

# The Turret Telescope

## A New Form of Mounting Adapted to the Comfort of the Observer

By Prof. S. A. Mitchell, Columbia University

THE lot of a professional astronomer is no easy one. Several years ago, while at the Yerkes Observatory of the University of Chicago, the writer had abundant opportunity to learn what hardships it is sometimes necessary to endure in order to get astronomical observations. Many nights during the month of February in a winter spent there, the thermometer was below zero; and on one particular night, while Prof. Barnard was working with the 40-inch, and the writer with the 12-inch, the thermometer dropped as low as 26 degrees below zero, Fahrenheit! And on this night, each of us worked for more than twelve hours! About three o'clock in the morning, work was interrupted by a sudden snow squall coming from a clear sky. This was caused by the freezing of the moisture in a passing cloud; and when this passed, the sky was brilliantly clear till morning. It is probably needless to add that the coming of the dawn was watched with a great deal of rejoicing. And though it is more than ten years since that night, the impression of it is as vivid as ever.

Those not familiar with the workings of an observatory will ask why it is not possible to keep warm by heating the building. Those who have ever seen the average observatory do not ask such a question, for they realize that the telescope is placed under a dome capable of rotating, with an opening or slit in the roof through which the telescope looks out to the sky. If the dome were heated how long would this heat remain when the slit in the dome was opened? And while the heated air was rushing out, the air in front of the telescope lens would be in violent commotion, and the "seeing" would be very bad. Ordinarily, the seeing is better when the temperature within and without the dome is the same. So that if it is a cold night in winter, there is no way for the astronomer to be comfortable, he must work in the cold—and he cold. And it is unfortunate, too, for the astronomer's work that the long nights come in the chilly winter, while the short ones come in the comfortable summer.

One must have a great love for astronomy and be gifted with wonderful enthusiasm to make a successful observer, for the disappointments of bad weather and poor seeing, and the rigors of the winter weather would deter any but the most ardent. If one is a professional astronomer, he puts up with the bodily tortures it is necessary to endure, for he has sufficient enthusiasm for his work. If one is an amateur, the enthusiasm of the beginner soon dwindles away, when it is discovered that it is necessary to be uncomfortable in order to gain a knowledge of astronomy.

It would be a great boon to both professional and amateur, if the mounting of the telescope could be so changed that the observer could be left in comfort in a warmer room. The standard form of erecting the telescope, known as the "equatorial" mounting, is placed ordinarily under a semi-circular dome, the equatorial form being necessary in order to be able to neutralize the rotation of the earth by a motion of the telescope about its polar axis. This standard form has come to its greatest completeness in the Lick and Yerkes telescopes designed by Warner and Swasey of Cleveland.

Many attempts have been made to keep the observer in a heated room, the most famous of which has been the *equatorial coudé*, or elbow-telescope of the Paris Observatory. With this form, two extra reflections from plane mirrors are necessary. These mirrors, which must be much larger than the objective, add greatly to the expense of the telescope, and largely decrease its optical efficiency. The well-known excellent photographs of the moon taken at Paris with this instrument are abundant proof that there are no serious

drawbacks to this form of mounting. While measuring with such an instrument, the observer sits in a comfortable position in a heated room, and looks in

entirely designed by him, and most of the work done in his own shop in Springfield. At the invitation of the inventor, the writer went to Springfield and saw the instrument, and can speak in the highest terms of it.

In this new instrument, the objective has the diameter of ten inches, one additional reflection only is necessary, introduced by a diagonal prism near the eye end. All optical parts are by Brashear.

Of polar axis there is none, its purpose being accomplished by a turret revolving in the plane of the equator. To the turret is fixed the declination axis about which the telescope revolves, and where the declination axis cuts the optical axis of the telescope there is located a totally reflecting prism turning the beam through 90 degrees. The observer sits in a comfortable position facing toward the north, and is obliged to change his position very slightly as the telescope follows the object. He may see what the weather is like by looking out through several windows in the turret near his head. There is no dome to shelter the objective, in fact, this is left free in the open air. The average professional astronomer would look askance at leaving a valuable objective unprotected from the elements other than by a cap. The cap on the telescope of Mr. Hartness fits very snugly, and though the objective had not been touched for two months before the time the writer saw it, there was hardly a trace of dust to be seen.

From Mr. Hartness' house, the observatory is approached through a tunnel 240 feet in length, and 9 feet high, the telescope being on the brow of a hill. The first room entered is a comfortable office. Through a door and up a few steps, one is in the observatory. Up a few more steps, and one seats himself at the eye end of the telescope. A circular ring about the eye-piece is the graduated declination circle of 24 inches diameter, and on this by means of a convenient handle is readily turned off the declination. Around the edge of the turret inside is the hour circle of 48 inches in diameter. This ring of four inches wide and three-fourths inch thick may be moved by hand and set to the right ascension of the star to be observed. The whole turret is now turned in right ascension by means of an electric motor, and when the sidereal time is set off, the quick motion is shut off and a slow motion substituted in order to drive the telescope. The writer set on several stars with the greatest of ease.

Regarding the mechanical precision of this form of telescope, one very naturally asks about the reliability of the turret to maintain the plane of the equator, and permit of rotation in this plane. These features are accomplished by providing the turret with a perfectly planed surface on its under side, and a truly circular track. It also requires in the building a stable mounting for rolls on which the turret rests. In fact, there are two sets of rolls; one set on which the flat face of the turret rests keeps it constant in direction while the circular part of the turret bears on the other set of rolls, and upon motion being imparted to these by the electric motor the telescope is re-

volved. It seems to the writer that the excellent precision of modern machine-shop work will insure for this form of telescope all the accuracy necessary.

This instrument is decidedly superior in optical efficiency to any Condé form of mounting, or any horizontal or other form of telescope fed by a coleostat or siderostat. In fact, is practically as efficient as the standard equatorial with a diagonal eye-piece, for this new telescope might be briefly described as a mounting in which the telescope revolves about its diagonal eye-piece. Consequently, it seems that no objection can be

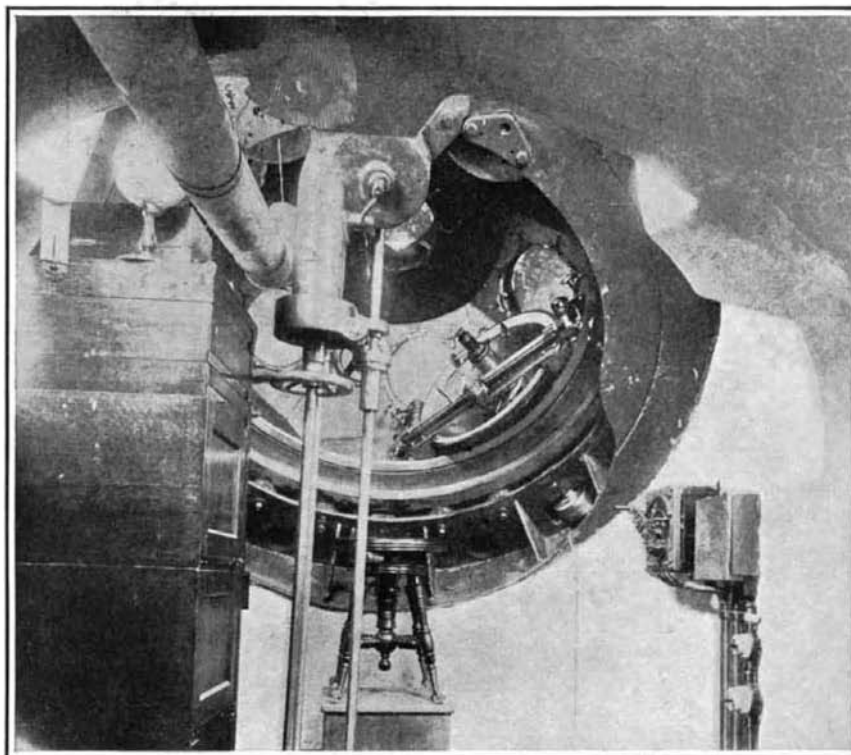
(Concluded on page 225.)



A tunnel 240 feet long connects the observatory to the house.



The novel turret-mounting as viewed from outside.



Interior of the observatory. Note the eyepiece at the right.

a fixed direction down the polar axis of the telescope. All observers know that their own measurements are most accurate when they are most comfortable, so that the quality of the work as well as the quantity would be improved if the astronomer could be kept in a heated room.

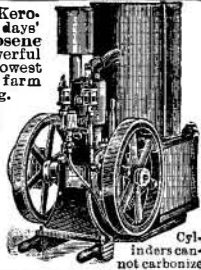
Undoubtedly, the most promising form of all mountings, which keep the observer housed is the "turret telescope" of Mr. James Hartness, of Springfield, Vt. Mr. Hartness, though making no pretensions to being an astronomer, is the efficient president of the Jones and Lamson Machine Company. The mounting was

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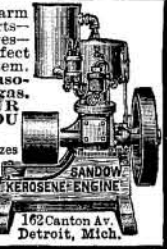


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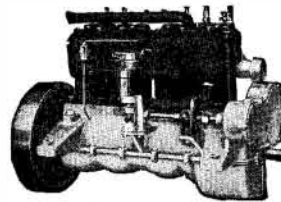
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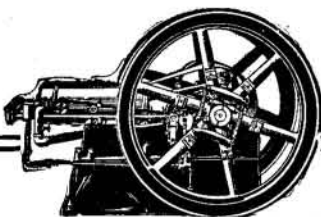
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### Our Latest Battleships

(Concluded from page 212.)

power of the side armor. Associated with the heavy belt in the work of protecting the ship's stability are two protective decks—a lower deck 1½ inches thick on the flat which will slope along the sides to a junction with the bottom of the armor plate 8½ feet below the water line. The slopes of this deck are 2 inches in thickness. On the deck above (the gun deck) is an upper protective deck, 3 inches in thickness. These two decks provide an excellent protection against plunging fire, and also against fragments of shells which might be exploded in passing through the thin ship's plating in the wake of the gun deck.

Equally massive is the armor protection for the main gun positions. The barbettes armor extends, with a thickness of 13 inches, from the turret down to the upper protective deck, and from the upper to the lower protective deck the thickness is reduced to 4½ inches—this because of the 13-inch protection afforded by the side armor. The turret armor is equally massive. The port plate is 16 inches on the two-gun turrets and 18 inches on the three-gun turrets, and the side and rear armor is 10 and 9 inches in thickness, while the roof carries 5 inches of armor.

The battle of the Sea of Japan showed how important it is to thoroughly protect the positions from which the fighting of the ship is controlled, and particular attention has been given to this in our new design. The conning tower and the signal station back of it each carry no less than 16 inches of armor, and to protect the communications—telegraph and telephone wires, voice tubes, etc.—the section upon which conning tower and signal station are supported has walls of 16-inch armor, which are carried down to the protective decks.

It will be noticed that the new ships have but one smokestack—and thereby hangs a tale. The new ships, as already stated, will burn fuel oil exclusively. This has enabled the designer to dispense entirely with coal bunkers—the oil being carried chiefly in the double bottom of the ship. The omission of bunkers sets free a large amount of space below decks, which has enabled the designer to concentrate all of the six boiler compartments at the center of the ship, where they occupy only 65 feet of her length. Hence, it was possible to use a single smokestack, placed immediately above the boiler rooms, and hence, again—and this is the important point—it was found possible to place around the whole of the uptakes a massive redoubt of inclined armor with walls everywhere 13 inches in thickness. This redoubt extends from the upper protective deck to the spar deck, and that portion of the smokestack and uptakes which is within the structure of the ship will be completely protected against perforation. The importance of this construction will be appreciated, when we bear in mind that, in the Japanese war, it was the perforation of the uptakes which contributed largely to the collapse of the Russian ships. The poisonous gases, escaping between decks, were drawn down and disseminated throughout the ship, frequently driving the crew from their quarters.

From the above description it will be evident that in the "Nevada" and "Oklahoma" the United States navy will possess two fighting ships which will be the equal, if not superior, to any ships in their gun power and which will be greatly superior in their power of endurance in a long-drawn-out fight. If Congress will only be wise enough to add year by year the two battleships which represent the minimum requirement of our navy, we shall be in a position to maintain our standing among the navies of the world. If less than two battleships a year be authorized, our navy will steadily retrograde.

### The Turret Telescope

(Concluded from page 218.)

made to the optical arrangements. The mechanical parts have a precision seemingly quite as great as the ordinary equatorial mounting. On the other hand this new mounting is in many respects decidedly superior to the standard form.

Disregarding for the time being the temperature of the observing room, the observer with the turret telescope should measure more quickly and more accurately with a micrometer, for the observer would always be in a comfortable position, and no time would be wasted in ad-

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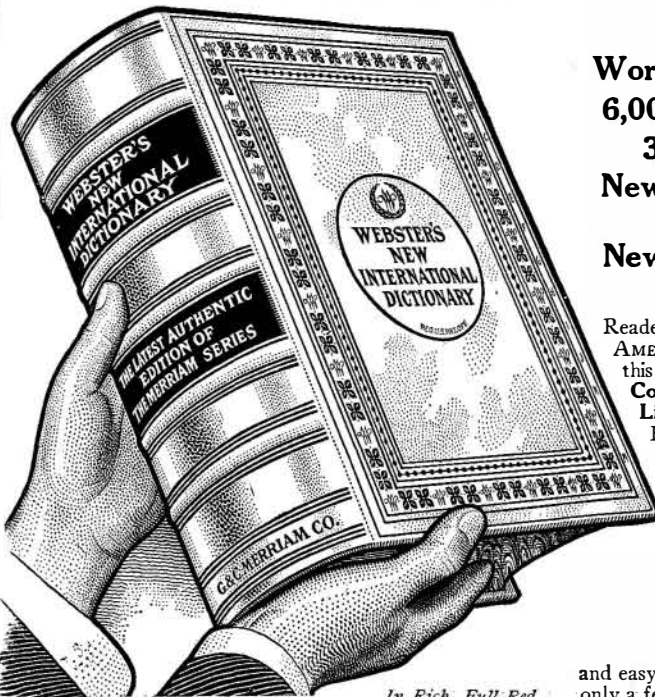
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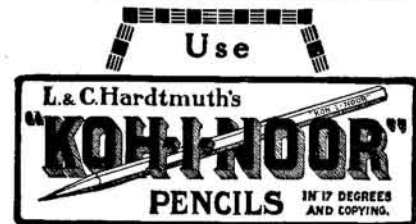
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justing the height of the observing chair, a star near the zenith being as easily observed as one near the horizon. For photographic or spectrographic work the new form of telescope should be also superior, for the eye-piece being firmly held in the turret, it would not be necessary to alter the counterweights when camera or spectrograph are substituted instead of micrometer. The added advantage of a comfortable room would seem to make this new telescope of Mr. Hartness the ideal mounting.

In fact, the only objection that seems possible to make against it is that it is an open-air telescope, and that it would vibrate badly from the winds. The ordinary telescope is sheltered by the dome except when the wind blows through the slit, and then by the use of wind screens, as at the Yerkes Observatory, the force of the wind may be minimized. It must be remembered, however, that the turret telescope is rigidly fixed at the eye end, and braced at the objective. Mr. Hartness was appealed to by the writer regarding this point, and has stated that the wind has little effect, that a rigid test of the instrument will be given, and then, if necessary, it will be easily possible to shelter the tube entirely from the wind.

The cost of this new form of telescope would be greater than that of the ordinary equatorial mounting. But no dome with running gear is necessary for it, so that the cost of building observatory and telescope together would not differ much in the two cases. If a demand were created for turret telescopes, their cost would gradually decrease.

Taken altogether, the invention of the turret telescope by Mr. Hartness is one of the biggest improvements in mountings that has taken place for a long time.

## Confusion of Names of Commercial Woods

NO branch of forestry requires the investigation of men of science more than the history and structural character of the commercial timber trees. It is lamentable to see so many talented men devote their entire lives to the study of small groups of relatively unimportant plants of the desert or the ocean, while we are still ignorant even of the botanical names of a good many trees yielding timber of commerce. A number of the trees of West Africa, which produce a large percentage of the choicest timber used in England and in the United States for furniture and high-grade cabinet work, are now known in the trade by no other name except mahogany, when in reality they do not belong to the mahogany family at all. Cocobola from Central America has been imported into this country for over a hundred years, but to-day no one seems to know what tree yields this wood. A number of examples of this kind could be cited in regard to important timbers which come from the tropics.

This lack of knowledge is the chief reason why so many different woods which bear the slightest resemblance have been given the same common or trade name. Such a duplication of vernacular names has produced among the woods of commerce a confusion and brought about a mass of errors that it appears almost hopeless to expect to unravel them. For instance, there are now more than fifty different woods sold under the comprehensive trade name mahogany; there are more than twenty-five referred to under the name cedar; there are more than a dozen rosewoods; equally as many satin woods, iron woods, and box woods, not to mention a number of beef woods, ebony woods, sandal woods, teak woods, gum woods, walnuts, and a host of others, named according to the fancy of the shippers and importers. The duplication of names has become so complicated that dealers are now unable to know what kind of mahogany, cedar, walnut, or gum to supply when their customers order woods by these names.

Timber constitutes a very important product of the foreign commerce of this country. To many the number of different kinds of woods imported will be a matter of great surprise, but numerous as they are now they are few compared with those which will be introduced into the American markets when the forest resources of Africa and South America become more generally available. Not a month passes but what some importer adds another mahogany, cedar, or rosewood to the long list of substitutes. Public attention and the investigation of

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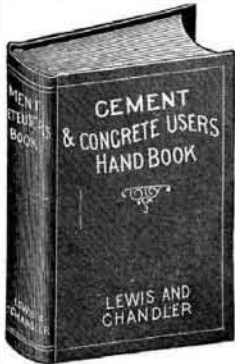
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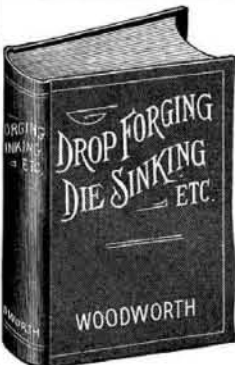


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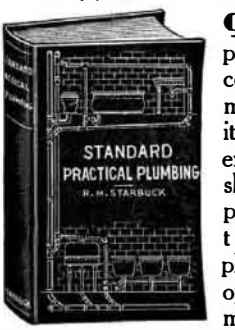


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