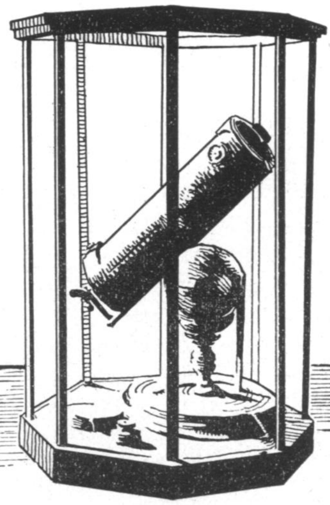
ASTRONOMY

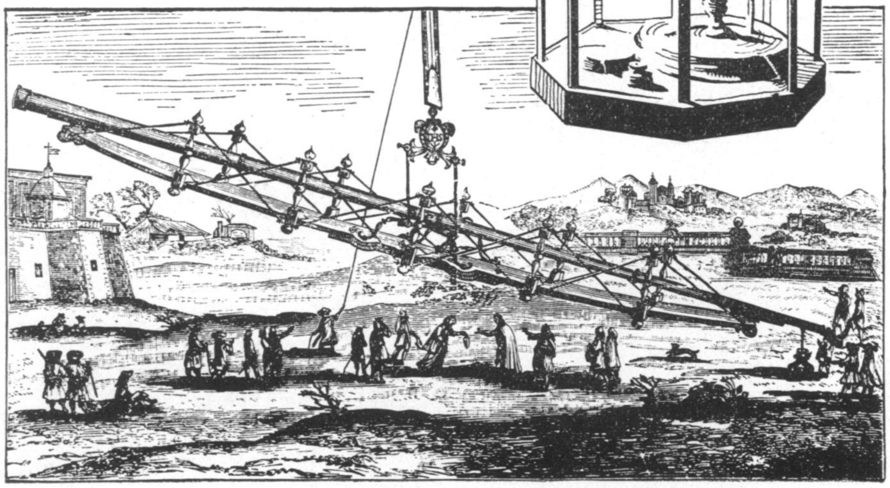
Making a Bigger Telescope

By JAMES STOKLEY

In Which It Is Told

How an infernal sleet storm will enable astronomers to peer into space ten times farther than they can now.





MONSTROSITY AND MIDGET

The huge, clumsy telescope with which the Italian astronomer Bianchini observed the heavens. Such instruments were made unnecessary by the development of the reflecting telescope from Isaac Newton's original model, shown above, and the later development of the achromatic lens.

FROM a sleet of quartz three thousand degrees hotter than the icy layers that form on streets and trees in the winter, scientists now promise to create huge mirrors which will reveal the secrets of the universe; to make more healthful windows for nurseries and hospitals and to grind lenses for microscopes that discover the germs of disease.

The chemist often uses a crucible of platinum in which to melt the things he studies, but platinum would flow like water at 3000 degrees Fahrenheit, the temperature of this infernal sleet storm.

Quartz is one of the commonest of minerals. The sand that you idly sift through your fingers as you lie on the beach is mostly quartz. So is your amethyst ring or stickpin. Rock crystal is the clearest of the natural forms, and has long been used to make useful things for scientists.

The trouble with crystals is that large ones are rare. Small lenses can be made from them, but not the huge mirrors for telescopes. Well, you say, why not melt the sand or crystals and cast the molten quartz in the shape and size desired?

This was one of the first experiments to be tried, but when quartz is fused in this way it comes out full of bubbles. Some years ago physicists at the Thomson Research Laboratory of the General Electric Company in Lynn, Mass., discovered that this problem could be solved by melting the quartz in a vacuum furnace. Electricity furnished the high temperature required, the entire furnace was air tight and the air was pumped out. This pulled the bubbles out of the quartz while it was liquid and the material was obtained in a clear glass-like form.

In such a way quartz has been made for many useful purposes. Sheets of quartz for nurseries to let the healthful ultraviolet rays of sunshine in to babies; condensing lenses for concentrating the light of motion picture machines on the film in big theaters; test tubes, flasks and beakers for the use of the chemist in his laboratory—these are but a few of the things that have been made from quartz prepared in the vacuum furnace.

But a vacuum furnace is not an easy thing to handle if it gets very big, so a way was sought of making it in larger sheets and slabs. Astronomers at the California Institute of Technology are already at work on a new telescope, four times as large and ten times as powerful as the one at Mt. Wilson that is now the world's largest. With this they will be able to gaze farther into the universe around us than they can at present, while the neighboring planets will move still closer to us.

For the seventeen-foot mirror in which these heavenly sights will be reflected, the astronomers called for quartz — superior in many ways to the glass now universally used in reflecting telescopes. What did it matter if no disc of quartz larger than about a tenth the necessary size had been made? There was a need for huge pieces, so Dr. Elihu Thomson, director of the Thomson Research Laboratory, set to work with his associates to find a way to do it. So confident were the astronomers of Dr. Thomson's ability to deliver a quartz disc when it was needed, that they immediately set to work designing the mounting, without worrying about the mirror problem. The success that has already been achieved at Lynn shows that their confidence was entirely justified.

A Veneer of Quartz

Since none of the methods would yield a disc large enough, the scientist sought for a means of making them still bigger. But this was not so easy. Possibly further research may reveal a way of making a clear quartz disc in one piece as large as desired, but at present it cannot be done.

How about making the bottom of the disc of one kind of material, and the top part a thin layer or veneer of something else that would take the curves of the mirror? Dr. Thomson thought. The rough white quartz, full of bubbles, could be made large enough, and so efforts were made to use this as a base, with a thin layer of clear quartz on top, in which to grind the figure. With the whole disc of quartz, it would behave as if made in one piece, while the bubbles in the lower part would help reduce the weight.

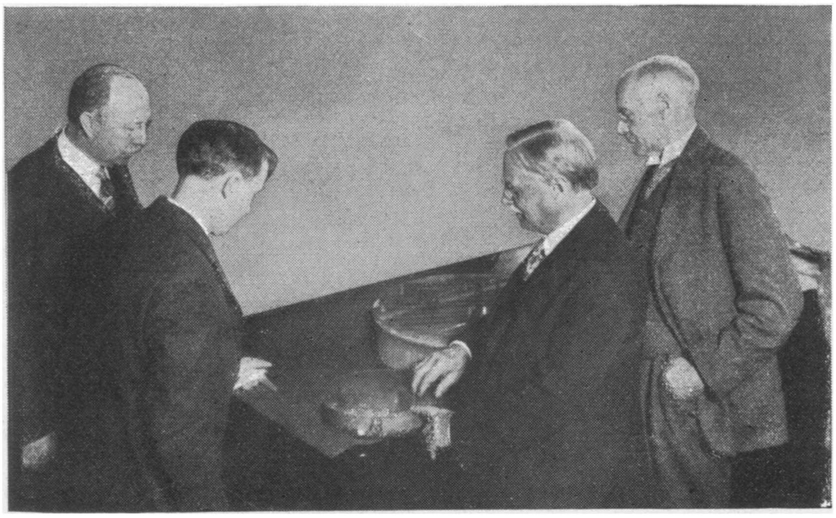
The first method tried, of putting a clear surface on such a base, was to take a large number of short quartz rods of the same length, stand them on end and close together, and then put the whole in an electric furnace. The quartz would melt, the rods would fuse together, and the resulting slab would be welded to a white quartz base. The tops of the rods would be ground off and a solid surface would result. This was fairly satisfactory, but not completely so, for never was it possible to get rid entirely of the divisions between the individual rods, and a mirror disc made this way presented a honeycomb appearance.

Then a skilled worker of the Thomson Research Laboratory thought of another way of doing it. He took small quartz crystals, of which unlimited quantities are available, ground them up into a fine powder and fed it into the gas stream of an oxyhydrogen blow torch. When oxygen and hydrogen are burned together, they give an extremely high heat, enough to melt quartz.

The Quartz Sleet Storm

As soon as the quartz powder reached the flame it melted into an actual quartz rain. This was applied to a disc of the rough quartz, which was cooler, below the melting point, and so the liquid froze solid as soon as it touched it. You can imagine the delight of Dr. Thomson after he first tried this experiment, and found that the layer of quartz deposited by the flame was perfectly clear and transparent.

They developed this method, until now a number of discs 22 inches in diameter have been made. Several have already been sent to Pasadena and tests made there show that they will be entirely satisfactory.



SAMPLE MIRRORS OF QUARTZ

Made by the sleet storm being inspected by prominent astronomers. Left to right; Dr. A. L. Ellis, assistant director, Thomson Research Laboratory; Dr. Harlow Shapley, director, Harvard College Observatory; Dr. Elihu Thomson, director, Thomson Research Laboratory; and Dr. Ernest W. Brown, of Yale University, president of the American Astronomical Society.

The furnace in which they are made is lined with fire brick. In the cover is a narrow slit that the blow torch hangs in. This is attached to a lathe bed, providing an automatic mechanism for slowly moving the torch back and forth across the base, depositing several pounds of quartz in an hour. A complete disc can be made in a couple of days, and then taken out and cooled, all ready for grinding.

In fact, the present limit to the size is set not by the difficulty of applying the clear veneer, but in making the rough base. It happens that the largest furnaces now at the Lynn laboratory will just take a 22-inch disc with crowding. With larger furnaces, it should not prove at all difficult to make them many times as large.

Dr. Thomson and his colleagues are now designing a furnace to make a 60-inch base. This will probably be ready soon, and then a disc as large as that of the fourth largest telescope in the world will be made. With several completed, and the technical difficulties solved, they will then tackle one 100 inches in diameter, and then the 200-inch itself.

Just how long this will take is uncertain, and Dr. Thomson is not hazarding any opinion. But with all the skill that these scientists have obtained with the smaller mirrors, and their practically unlimited resources it seemed to a group of astronomers who recently saw the process at work that a few more years will see this part of the work completed.

It will take just about as long for the mechanical parts of the mounting to be designed and built, so all concerned are confident that when the Pasadena astronomers are ready to start final work on the great mirror, they will have the disc to work on. The small discs made in the preliminary work will not be wasted, for a great reflecting telescope requires a battery of lesser ones to work in conjunction with the big mirror.

Much Still To Be Done

Of course, a great deal yet remains to be done. Even when the discs are made, their forming by polishing will be no easy task. But because of the slight temperature changes, quartz can be corrected much more easily than glass, even though physically it is harder.

Several years were required to polish in order to form or figure the 100-inch mirror now in the Mt. Wilson telescope. When started, probably the work on the 200-inch quartz mirror will be finished in a few months. Then it will be put in the telescope, and the astronomers will peer into space farther than they can now, and see closer objects better. But even then they will not be satisfied. Probably before the 200-inch is actually in use, plans will be under way for one with a mirror of 500 inches, or perhaps even larger!

Science News Letter, November 15, 1930

Fruit growers in the northwest are ridding their orchards of insect pests by means of radio, using a series of antennae and ground wires and a generator of high frequency electricity.