contact with the hole which we shall require to bore in the flange. We then dress off the face of the flange to nearly the required thickness, using the gouge to rough it out with, and the scraping chisel to finish. It is not necessary to finish right down to the center, but merely down to a diameter somewhat smaller than the hole in the flange will be. Our next procedure is to mark the size of the hole, which is done by setting the compasses to the required diameter, and then holding them with one leg resting upon the hand rest; and by bringing the point into contact with the face of the work, we may describe upon the latter a true circle, somewhat smaller in diameter than that required. This circle will serve as a guide to us while we hold both compass points against the work to describe a circle of the correct diameter, which will be done by keeping the compass points at equal distances, one on each side of the circle first described. We must, in the last operation, hold the compass points lightly against the work until we can see that the line described by one point falls in the same line as that described by the other, and then we may make a deep mark. This method is quite as easy an operation as setting the compasses to the radius of the hole, and, putting one leg in the center of the work, describing a circle with the other; and this process is also more exact when the wood is rough. We next take a chisel of about $\frac{1}{8}$ inch wide, and cut out the hole at one cut by forcing the chisel lightly through the thickness of the flange, taking care to cut the hole nearly $\frac{1}{32}$ inch too small, so as to allow of finishing with the diamond point or side tool. The hole being finished, we may turn the outside diameter of the flange with a very sharp gouge, leaving about $\frac{1}{32}$ inch for finishing, which may be done with the scraper. When the scraping chisel, as indeed all scraping tools, is in proper order, a slight burr can be felt on the top face of the tool, which is caused by oilstoning the beveled face of the chisel last.

To form the body of the pattern, we take a piece of timber of sufficient size to make the hub and core prints in one piece; and with an ax, we hack off the corners so as to save lathe work. We then place it in the lathe between the centers, using the fork shown in Fig. 48 as the running center and to drive the piece of wood, and screwing up the back center sufficiently firmly to hold the wood tightly. The large diameter is turned to its size with the gouge and scraper, using the latter to finish with, and bearing in mind that the wood is apt to become loose between the lathe centers by reason of the latter becoming imbedded in the wood; and it is necessary therefore, during the earlier portion of the turning, to try the back center and screw it up into the work, if necessary. Then, with the skew chisel, we cut two recesses, as shown in Fig. 96, the distance from A to B being the length of the body or hub of the pattern, and the small diameter of the recess being a little above the required diameter of the core prints. We next turn down the core prints to the required sizes, and turn the part shown at C, in Fig. 97, to fit the hole tight to the flange; and it will be perceived that, by leaving a longer end outside of the recess or nick at one end than at the other, we have left room for the flange, and so kept the core prints of equal length at each end, as shown in Fig. 97. The part that protrudes through the flange will in this case be for the top print, and it is therefore given an excess of taper, for reasons before explained. The hub or body of the pattern is also made taper, being a little the smallest at the end farthest from the flange (A, in Figs. 87 and 96), because this hub, being cast endwise, requires draft to permit it to be extracted easily from the mould.

Fig. 96.



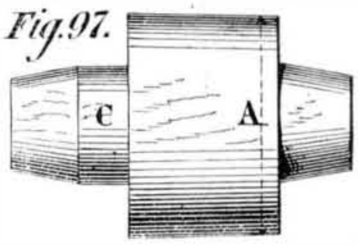


Fig. 97.

Having brought our pattern, as nearly as possible, to the requisite size and form with the cutting tools, it is necessary to consider those final processes which so much add to the appearance and smoothness of pattern work. The first of these processes is termed sand-papering or glass-papering. Sand paper is a sort of Will o'-the-wisp to the beginner, luring him on to scamp his work, under the impression that sand paper will hide the defects and bring it all right, while the fact is nearer the reverse; for let a pattern be never so truly shaped and turned, if the sand-papering be be injudiciously performed, the sharpness of its outline will be destroyed, and very likely its size and shape be seriously interfered with. It is true that it is scarcely possible to do much damage to large surfaces; but that is merely because of the great disproportion that would exist between an error engendered by sand-papering and the whole size of the pattern itself. If we have an inch cube to sand-paper, and should take $\frac{1}{64}$ inch more off one side than off another, our error would amount to the $\frac{1}{64}$ of the whole size of the pattern; but had the same thing been done upon a 12 inch cube, the error arising therefrom would only amount to the $\frac{1}{768}$ of the whole size of the pattern. Again, to remove $\frac{1}{64}$ inch from one side of each of these respective cubes, we should have 144 times as much wood to abrade away in the one case as in the other; so that it will be readily perceived that the difficulties attending the sandpapering of a pattern, so as to preserve its true form and size, increase in a twofold ratio as the size of pattern diminishes, until at last it becomes impracticable. Exactly where this point is reached it is not possible to state; it will, however, vary with the capabilities of the workman, the steadiness of his eye and hand, and the nature and material of the work. It must have happened to many that they have made patterns so small that they dared not attempt to sand-paper them, and that they have turned intricate details upon a piece of work which could not be preserved in their sharpness under the abrasion of sand paper. While therefore we respect sand-paper, let us respect our tools more, and let the pattern or core box, as the case may be, be brought as nearly to the form required as practicable with the cutting instrument, and then let the sand paper be applied, not by folding it together and rubbing it upon the work, but by considering the shape we intend to finish, and preparing a piece of wood to correspond to the shape. Such a piece of wood is called a rubber. A flat surface requires a flat rubber, a convex surface a concave rubber, and *vice versâ*. Rubbers are made of a size suitable to hold in the hand, and in length range up to 12 inches. Longer than this would be useless for one sheet of sand paper, and that is all that is generally used at a time. Turned cylinders make good rubbers, for core boxes that are semi-circular, up to about 3 inches in diameter; above that size, the turned rubber becomes clumsy, and a piece flat on one side and planed to suit the curve is used. Such a piece is shown in Fig. 98. To use it, place one fold of sand paper only around the rubber; and applying it to the work, move it over the surface of the work, and across the grain of the timber, if it is possible. If the size of the work is smaller than the rubber, we must take short strokes so as to be able to move the latter steadily, and not round off the work at and towards the edges. A very good plan, where extra care is required, is to either glue the sand-paper to the rubber, or else fasten it with a few tacks. Sand-paper glued to a flat board is very useful for small surfaces; but in this case, we rub the work upon the paper, and not the paper upon the work. The grades of sand paper used upon pattern work range from No. $\frac{1}{2}$ up to No. 2, Nos. 1 and $1\frac{1}{2}$ being most commonly employed.

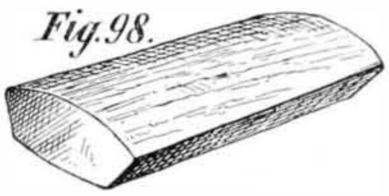


Fig. 98.

The surfaces of the hub or body of our gland pattern being straight in their outline, we sand paper them in the lathe with the paper wrapped once around a flat rubber, applying the paper lightly to the work, and moving it very slowly over the work in the manner in which a file is used. We next fasten the flange to the body by gluing it by using finishing nails, or by both. If finishing nails are used, care must be taken to use a bradawl before inserting the nails, for fear of splitting the work.

To make the pattern in the manner shown in Fig. 90, the method of procedure is the same as the above, with the exception that the tapering of the core prints must be *vice versâ*, as in this case the core print the farthest from the flange will be the top one in the mold, and must therefore be given the most taper. And since the body of the pattern will lift with the cope, while the flange will remain in the nowel of the flask, when the mold is taken apart (as shown in Fig. 91), the flange of the pattern must be made an easy fit to its place on the body or hub, and must not be leftof a tight fit, as in the former case. A pattern of the form shown in Fig. 92 may be turned, flange and all, out of a solid piece of wood; or if too large for this, we may plane up a piece for the flange and glue a hub to it; and when the glue is dry, turn up the whole patttern at one chucking in the lathe.

Protection of Buildings from Lightning.

Professor Clerk Maxwell read an abstract of a paper before the Mathematical and Physical Science Section of the British Association at the recent meeting at Glasgow, in which he stated that those who erected lightning conductors had paid great attention to the upper and lower extremities of the conductor—having a sharp point above the building and the lower extremity carried into the earth as far as possible. The effect was to tap, or, as it were, to gather the charge by facilitating the discharge between the atmospheric accumulation and the earth. That would cause a greater number of discharges than would have otherwise occurred; but each of them would be smaller than those which would have occurred without a conductor. That arrangement was therefore more for benefit of the surrounding country, and for the relief of the clouds laboring under an accumulation of electricity, than for the protection of the building on which the conductor was erected. What was really wanted was to prevent the possibility of an electric discharge taking place within a certain region. An electrical discharge could not occur between two bodies unless the difference of their potentials was sufficiently great compared with the distance between them. If, therefore, they could keep the potentials of all bodies within a certain region equal or nearly equal, no discharge could take place between them. That might be secured by connecting all these bodies by means of good conductors, such as copper wire ropes. It would, therefore, be sufficient to surround a powder mill with a conducting material, to sheath its roof, walls, and ground floor with a thick sheet of copper, and then no electrical effect could occur within it on account of any thunderstorm outside. There would be no need of any earth connection. They might even place a layer of asphalt between the copper floor and the ground so as to insulate the building. If the mill were struck, it would remain charged for some time, and a person standing on the ground outside or touching the wall might receive a shock, but no electrical effect would be perceived inside even by the most delicate electrometer. A sheathing of copper was by no means necessary in order to prevent any electrical effect taking place. Supposing a building was struck by lightning, it was quite sufficient to enclose it with a network of a good conducting substance. For instance, if a copper wire were carried round the foundation of a house, up each of the corners and gables, and along the ridges, that would be a sufficient protection for an ordinary building against any thunderstorm in England; but it might be well, to prevent theft, to have it built in the wall, and then it would be necessary to have it connected with some metal, such as lead or zinc, on the roof. It need scarcely be added, said the Professor, that it is not advisable during a thunderstorm to stand on the roof of a house so protected, or to stand on the ground outside, to lean against the walls.