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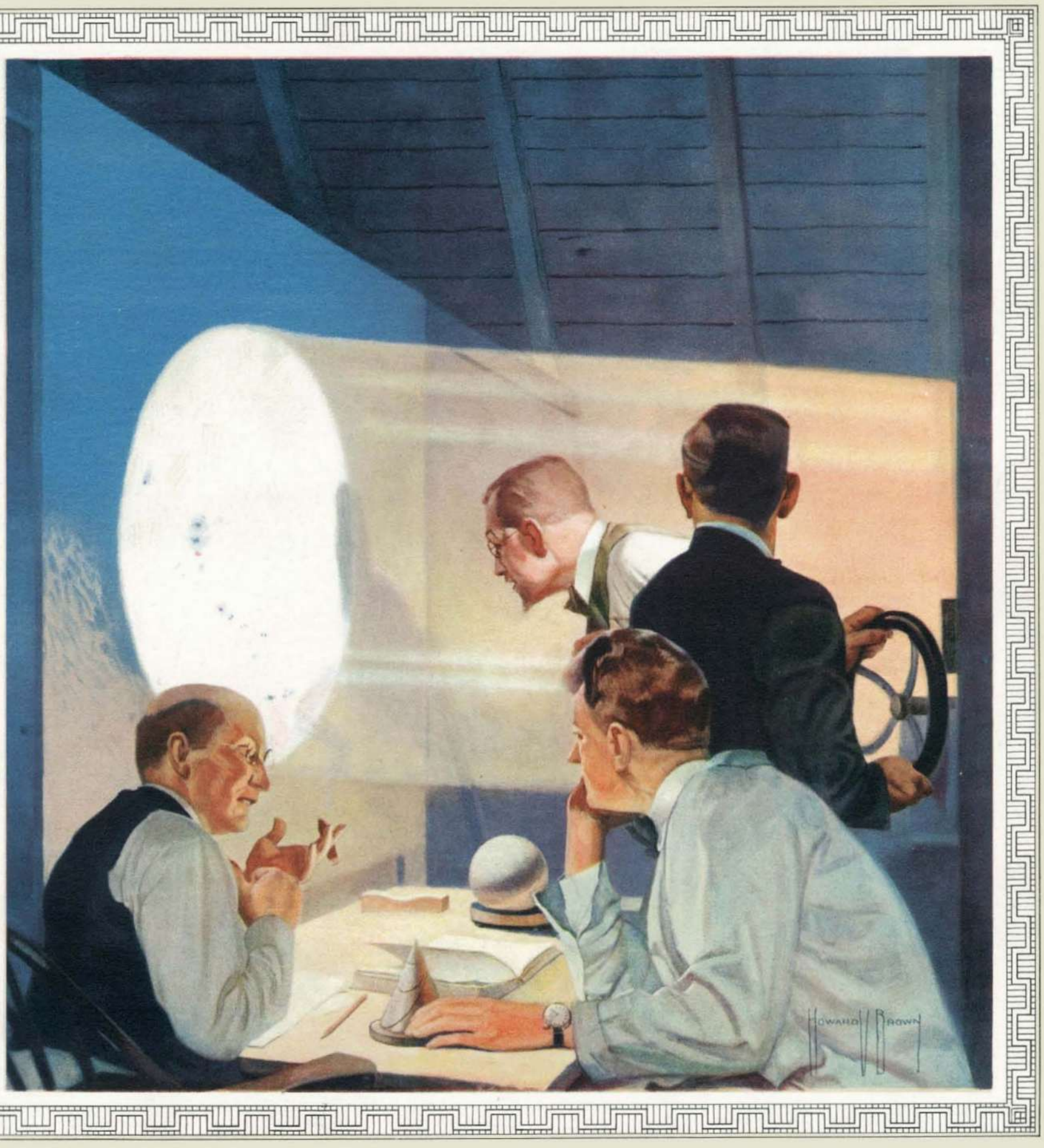

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"The Heavens Declare the Glory of God"

How a Group of Enthusiasts Learned to Make Telescopes and Became Amateur Astronomers

By Albert G. Ingalls

"WHY not make your own telescope?" said Mr. R. W. Porter, the telescope maker, as the waiter in a famous Broadway chop house started for the kitchen with our order. "Astronomy would mean a lot more to you if you did."

We had met to talk about Porter's hobby, astronomy. I had already heard quite a lot about this versatile man whose whole life had centered about the study of the stars. In his earlier years he had spent a dozen winters in the Arctic as astronomer, topographer and artist. Three years he had been with Peary, three more with Fiala in Franz Josef Land, and two years with Cook, who Porter says certainly did not climb Mt. McKinley. Other seasons he spent in northwestern Canada and in unknown Labrador. During all these years in the Far North where the Arctic stars fairly snap in the cold, clear air, he was studying astronomy.

Now he had settled down in the picturesque manufacturing village of Springfield, Vermont, tucked away in a deep valley in the foothills of the Green Mountains, where, as everyone in the mechanical industry knows, a famous type of flat turret lathe is made. Here he had fired a score of men with his own keen enthusiasm for the stars and had organized them into a group which is perhaps unique —machinists by day, amateur astronomers by night.

"You'd have no trouble in making a good telescope," he assured me.

"I could make the mounting all right," I replied, "but when it came to making the optical parts I'd be out of it. Only a handful of men in the world are skilled enough to do that fine work."

"You come up to Springfield, where I live," he laughed, "and I'll show you a good many home-made telescopes, made in spare time by men who knew nothing about it when they began. They'll tell you how any amateur—even an editor—can make his own telescope for less than fifty dollars, providing he's reasonably handy and will take pains. And it will be a real telescope, fit for serious work, not just a toy or a makeshift."

The "Poor Man's Telescope"

He went on to tell me how in the Vermont village a group of men, most of them mechanics in the local machine shops, had banded together to study the stars; how each one had made and mounted his concave mirror; how they had later pooled their efforts and built a sort of combined clubhouse, lodge and observatory on the top of a mountain near their homes. Here they gathered when the week's work was done, to study the stars. "The Telescope Makers of Springfield," they call their club, and none may join who has not made his own telescope.

When summer rolled around, I went to Springfield, as Porter had suggested, and there the amateur astronomers told me how they had learned their new avocation.

There are two common types of telescopes, the refractor and the reflector. The refractor is the ordinary type that everyone knows. It is like a big spyglass; you look *through* it, the light actually passing through its lenses. For serious amateur work such a telescope, having an objective lens four inches in diameter, is very valuable, but it costs several hundred dollars to buy, while the ordinary amateur cannot hope to make it himself.

But the reflector works on a different principle. It is a shorter, thicker instrument having a large, round, concave mirror in its lower end. The light coming from a star strikes this concave mirror and is reflected upward in a converging cone. Near the upper end of the big tube, which is open at the top, a small diagonal mirror or sometimes a three-sided prism of glass is mounted in such a position that the cone of light reflected by the large mirror is intercepted and is turned at right angles toward the eyepiece in the side of the telescope. Owing to the fact that the light does not pass through the glass as in the other type of telescope, the mirror does not have to be made of optical glass—simply ordinary thick plate glass; and since the mounting of

ON THE SPRUCE-CLAD SUMMIT OF BREEZY MOUNTAIN THE VERMONT ASTRONOMERS HAVE BUILT THEIR STELLAR FANE. A SEVENTY-FIVE FOOT SOLAR TELESCOPE PROJECTS THE SUN'S IMAGE ON A SCREEN INDOORS

In this type of telescope, no tube is required. The light from the sun is reflected by the sixteen-inch, flat, pivoted mirror B, to an equally large concave, paraboloidal mirror mounted on a stone pier at A. Thence the light converges through a circular opening just above the first mirror, and focusses on the screen, C, where the amateurs study the sun's image

"THE HEAVENS DECLARE THE GLORY OF GOD"
So runs the biblical verse on the front of "Stellar Fane." Two reflecting telescopes show in the foreground

the telescope does not have to be very accurately constructed, this type of telescope may be made for fifty dollars or even less. Therefore it is called "the poor man's telescope." One having a six-inch mirror will magnify from 100 to 200 diameters, and more in transparent atmosphere, and will do really effective astronomical work.

The Springfield amateurs set to work enthusiastically, and before many weeks most of them had surprised themselves by making the most difficult part, the mirror. The best work was done by the elderly men of the group, for they proved to be most patient and painstaking and did not try to rush the job through. The only feminine member turned out an excellent mirror, without a scratch on its polished surface.

When the telescopes were completed the back yards of Springfield bristled like Mt. Wilson, the California mecca of astronomers, with heaven-pointed instruments. This was great fun, but the observers soon discovered that they were missing a lot because they and their telescopes were scattered. They were not within talking distance of one another.

Several expeditions to neighboring peaks resulted, the would-be astronomers and their wives, telescopes, coffee pots, frying pans and bean kettles, all partaking together. But shivering, shelterless nights on windy mountain tops set the telescope makers planning further. Why not buy one of these peaks, they asked themselves, and build a shelter on it, with a warm fireplace, cots and a kitchen, as well as a place to store the heavy telescopes when not in use? Thus resulted Stellar Fane, "The Temple of the Stars."

The Saturday afternoon of my visit we climbed the mountain in cars piled high with provisions, for at least half the fun in one of these astronomical jaunts to Stellar Fane is the gathering of the observers about the long board and the stowing away of acres of johnny cake and other good things prepared by one of the members, Mr. Redfield, the duly appointed "cook-laureate" of the club. His double title is due to the fact that with his edibles he also serves up poetry.

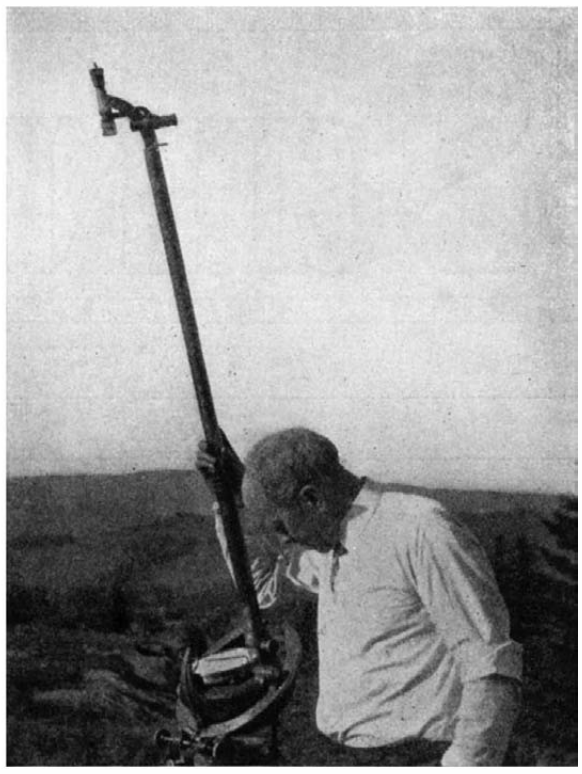
From the highway we passed through an ancient, rustic gate and churned our way spasmodically up across a boulder-strewn slope, and then up a steeper pitch. The radiator boiled furiously. The upper half of the peak was clad with virgin forest of birch and beech and black spruce, so that I got no glimpse of Stellar Fane until at last we came out on a level clearing at the summit. There, enclosed in a semicircle of trees was the Fane, a bizarre little house with steeply sloping roof anchored to the solid rock at all four corners by means of steel cables in order to keep it from blowing entirely off the mountain.

A Close-up of the Sun

All around the north and west horizon stood a ring of wooded mountain peaks, thin blue in the distance and as untouched as the day before man was man. Not a sound came up from the world below to annoy the star lovers in their lofty retreat.

"That peak over there is Ascutney," Porter explained, "and just behind that ridge is the place where President Coolidge grew up. But let's go inside and look around—we've got some things in there that may interest you."

In the front of the building there was a long room, finished in gray-stained pine, timbers naked. On the walls were a few pictures of the moon and other celestial bodies. There were several astronomical drawings, and a small blackboard was built into one corner for use in demonstrating disputed points raised by the amateurs. Sundry books on astronomy were tucked into odd niches in the walls. A folding staircase led aloft somewhere. A massive, home-made table was decorated with sawed-out signs of the zodiac. One end of the room was crowded with reflecting telescopes of various shapes and sizes, waiting to be dragged out by their owners and set



PORTER AND HIS SIX-INCH, TUBELESS TELESCOPE
Near the top, opposite the horizontal eyepiece, is a prism which reflects the converged light into the eyepiece

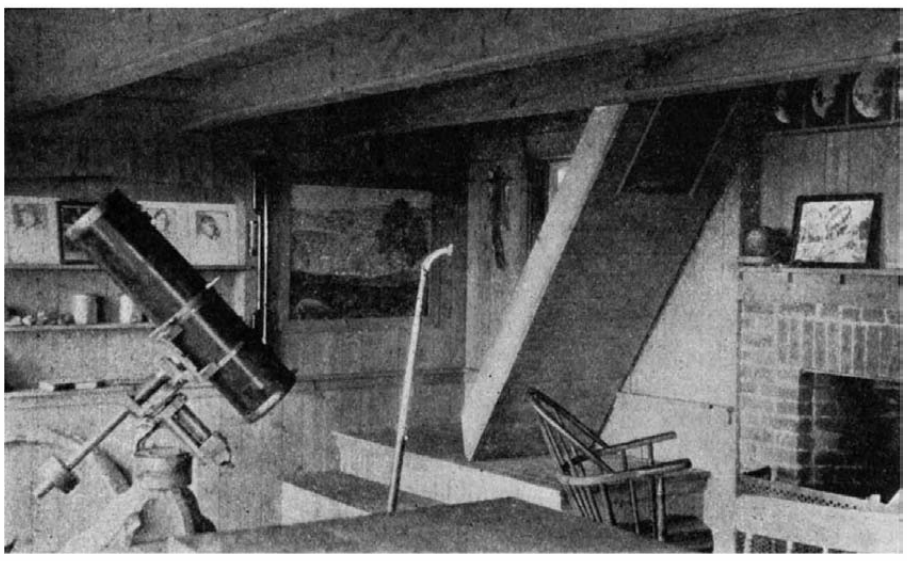
up on selected spots nearby for the night's observation.

In the rear was a complete kitchen, with a workbench at one end for quick repairs to damaged telescopes. Upstairs were two rooms, one packed with cots, the other used for the solar telescope.

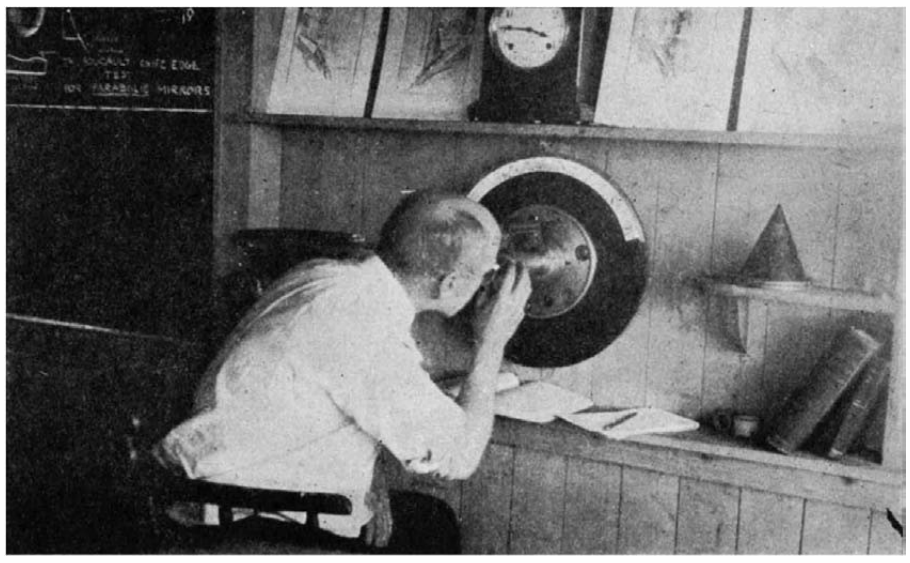
"While the sun is still up," said Porter, "let's set up the solar telescope." He drew out a big flat, round mirror and attached it to a heavy bracket just outside the window opening. This mirror reflects the sun's light to another mirror on the ground, seventy-five feet distant. There is no telescope tube in this type of instrument, for none is necessary.

With a wheel and worm gear the flat mirror was moved into proper relation with the sun and the concave mirror back of the Fane, when suddenly a powerful shaft of sunlight bored into the darkened room and the beautiful, silvery image of the sun appeared on a perpendicular screen. Each separate sunspot and every prominent detail showed sharply and clearly.

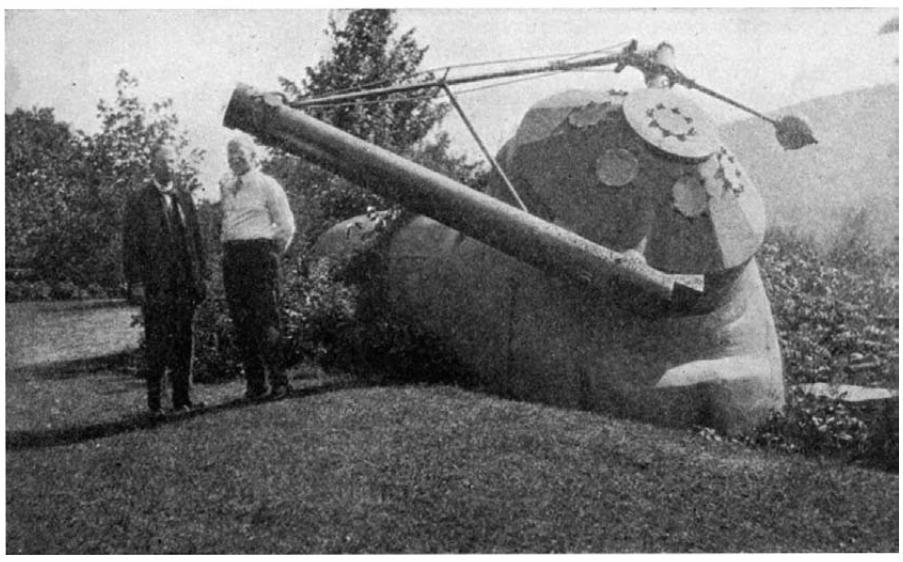
"We gather around this screen," said Porter, "while one of us keeps the sun's image centered on it with this wheel. We can study old Sol's face here in comfort and with precision, and at night we can see the moon, too, but not so vividly."



THE COZY FRONT ROOM OF "STELLAR FANE"
Here, in the cloudy intervals of the night's outdoor vigil, the astronomers gather 'round the crackling hearth and talk about the stars. Fullam's ten-inch telescope shows in the corner

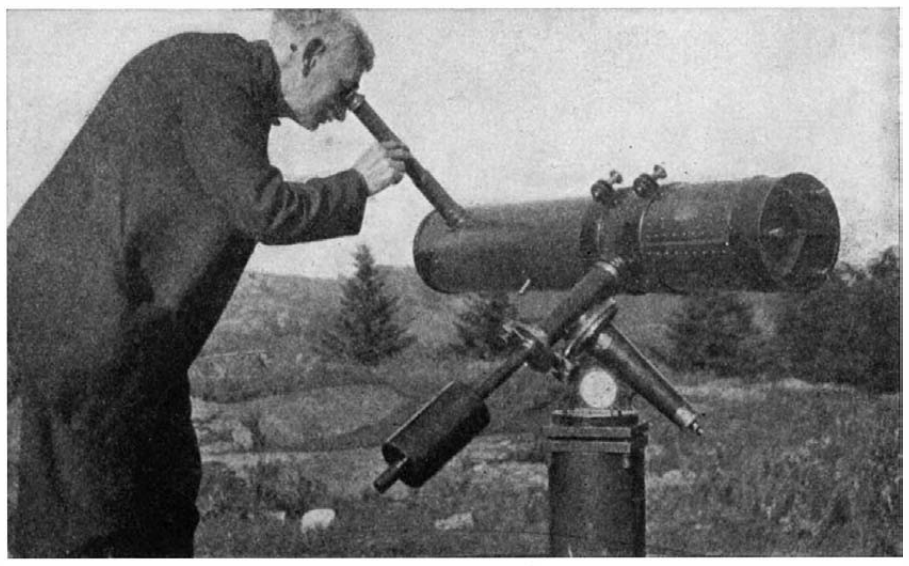


THE TRANSIT INSTRUMENT FOR OBTAINING STAR TIME
It extends through the wall of the Fane, the totally reflecting prism on its outer end catching the reflection of equatorial stars, which transit across the cross-hairs as the earth revolves



THE TEN-INCH, HARTNESS, REFRACTING, TURRET TELESCOPE

Described in the Scientific American, March 9, 1912. This type of mounting affords protection against both winter cold and summer insects. Porter says that but for former Governor Hartness there would be no "Telescope Makers of Springfield"



ONE OF THE TRIM, HOME-MADE REFLECTING TELESCOPES

While some chose wooden mountings, others, like Mr. Whitney who is a machinist, chose to use metal. Both types work well and are a delight to the eye. The metal from which this mounting was made was actually selected from the scrapheap!

By the time we got downstairs again the telescope makers had set up their instruments for the night's vigil.

"This fat, wooden one is Mr. Fullam's," said John Pierce, the vocational teacher at the Springfield School. "Fullam is a pattern maker, so naturally he used wood for his mounting, and it has proved very satisfactory."

"Here's Marshall," said the cook-laureate, "let's have a look at his telescope. He's a foreman in the shops."

Marshall's telescope is unique. Its main feature is its ever-upright eyepiece. With ordinary telescopes one often has to take up very awkward and tiresome positions to see stars directly overhead, but with a telescope like Marshall's you always look down into the eyepiece much as if it were a microscope.

The light reflected by the eight-inch main mirror is intercepted several inches short of its focus by means of a prism of glass which turns it through an angle of ninety degrees to a second prism, and this in turn turns it another ninety degrees into the eyepiece. Powers up to 560 diameters are available for exceptionally clear nights, though the 140 power is usually used. Provision is made for a driving clock in the turret, which is mounted on seventy-two steel balls. Marshall's telescope was a thoroughly workman-like job which took him two weeks to finish.

By the time I had inspected everything in sight and taken some photographs, it was dark. We all sat down at the long table inside and "stoked up" for the night with the cook-laureate's excellent provisions.

"There'll be another feed or two during the night," said one of the men, "for when we're not star gazing we're always eating."

One by one the telescope makers drifted away from the table, as I sat talking with a professor from a New England university who had motored over to visit Stellar Fane. Someone touched my arm.

"Come out and have a peep at Saturn," said Marshall, disappearing into the night. I followed him. There was Saturn, looking just like the Saturn of the pictures, but far more beautiful. Even the narrow Cassini division between the two pearly rings was clearly visible. Pretty good for an amateur's first telescope, is it not?

You Can Make a Telescope

Marshall now turned his telescope on Jupiter, revealing four of its satellites, tiny yellow balls whirling around the parent planet. Then we hunted up a spiral nebula, setting the two graduated circles on the telescope for the exact number of degrees and minutes called for in the ephemeris, the book which is used for locating the stars. With its spiral structure looking like a whirling pinwheel the nebula stood out sharp and clear, a whole universe of suns, distant so far that the light had required a million years to travel the 6,000,000,000,000,000,000 miles from it to our eye.

The night grew chill. Inside, a fire burned cheerfully on the hearth and someone had found a big, flat pan of johnny cake—"about a square mile of it," one remarked. I thought they ought to measure across Redfield's enormous pans in astronomer's terms, by light years.

I was getting dozy but someone brewed some heavy, black coffee as strong as dynamite, and guaranteed it to break up all desire for sleep. Pretty soon—for it was June with its short nights—the birds were chirping in the trees. Faint dawn.

"You haven't seen the moon yet," someone put in, "and it's just rising above the trees." Damon's six-inch telescope brought the moon's yellow face, now turning in the dawn to gray, right up into Vermont.

The lunar landscape forms a striking telescopic study. Men become so interested in its infinitude of minute detail that they spend years, nightly inspecting its volcanoes, craterlets, clefts, ridges, ramparts, rills, terraces, cracks, fault lines and cliffs, all of which look different from night to night as the sunlight strikes the moon at different angles.

So ended the night at Stellar Fane, and breakfast came on with the sun. A Vermont breakfast since time immemorial is traditionally incomplete unless topped off with pie. We didn't have pie, we had strawberry shortcake! Some folks say that men, when they are alone, will not bother to fix up fancy things to eat. They ought to put in a night at Stellar Fane.

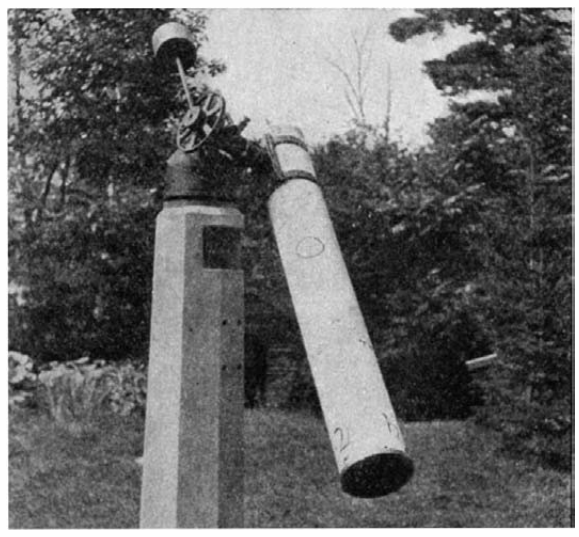
The next day we visited the workroom in Springfield, where some of the telescope mirrors were made. We silvered a telescope mirror, ten inches in diameter—at least I watched Porter do it. This job, often said to be tedious, took only twenty-five minutes. It requires a few chemicals, not many; and a willingness to take pains and to follow directions minutely. In fact, from those with whom I talked and from work which I have subsequently done I have gathered that the whole art of making telescopes is pretty much a matter of taking pains. You must be handy, of course, but you do not have to be a genius. Patience is necessary, but no knowledge of mathematics, abstruse science or astronomy itself is required for telescope making.

The tools are simply a barrel to work on, two inexpensive plate glass disks, a bit of common pitch, half a dollar's worth of optical rouge, a very few household tools, about four dollars' worth of abrasive, and your two hands to keep the upper disk moving back and forth over the lower one.

¶ *Provided enough of our readers write and request it—as some have already—we shall endeavor to publish an article telling how to go about the making of a reflecting telescope.*

CHARLES LONGE'S TUBELESS REFLECTOR

The mounting does not have to be as trim and accurate as this. A simple, wooden mounting without graduated circles suffices for the beginner's purposes and it costs little



MARSHALL'S PORTER-TYPE REFLECTOR

As the eyepiece is always in the same position, no matter what the angle of the tube, one's position is always comfortable. The mirror is in the bottom *of the tube*