IN THE STARRY SKY.

WHAT MAY BE SEEN THROUGH THE YERKES TELESCOPE.

Powerful Glass at the Williams Bay Observatory—Brings the Moon Within Sixty-four Miles of the Earth—Close Study of the Planets.

For nearly two years the big eye of the Yerkes telescope in the observatory of the University of Chicago, at Williams Bay, Wis., has been spying out the secrets of the stars. It has looked one-fourth further into space than any instrument devised before it. Night after night the huge, grim Cyclopean eye swings slowly round in its ponderous frame, crouched in its big white dome, and keeps a sleepless watch upon the heavens. The great dome is open to the sky. The ponderous tube swings slowly, imperceptibly, with the turning of the earth from sunset to sunrise again. Shut in the black shaft which supports the barrel of the refractor is a clock, a wonderful piece of mechanism, which tells off the motion of the globe on its axis. The telescope shifts, hair breadth by hair breadth, guided by the clock, and making the circuit of the heavens, with tireless eye fixed all night long upon a single star. There is no escape from the big eye. As the earth swings in one direction, the eye silently alters its focus, never aweary and never asleep.

What can the ordinary observer see through the largest and most perfect telescope in the world? What has the big lens so far revealed to the astronomers who have watched it as an oracle since the first day it peered into space? What does the finest telescope in the world look like to a man who doesn't know a telescope from a barrel?

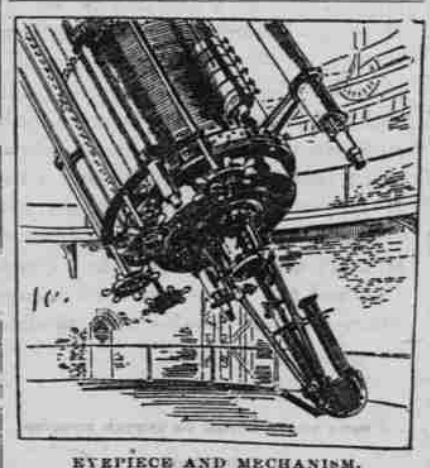
A reporter for the Chicago Inter Ocean visited the Yerkes observatory of the University of Chicago at Williams Bay for the purpose of answering these questions. A big telescope is almost human. It is furnished with a curious sixth sense, a marvelous second sight. Mysterious, uncanny, huge, it powerfully impresses one and grows more wonderful on closer acquaintance. The whole observatory is built about its monster eye. For the eye alone are the motors, the flying pulleys, the movable dome, the rising floor, and all the curious instruments varying from the delicately strung spider web of the micrometer to an apparatus weighing fifty tons. Without the huge eye everything would be useless. This eye is the lens of the refracting telescope in the main tower at the western end of the observatory. It is reached by a flight of marble steps from the main corridor. Entering the building in the evening, all is quiet and dimly lighted, the main tower quite dark. About midway of the round dome is the rising floor, over which the telescope swings. It is a triumph of mechanical skill, the only satisfactory means devised for reaching the eye piece of a big telescope as it is tilted up and down or swung around on its axis.

The telescope itself is a big iron tube sixty-two feet long, painted black. In the end which looks out through the dome is the object glass or refracting eye, forty inches in diameter, or four inches wider than the lens of any other telescope of the kind in the world. The iron tube, with its lenses, finder, eye pieces and other appliances, weighs nearly twenty tons. And yet so nicely is it balanced that a strong pull with the hand will swing it a foot or more. The huge telescope is moved on its axis by electricity.

Describing the apparatus, Dr. Hale finally fixed the big eye of the telescope on the planet Saturn. It was a fine, clear night, with little disturbance in the atmosphere, and Saturn appeared to twinkle about half way between the sky line and the zenith. The eye piece which was put on magnified nearly 500 diameters, one-eighth the highest power used. This is how the planet Saturn looked to the reporter gazing through the biggest telescope in the world: It appeared a yellow, round disk about the size of the moon, not flat, but clearly globular. Around it twinkled a purple band a quarter of an inch wide. Next to this was a solid ring encircling the planet, of the same bright yellow color, and quite distinct; next to this was a second narrow violet band, and surrounding that a second broad yellow band like the first. Around the whole sparkled a brilliant violet circle. Saturn's moons appeared as three tiny round yellow marbles grouped to form a pruning hook to the left of the planet's disk, while a fourth one hung a little lower down to itself on the same side. No oscillation was apparent. Saturn's rings and satellites apparently were of the same yellow color of the planet. Sometimes these rings can be discerned in their colors and form a brilliant rainbow about the planet. From the outer rim of the planet proper to the outer edge of the outside ring, the distance, through the telescope, looked to be about two inches. It is, in fact, 172,000 miles! Looking through the huge refractor, the human eye is able to discern a space of 172,000 miles as two inches in the area of the heavens! To the ordinary observer the shining violet rings about the planet form a beautiful feature of the view. These rings, however, are due to imperfections which exist in every telescope, and which astronomers would be only too glad to dispense with.

The telescope was next turned upon Jupiter, the largest planet in the solar system, and as big as all of the other planets put together. The distance from this earth to Jupiter is a trifle of 400,000,000 miles, and it takes forty-three minutes for its light to reach the earth. Jupiter's disk looked about as big as a large marble, probably two inches in diameter. At its side, in a nearly straight line to the right, appeared four small marbles, its satellites. The color of the planet was almost white, a very light yellow. Across the planet appeared three faint purple streaks, on the order apparently of the man in the moon. While at Lick Observatory Professor Barnard discovered the fifth satellite of Jupiter, but was unable to study it to any advantage. The Yerkes telescope brings out this fifth moon very clearly to the eye of the astronomer, and Prof. Barnard has been able to observe it and measure it with great accuracy.

Star clusters seen through the Yerkes telescope are wonderfully beautiful, a great ball, like a swarm of golden bees. The moon was too full for a good view, and showed merely a pale yellowish surface.



EYEPIECE AND MECHANISM.

About noon Prof. Hale had the telescope turned on the sun. No sun spots were visible, so the telescope was directed along the disk of the sun at the flames which burst through its dense, gaseous cloud wrappings and thrust their tongues far out into space. On a pink background, shading into dark red, and fully rounded, one saw a hooked yellow flame half obscured by what looked like gray vapors. There was an apparent movement, the flame darting high, sinking down, or again bending over to lick the round disk of the sun. Curious as it may seem, a glimpse through this powerful glass is more wonderful to the astronomer than to the man who looks millions of miles into space for the first time. To the astronomer each object is full of details which escape the untrained eye. Every line has a meaning, and in the merest trifles he reads the story of a million years.

The history of the Yerkes telescope itself is the history of the evolution of an eye, of the most wonderful artificial seeing apparatus yet devised. This great eye is 200 times as large as the human eye. That is to say, its diameter is forty inches, while the diameter of the pupil of the human eye is one-fifth inch. It is made of two separate lenses, one of crown glass, two and one-half inches thick at the center, three-fourths of an inch thick at the edge, and weighing 200 pounds; the other of flint glass, one and one-half inches thick at the center, two inches thick at the edge, and weighing 300 pounds. One of these glasses is convex and the other plano-concave. These two lenses are mounted eight and three-sixteenths inches apart in the end of a big steel tube sixty-two feet long, about forty-two inches in diameter, and weighing six tons. No figures, however, can properly express the size, the delicacy, the almost human intelligence of the great machine. The object glass of this telescope is as delicate as a human eye. A superfine silk handkerchief rubbed across its surface would destroy it. And yet, with proper care, it will never wear. The glass for each lens was cast in Paris by the firm of Mantois, celebrated for the manufacture of optical glass. Up to the time of the Lick telescope they had not been able to cast a solid, perfectly achromatic block of glass more than thirty inches in diameter. Then came the American order for two lenses thirty-six inches in diameter. The Frenchmen could but try, although they were skeptical as to the outcome. Nineteen times the trial was a failure. For months the mold was allowed to cool imperceptibly each day until all the heat had gone out of it. Then came the test. Nineteen times the glass contained flaws too great to be remedied—minute bubbles, unequal densities, various other defects. The twentieth trial produced a magnificent piece of glass, which finally became the property of the Lick Observatory. Encouraged by this success, the firm of Mantois set about the manufacture of a glass one-fourth more powerful than the one they had just made. Again and again they tried, schooled by the nineteen failures in making the Lick glass. Each trial required several months. At last the patient French makers were rewarded with two disks forty-two inches in diameter and as nearly colorless and flawless as glass was ever made. These blocks of glass were made into the lenses now in the eye of the Yerkes telescope. The glass was ground and finished by the firm of Alvan Clark & Sons, Cambridgeport, Mass.

Just as Americans have never been able to cast perfect and large disks of optical glass, so the French have not been able to polish the disks perfectly after they are cast. For four years Mr. Alvan G. Clark worked at the lenses. It may be that another such perfect glass will never be made. The secret of the polishing has been handed down for three generations in the Clark family. Previous to the work of the Clarks a German family—the Frauenhofers—had polished these glasses. For a century after the death of the last Frauenhofer it seemed that the art of polishing optical glasses was lost. Then Alvan Clark, a portrait painter in Massachusetts, attracted the attention of English scientists, and he and his family far excelled the German artists in glass. Mr. Alvan G. Clark, the last of his family, attended the dedication exercises of the Yerkes glass, returned to his home, and died within a few days.

The eye piece of a telescope, through which the observer looks, is the part of the instrument which magnifies the objects seen. The number of diameters to which an object can be magnified to advantage depends largely upon the perfection of the object glass. In the Yerkes telescope a glass which magnifies 3,700 times has been employed successfully. Through this the moon would appear as it would to the naked eye at a distance of sixty-four miles. The eye piece ordinarily used magnifies 460 diameters.

Incredible as it seems, the delicate measurements of the movements of the stars are calculated by cobwebs nicely stretched and forming the real measuring apparatus of the micrometer. They last for years and are even cleaned of dust with a delicate camel's-hair brush. Taking off the glass covering one evening, Prof. Burnham was examining the webs. He absentmindedly breathed into the aperture, breaking one of the filaments, which it took considerable time to replace. At the Yerkes telescope a device has been perfected for lighting the threads with electricity and making them a faint red color. A white light on them would be so brilliant as to injure the eye of the observer. In addition to its micrometer, the big telescope is equipped with all other accessories, such as spectroscopes, spectographs, spectro heliographs, photo heliographs, etc.

While interest centers around the main dome and its sleepless eye, the Yerkes Observatory would be a big institution if it had only its minor glasses to depend upon. One of these is a twelve-inch refractor mounted in the north dome. A twenty-four inch reflector will shortly be mounted in the south dome. A sixty-inch reflecting telescope is also being built now in the instrument shop of the observatory, and will be mounted in another building at some future time. As it stands equipped the Yerkes Observatory cost $500,000. It is the most complete in the world, with a refracting telescope forty inches in diameter. Next in order is the Lick Observatory on Mount Hamilton, with its thirty-six inch refractor, and third in order is the Imperial Observatory at Pulkowa, Rusia, with a lens thirty inches in diameter.

Home of the Telescope.

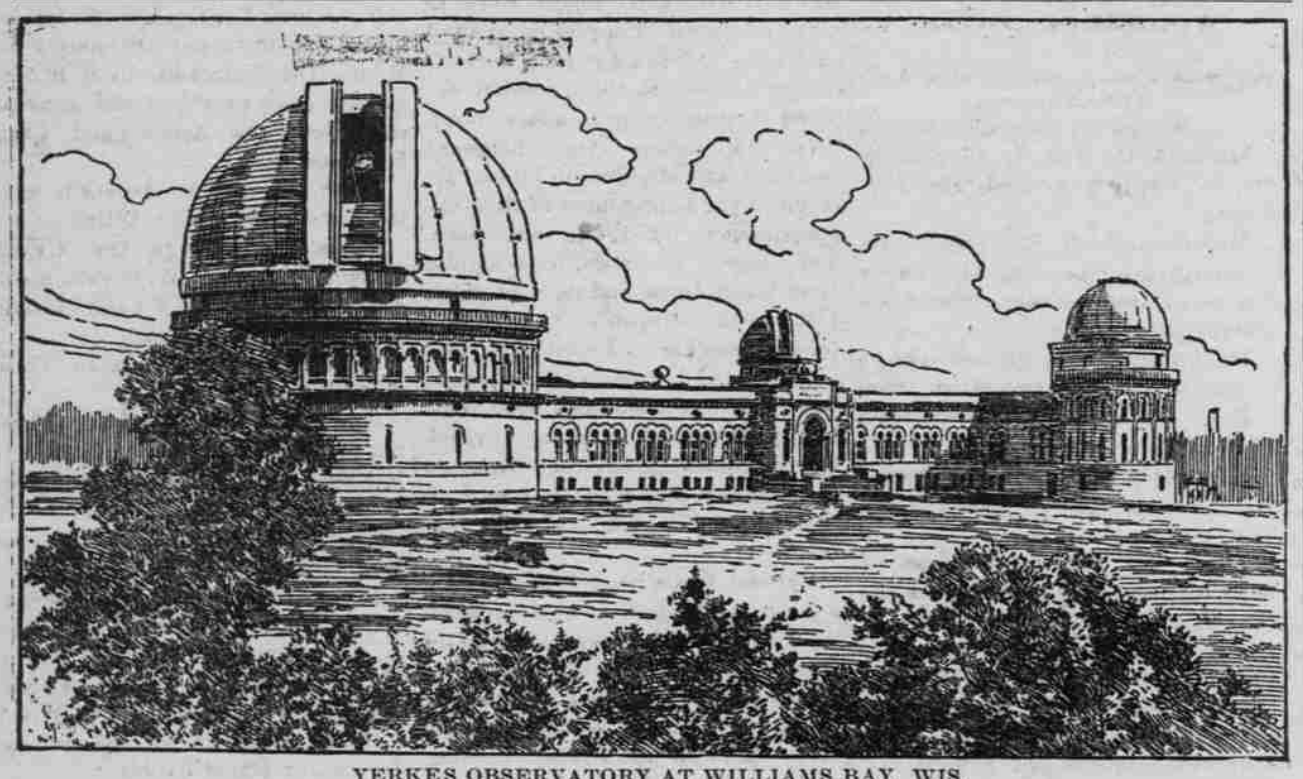
The building is in the form of a Latin cross, the longer axis of which lies due east and west. A great ninety-foot dome completes the western end and twenty-six foot and thirty-foot domes terminate the north and south transepts. The body of the building is divided into laboratories, libraries, offices, computing rooms and photographic dark rooms. The ground floor is equipped as an instrument shop, making this the only observatory in the world which manufactures its apparatus under the direct supervision of those who use them. This gives unexampled facilities for the application of new methods of research, and already more than a dozen intricate machines have been constructed and used successfully. The observatory is built of yellow brick, ornamented with fluted columns carved at the bases with gargoyles and other symbolic devices. The corridors and stairs are finished in white marble delicately veined in green and the wood is of massive oak.

The observatory has a little life of its own. Professors in charge have built their homes along the lake, and a small colony of scientists has gathered about the big telescope. Dr. Hale, the director, has a beautiful cottage a short distance away. Prof. Barnard, of the observatory staff, and one of the best-known of American astronomers, has built a homelike house of Southern architecture commanding a grand view of the lake. Here he and his charming wife dispense hospitality to many a visitor, and on the front porch the most distinguished astronomers of this country and of Europe have smoked an after-dinner cigar and discussed the puzzle problems of the universe.

Much of the work at the Yerkes observatory during the past eighteen months has been of a kind which could not be accomplished at any other in the world. In all observations which involve minute measurements of the highest precision the Yerkes telescope is unrivaled. The measurement of the motions of the stars, which approach or recede from the earth, are of great importance, as data gathered from these throw light upon the movements of the entire solar system. To this problem, the greatest in astronomy, Dr. Hale, Prof. Frost and Mr. Ferdinand Ellerman have applied themselves.

The sun, with all its attendant planets comprising our solar system, is rushing toward the star Vega, or Alpha, of the Lyre, at the inconceivable rate of ten miles a second. Vega is one of the most beautiful stars in the heavens and can be seen now near the zenith on any fair evening. Probably since the life of man began, perhaps since the universe was born, our solar system has been speeding toward this star. In the life of a generation the sun comes hundreds of millions of miles nearer its destination. But in many generations, to all appearances, this approach would not be perceptible. The journey, so far as mortals are concerned, must be eternal.

When, where and how, if ever, did this journey begin; when, where and how, if ever, will it end? Is the greatest of the unsolved problems of astronomy.



YERKES OBSERVATORY AT WILLIAMS BAY, WIS.

STILL MORE COUNTERFEITING.

The Secret Service has just unearthed another band of counterfeiters, and secured a quantity of bogus bills, Which are very clevgrly executed. Things of great value are always selected for imitation, notably Hostetter's Stomach Bitters which has many imitators but no equals for disorders like indigestion, dyspepsia and constipation.

Luxury.

"Mike," said Plodding Pete, "dere's only one time when I envies de rich."

"I'm ashamed of yer wea ness."

"I don't blame you. But when I read about dese swells comin all de way from Europe as saloon passengers I can't help feelin a pang o' jealousy."

Knew What Poverty Meant.

"You have never known the pangs of poverty!" he exclaimed bitterly.

The heiress' eyes softened, though liquid to begin with.

"Indeed I have," said she warmly. "I went to a bargain sale where no one knew me and found I had left my purse at home."—Indianapolis Journal.

The longest plants in the world are seaweed. One tropical and subtropical variety is known which, when it reaches its full development, is at least 600 feet in length.

Important Social Question.

When a young man takes a girl to a theater, and pays an extra dollar, and goes after her and takes her home, where does he get even? Is it the pleasure of her company or the consciousness that he has done his duty?—Atchison Globe.