going during observations. By this arrangement he hoped to be able to have trials whenever required, without waiting hours or days for a favorable moment.

PROPOSED OBSERVATORY FOR CALIFORNIA.

After stating that the general idea that the working of a plane mirror is more difficult than one with curves is not quite correct, the lecturer drew attention to a working model of a proposed observatory for Mount Hamilton, in California. [An engraving from Mr. Grubb's design for this observatory is given herewith, from the *Engineer*.] A Mr. Lick has left a large sum of money for the erection of a monster observatory, which is already partly complete, and contains some excellent instruments of moderate size, the work already done with which favors the idea that the great 36 in. refracting telescope about to be erected there will be placed under more favorable conditions for observations than any other large telescope in the world. The trustees of the Lick Observatory had invited him to design an instrument for the 36 in. objective now in course of construction by Messrs. Clark, of America, the contract for the mounting not having yet been made, and in the model he had put his ideas into practical form. The conditions he laid down for himself in designing the observatory were that it should be possible for the observer single-handed to enter the equatorial room at any time, and that, without using more physical exertion than is necessary for working the smallest sized telescope, or even a table microscope, he should be able to open the 70 ft. dome, turn it round backward and forward, point

balanced by counterpoise weights, and raised and lowered at will by the observer. Then the observer can without any effort raise and lower the whole floor, carrying himself and twenty people, if desired, to whatever height is most convenient for observation, and wherever he is observing he is conscious that he has a 70 ft. floor to walk about upon, which even in perfect darkness he can do in safety. The valves and reversing gear of the water engines are actuated by a piece of mechanism, the motive power of which may be a heavy weight raised into position some time during the previous day by man or water power. By means of a simple electrical contrivance, this piece of machinery is under the complete control of the observer, in whatever part of the room he may be, and he carries with him a commutator of a compact and convenient form, with eight keys in four pairs, each pair giving forward or backward movements at will to the portion of the observatory appliances intended to be controlled. The shutter of the dome moves back horizontally. To open it, it is but necessary to anchor it to a hook in the wall, and to move the dome in the opposite direction.

Supposing the telescope to be in a vertical position, and the observer at the eyepiece to accidentally start the machinery for raising the floor, it would be bad for him. So safety apparatus had been devised, which after the floor had been raised to a particular level, would cut off all the water power of the establishment. At the same time, a certain amount of intelligence in the operator has to be assumed.

A LOOK THROUGH THE GREAT OBJECT GLASS.

By Professor C. A. YOUNG.

THE object glass of the great Lick telescope is now practically completed, and only awaits examination and approval by the experts who are to be appointed by the Lick trustees to test it. As all our readers probably know, this enormous lens, by far the largest ever made, is thirty-six inches in diameter, and has a focal length of fifty-seven feet. It is composed of two lenses, of which the front one (outside) is an equiconvex lens of crown glass, while the other is a concave lens of flint glass. One side of this—the one next the eye—is very slightly concave, in fact almost flat; the other, next the crown glass lens, is considerably concave, the curvature being somewhat deeper than that of the crown glass surfaces. The inner surfaces of the two lenses are separated by a clear air space of about six and a half inches, and there are perforations in the steel cell which allow a free circulation of air between them. The glass disks were made by Feil, of Paris, and they have been figured and worked by our own Clarks at their modest, but famous, establishment in Cambridgeport.

Through their courtesy, the writer had the privilege of looking through this most powerful of all existing telescopes a few evenings ago, in company with some of his astronomical friends; and although the state of the air was not all that could be desired, and the moonlight interfered somewhat with the view of faint objects, yet the experience was something to be long remembered.

The instrument is mounted on a temporary stand, first erected for the testing of the thirty-inch Poulkova glass, which, until within a week or two, was the largest in existence. In constructing this mounting, the Clarks, however, had also the Lick instrument in mind, and proportioned the parts accordingly. A huge pyramid of brickwork rises some thirty feet from the ground, and bears on its sloping top a sort of cast iron saddle with the bearings of the polar axis, which is ten or twelve inches in diameter, and some twelve feet long. It carries at the upper end the declination axis, of about the same dimensions as itself. The tube of the telescope, an immense cylinder of boiler iron, forty-two inches in diameter, and nearly sixty feet long, is secured to one end of the declination axis, as near the pier as possible; and the other end of the axis, protruding awkwardly, is loaded with counterpoising weights.

As we came into the garden where the instrument is placed, the great tube towered high and white in the moonlight far above the surrounding trees and buildings, directed toward the bright star Alphacca, the gem of the Northern Crown. At the lower end, two or three men were sitting around; and one was lying on the ground, craning his neck to look into the eyepiece, which came a little too low to allow the use of the chair. The observer was Mr. Alvan G. Clark, the youngest member of the firm, and the one who at present does most of the purely optical work. He was trying to see how the figure of the lens had been effected by the delicate work of the last two or three days. The other onlookers were Mr. George Clark, his older brother, the mechanic of the firm, and the venerable Alvan Clark, Sr., their father, with one or two of the most trusted workmen of the establishment. Before long we were joined also by Professors Pickering and Langley.

In a few minutes the glass was turned to a neighboring star, γ Coronæ, which is an exceedingly close double, its components not being more than about $\frac{1}{4}$ " apart. Although the roughly mounted telescope vibrated a good deal in the breeze, and the air was rather unsteady, so that the star blazed and danced about, yet under a power of about a thousand the two components were distinctly separated with a fine dark line between them. I had seen the object just as *plainly* with a different instrument not very long ago, but not so impressively; the stars had no such brightness. In fact, the Lick object glass gathers in from any star nearly two and a half times the light collected by the Princeton glass, the areas of the lenses being as 1,296 to 529.

Everything about the image showed that the figure of the lenses is excellent, and the aberrations nicely corrected. Nobody but a Clark would think he could improve it "just the least bit."

Then we turned to the great cluster in Hercules, and wished that for a few moments we could extinguish the moon. For although the telescope resolved the cluster in a marvelous manner, and showed its own optical excellence in the perfection of the images, yet the moonlight and the haze robbed the object of its glory. The blaze and glow of the innumerable stars upon the black background of a darker night were missing.

The instrument was next directed upon ζ Hercules, an interesting and rapidly moving binary; and then upon the great white star Vega, or α Lyra, at that time nearly in the zenith, and admirably adapted for testing purposes. This defied the moonlight; one understood now what Herschel meant in speaking of Sirius coming into the field of one of his great reflectors "like sunrise."

And yet, when the glorious star was passing through the field, one could see at the same time, and without any need of hiding the larger luminary, the delicate companion discovered by Winnecke long ago with the old Poulkova telescope. Hitherto it has been possible to see this, even in the very largest telescopes, only when the great star was put out of the field. Of course we do not refer to the old and well known companion, easily seen in all telescopes of any size above four inches. In the great telescope, that was about as bright as the polar star to the naked eye. Nothing was seen, however, of other little stars that have been reported by certain amateurs as visible in this field of view.

On withdrawing the eyepiece, and placing the eye in the focus of the great lens, one could examine it critically for every vein and flaw and air bubble. It is rare that one finds a pair of disks so perfect. Under the trying test, one could indeed make out a few little wisps of veiny structure, and one small dark speck that was easily visible; but there was nothing that could do any mischief to the image of a star.

ϵ Lyra, the exquisite double-double very near to

PROPOSED OBSERVATORY, MOUNT HAMILTON, CALIFORNIA.

the equatorial to any part of the heavens, revolving it in right ascension and declination to any extent, and finally, the most difficult of all, to bring his own person into a convenient position for observing. There is generally far more trouble in moving the observatory "chair" and placing it in proper position than in pointing the instrument itself. In this instrument the chair would require to be 25 ft. high, and with its movable platform, ladder, balance weight, and so on, would weigh probably some tons. Even if very perfect arrangements were made for the working of this chair, the mere fact that the observer while attempting to make the most delicate observations is perched upon a small and very unprotected platform 25 ft. above the floor, and in perfect darkness, tends to reduce his value as an observer to an extent only to be appreciated by those who have undergone the trial. Personal comforts and discomforts have much to do with the value of observations.

He proposed that all the various motions should be effected by waterpower. Some water engines have no dead point, and, having little *vis inertia*, are easily stopped and started. He proposed to use four of them; one for the right ascension motion of the instrument, and one for the declination; one for revolving the dome, and one for raising or lowering the observer himself; but instead of having anything of the nature of a 25 ft. chair or scaffold, he proposed to make the 70 ft. floor of the observatory movable. It is

The remark had been made to him that by laying bare the particulars of his work, men would pick up his trade secrets. Up to the figuring, the processes were purely mechanical; but the last process was something beyond mechanical work. A person might spend a year or two watching every detail of the manufacture of large objectives, see every part of the process, and take notes, yet he could then no more expect to figure an objective himself than a man could expect to be able to paint a picture because he had been sitting in an artist's studio for the same time watching him at his work. The art can only be learnt by experience, and then only by particular persons. He agreed with an experienced amateur who said that nine years' hard work was necessary to acquire the experience. It is true that some large objectives are turned out by machinery; but what kind of an objective can be turned out by a machine left to inexperienced hands? At the risk of being accused of working by rule of thumb, he confessed that conditions often arose to meet which he seemed to know intuitively what ought to be done, what crank to lengthen, what tempering is required of the pitch square, yet would find it difficult to give a reason satisfactory even to himself; and over every new objective he had found some new set of conditions to be then met by newly devised arrangements. A well known English astronomer once told him that he considered a large objective as much a work of art as a fine painting.

Vega, was next looked at: the only notable thing being that certain little stars between the two pairs, which in large instruments, but not so large, are rather hard to see, even in a dark night, were easy and almost conspicuous, notwithstanding the moonlight.

The "Ring nebula" was very pretty, but a mere pale ghost of what it would have been on a moonless sky.

α Herenlis showed its contrasting colors finely; and, by putting the large star out of sight, we could see a little companion which Mr. A. G. Clark has just discovered; it is in the N. P. quadrant, and about 10" or 12" distant from the larger star of the pair. Probably it can be seen by some of the other large telescopes under favorable conditions, but it is certainly a full magnitude smaller than Winnecke's companion of Vega.

A number of other objects were looked at, but nothing that calls for special notice here.

The elder Clark remained present during the whole evening, and despite his eighty-three years examined every object, even when the position required was such as to cramp and try younger limbs and muscles. His eye seems to have lost little of its original keenness, though trembling hands and easy weariness no longer permit him to do much actual labor. But what a step from his first three inch glass made for Dr. Wells, of Salem (in 1850, I think), to his great three foot lens!

Toward midnight, when the time came to leave off work, the telescope was turned vertically, object glass down, and strapped tightly to the pier. In this position the lens was about eighteen inches from the ground, on which was a floor of heavy plank. A sort of low baggage truck was then rolled under the telescope, and, by a stout screw underneath, the floor of the truck was raised until it touched the cell which holds the lenses. On loosening the screws which hold the cell to the tube, the weight of the object glass, about 750 lb., settles down upon the truck; and when everything is clear, three men haul it away along a plank walk, and store it, with its sixty thousand dollar burden, in the little fireproof building where the grinding and polishing are done.

While the making of the great lens has gone on thus rapidly and successfully since the crown glass disk was received, only about a year ago, the opticians have just met a serious setback in the matter of the "photographic corrector," which was to go with it, and fit it for astronomical photography. The disk out of which this lens was to be made was received from Feil last spring. Examination by polarized light showed that the glass was under a severe internal strain, due to insufficient annealing; and the Clarks at once notified the maker of the fact, and told him that they feared the disk would not bear working. The maker, however, thought otherwise, and directed them to proceed at his risk, which they did. The upshot of it was that, a few days ago, the disk burst into three pieces while on the grinding tool; and so, of course, that part of the work will have to be postponed until a new disk can be obtained; how long that will take, no one can predict with certainty.

This will not, however, delay the erection of the instrument. Its mounting is already well under way in the shops of Warner & Swazey, at Cleveland; and, unless there is some unexpected delay about the observatory building and dome, there is every reason to expect that, within a year from now, this monstrous piece of astronomical artillery will have opened fire upon the heavens from its chosen mountain top. We may well hope that, under the able direction of Professor Holden, it will prove effective.

ON A METEORIC IRON FROM SOUTH CAROLINA.

By WILLIAM EARL HIDDEN.

THE meteorite here described and illustrated "was found, in the year 1857, in the northwest corner of Laurens County, South Carolina, and was deposited in the cabinet of the Laurensville Female College, at Laurens C. H., very soon after its discovery. It was sent to the New Orleans Exposition of 1884-85, where it formed a part of the State exhibit of South Carolina." The writer first saw it there, and was enabled, through the kindness of the State Commissioner, to gain possession of it.

An analysis of a small piece, cut from the mass with some difficulty, yielded Mr. J. B. Mackintosh the following results: * Iron, 85.33; nickel, 13.34; cobalt, 0.87; phosphorus, 0.16 = 99.70; sulphur and carbon in traces. Thus it is seen that in composition this mass of meteoric iron is of unusual interest, the percentages of nickel and cobalt being uncommonly high.

Fig. 1 shows the mass in its exact natural size, and exhibits well the natural appearance of the Widmannstatten figures brought out on this surface by etching with dilute nitric acid. The rough surface, surrounding the smooth, countersunk, etched panel, was purposely left in its original condition, so that the homogeneity of the mass could be readily seen. The extension of a few lines of the panel surface can be traced running over the rough exterior, and other lines are seen to be parallel when not continuous. The very apparent tendency of the perpendicular lines of this figure to form a right angle with the upper and lower sides, and a parallelism to the right and left hand edges, confirms the belief that we have, in this mass of meteoric iron, a well marked relation to a cuboidal form; a shape very rarely, if ever before, observed in masses of this nature.

Since the illustrations are made by a photo-engraving process (Ives'), we can look at them minutely and with satisfaction, knowing that nothing is misrepresented, or incorrectly drawn.

On five sides of this mass, an angle of 90° seemed to be very closely approximated, which tends to prove the form to be cuboidal by design rather than by accident. The other surfaces were either rounded, deeply pitted, or they presented the appearance of having been broken apart, by occult causes, from parts of the mass which are now lacking, these missing parts, possibly, completing the cuboidal form on all sides.

Fig. 2 represents part of a surface parallel to Fig. 1, but distant more than an inch from it, at the back of the mass. It is placed on the page in its natural

relative position to Fig. 1, the lines in both figures being parallel.

Of special interest is the broad double line on the right-hand side of Fig. 2. From it, pointing upward at an angle of about 70° from the perpendicular, are seen lines, diverging right and left, at the same inclination, thus showing that twinning has occurred in this iron, parallel to an octahedral face. This broad line the writer has traced over the entire exterior of the mass, and identified it with the line in Fig. 1, situated two centimeters from the right-hand edge of the panel. The homogeneity is thereby clearly proved.

FIG. 1.—Meteoric Iron (Cuboidal), from Laurens County, S. C. (Natural size.)

The sharpness and general perfection of the Widmannstatten figures in this iron have seldom been equaled.

Fig. 3 represents a small surface situated at right angles to the lower right-hand edge of Fig. 1, and is, in the writer's opinion, the place of impact when this mass struck the earth. It is of interest to compare the fineness of these lines with those of the other figures; the parallelism of the lines to the longer straight edge—the cuboidal face—is also noteworthy.

The presence of hydrogen was proved by simply rubbing powdered sulphur over the smoothed surfaces, when, instantly, the disagreeable odor of hydrogen

FIG. 2.—Widmannstatten Lines on the Laurens County, S. C., Meteoric Iron. (Natural size.)

sulphide was made noticeable. In the action of nitric acid, carbon was also proved to be present, probably as graphite.

Lawrencite (ferrous chloride) was noticed in the solid state, and in Fig. 2 the dark, rhomboidal spots represent the situation of this rare mineral in the mass.

This meteorite approaches that of Babb's Mill (Tennessee) and of Kokomo (Indiana) in its high nickel percentages, and in the fine development of the Widmannstatten figures to that of Smith Mountain (North Carolina), described by Smith and Kerr. It is the fourth meteorite found in South Carolina thus far, the others being known as the Bishopville (stone), Ches-

FIG. 3.—Laurens County, S. C., Meteoric Iron. (Transverse section.)

terville, and Ruff's Mountain (Lexington County) meteorites.

I here extend to Mr. Mackintosh my thanks for his kindness in making the analysis here given, and to Mr. R. W. Milner, of Laurens C. H., South Carolina, for his information as to the history of this very interesting mass of meteoric iron.

POTASSIUM ALCOHOLATE.—The author has obtained a compound which he names potassium alcoholate. The same name has been applied to compounds of alcohols and bases in which the metal is substituted for the hydrogen of the alcohol. To avoid confusion, he therefore proposes to reserve for these latter bodies the names of methylates, ethylates, etc.—R. Engel, in *Comptes Rendus*, vol. ciii., No. 2.

WIND AND BAROMETER.

THERE has been quite a lively discussion on this question, the past few weeks, in *Science*. This has brought out a number of interesting facts which I desire to briefly state and to add a few comments. This question is of much importance, as may be readily seen from the fact that a paper discussing it was read at the last meeting of the American Association for the Advancement of Science; and quite recently a statement has been published in *Nature* to the effect that at the high station Ben Nevis, in Scotland, the

pressure is frequently lowered 0.10" in high winds. The question is, Can the wind blowing across a chimney or by the side of a building produce a partial vacuum in the house sufficient to make an impression upon a barometer column? If we grant for a moment that an effect will be produced, what will be its nature and characteristics? Of course, the best possible answer to this question would be a few careful experiments under the above conditions. In lieu of these, it seems safe to assume that the direct effect would correspond to the cause, that is, since the wind does not blow steadily, the effect, if appreciable, would be more or less intermittent. The action of the wind is familiar to every one, and I think that all will admit that in most cases it is quite steady, with momentary lulls, but no absolute cessations. Just the period of the steady action and of the lull cannot be told by an ordinary Robinson anemometer, but may be told by one of Ossler's pattern, which acts by pressure and gives all the fluctuations. With these fluctuations in mind, we may consider that the effect of a high wind would be to depress the barometer column almost continuously, with occasional more or less sudden and momentary jumps at short intervals. These sudden jumps would hardly reach the actual air pressure before the end of the lull and the accompanying sudden fall.

In fact, it has been believed by some that it would be impossible to even determine that the wind has any effect at all except by closing up all communication with the room, noting the effect, then opening, noting the result, and so on until an absolute synchronism were established between the cause and the effect. In many very steady winds this would undoubtedly be true, but often it would seem as though the effect of the lull would be sufficiently marked to be noted by an observer with an ordinary aneroid or even a mercurial barometer. There is also an additional consideration relating to the situation of the chimney or other opening communicating with the room. If this were at the edge of a high wall, on the side of a sloping roof, or at the top of a tower, then it might happen that the effect of the wind would be re-enforced, so that the fluctuation would be due, not only to the blowing of the wind across the chimney, but also to a tendency to produce a partial vacuum by the air blowing up the inclined surfaces.

Let us turn to some of the facts that have been thus far developed. Mr. Clayton, of Blue Hill Observatory, near Boston, Mass., some 600 feet above sea level, has noticed some remarkable fluctuations in a self-recording barograph of Prof. Draper's pattern, and has been led to conclude that they were caused by a partial vacuum produced by the wind, as suggested above. This barograph was situated in the tower of a building at the summit of the hill. The fluctuations are traced by a pencil attached to a frame holding a barometer tube, which is suspended by two spiral steel springs about a yard in length. The tube of the barometer is free to move up and down, its lower end being immersed in a cistern of mercury, but not fastened to it in any way. With a wind above forty miles an hour, Mr. Clayton has noticed irregular fluctuations of the pressure trace, which in many instances have a period of two to five minutes from crest to crest of the wave-like oscillations. In many cases the amount of this fluctuation was over 0.05", and in one case, about the time of opening a trap-door in the top of the tower, the trace shows a depression of 0.10". In the last case, the time interval was over twelve minutes; it would be an interesting fact in this connection if we had given the time the trap-door was open. In *Science* for October 8, 1886, we find published a trace of this barograph for three hours, and very near the center of the three hours the above remarkable depression of 0.10". A study of this trace shows the characteristics already noticed, that is, a wave-like appearance with a period of two to five minutes. We may add to this the fact that other barographs, of entirely different construction, show the same wave-like appearance, during high winds, differing only in degree from the one above. In some instances the trace is somewhat different from the one in *Science*; the trace with an electrical barograph shows a tendency to a movement above as well as below the general pressure line. Bearing in mind the principles laid down at the opening of this paper, we must conclude that there is nothing in common between this

* Analysis completed June 24, 1885.