

CN: Behind the Scenes OMI - Optical Mechanics Inc.



James Mulherin - Owner OMI / Torus

Here at CN, we realize that many of our readers are equipment junkies, but sometimes it's nice to get a glimpse into the people and the company behind the equipment. With this in mind, we've decided to launch a new series of articles spot lighting and interviewing some of the better known manufacturers for the amateur astronomy community. Think of this as a chance to get to know the people who make your favorite toys.

*This month in Behind the Scenes we're thrilled to interview **James Mulherin** the owner, head optician and founder of **Optical Mechanics Inc.** **Optical Mechanics** is a large supplier of top-of-the line mirrors for the amateur community and one of the major suppliers of primary mirrors for **Obsession Telescopes**. James, his wife Stasi and their three children Porsche (19), Gabe (18) and Chris are residents of Iowa City, Iowa.*

Hi James, and welcome. Thanks for taking the time to visit with us today. I guess our readers would probably like to hear a little bit of your background and how you got started making mirrors. I know I would. How long have you been active in astronomy?

Growing up I always had a strong interest in science in general and a mild interest in astronomy. The interest in astronomy peaked when I took my one and only course in astronomy at the University of Iowa. I studied Physics at the U of I, mainly because I couldn't decide what field of science I wanted to specialize in. I figured with Physics I would get the most general coverage of the various fields, then I would specialize in graduate school. I finally got around to taking the astronomy class during the second semester of my Junior year. Part way through the course I realized I was having a lot fun.

It was then that I realized how incredibly interesting astronomy is, both for the science and the history of the subject.

I've been active in astronomy since 1989. With the astronomy course at the U of I there was a lab component that met one evening per week. On cloudy nights we did our labs with canned data from the lab manual. On clear nights we were supposed to use the telescopes on the roof of Van Allen Hall. Well, as luck would have it, we never got a clear night during labs. I had an intense desire to get a look through a telescope so I hooked up with a couple of local amateurs to finally see what things look like through an eyepiece. That's where the interest in amateur telescope making took root. After my first real observing session with an 8" Dob I had to have a scope of my own.

As soon as I realized that you could make your own mirror with no special tools or machines the optics fire was lit. I was completely fascinated by the idea of making something so precise by hand. And that you could see and measure details as small as a few millionths of an inch with a light source and a knife edge; to me that was mesmerizing. Finally, that piece of glass that you made by hand would produce images of those exquisite astronomical objects. It was just too much to bear. I had to make the mirror myself.

I bought all of the requisite supplies and some books on mirror and telescope making. I also enrolled in the optics course at the U of I the very next semester. As soon as my supplies arrived I went to work in my spare time. My first mirror was an 8" F/4. It took me about 6 months to make it and the process turned the whole house into a makeshift optics shop. The operation went from a night stand that I walked around in the bedroom to a 50 gallon drum in the kitchen. The hallway of the mobile home where Stasi and I lived at the time was my test tunnel. Eventually I built a small machine that consumed most of the bathroom.

I've yet to make a mirror, but know several who have - they tend to relate similar experiences - but they've never sold commercially, nor are did they become head of an Optics company! How did you manage to make the leap?

After making my first mirror I had all this makeshift equipment and the desire to keep going. I made some small mirrors for local friends and ATMs, tried some different optical designs like the Yolo and Cassegrain, etc. Being a college student with a family, the extra income was kind of nice. Eventually the little light bulb went on. Could this be a career opportunity?

Because of my interest in ATMing I had a subscription to Amateur Telescope Making Journal. Shortly after I graduated from the U of I, I thought "What the heck. I'll put an ad in ATMJ and see what happens". I figured I'd sell a few mirrors here and there to supplement my income from my teaching assistantship position at the U of I. Well, I did sell some mirrors. Enough to convince me that making a full time go of it was worth a shot. So I left the Physics program to pursue the optics business full time. Like I said before, I was in Physics because I couldn't decide what field to specialize in. What I

realized was that I had finally found my calling. Optics! I started in the optics business straight out of college and have been at it since 1991.

My brother Toney joined me in 1993 to set up our machine shop. At the time he was already working as a machinist, and I had a request from a customer to build an observatory scope (a 20" Classical Cassegrain). Toney had enough faith in me to make the jump to private business and off we went.

One of our first tough jobs in 1993, a 20" Cassegrain for a private observatory, was for a man named John Jamieson. This was my first F/3 mirror and John and I knew it would be a challenge. John arranged for me to spend a couple of weeks in training with Bob Goff of AXE in Tucson. Bob then made a follow up visit to our shop in Iowa City to help get our interferometer working. When the scope was completed we loaded it in a U-Haul and drove it out to Orcas Island, west of Seattle to install it. The whole job was such an adventure from start to finish. I truly admire John for giving two rookies a chance and Bob for sharing so freely of his optical knowledge. Both John and Bob passed away a couple of years ago.

I can imagine. But I'm sure that wasn't the FIRST mirror you sold was it?

My first real customer was an amateur astronomer in Wisconsin. I made him an 8" F/5 Dob with a fiberglass tube. We later made him a 14.5" truss Dob. Don't tell Dave Kriege, but we were competitors back in 1994. We built and sold about 10 truss Dobs in the 12.5" to 24" range. Obsession pretty much kicked our butts so we got out of that business.



Another happy OMI crew member figuring amateur sized mirrors

So where are you now - obviously a lot further along than 12 years ago, I'd bet. Tell us a bit about your product line.

Well, I'll start by saying that our products are probably more diverse than you think. First of all, we keep optics in production for the amateur astronomy community. Most of our sales in this market are to Obsession Telescopes and direct to ATMs. These mirrors range in size from 12.5" to 25" aperture. For this market we produce over 100 mirrors per year.

My wife Stasi runs the machine that figures 12.5" and 15" mirrors. Dean Carlton figures most of the 18", 20" and 24" mirrors. I do all of the testing and call out the figuring runs we use to parabolize the mirrors.



An OMI telescope being installed in Korea

We also build observatory grade Cassegrain telescopes for the university and government markets. These scopes are fully automated with software and controllers to operate the scope, filter wheel, CCD camera, etc as well as the telescope enclosure. This system is an offshoot of a system initially developed for the Iowa Robotic Observatory, operated by the University of Iowa. It started as a scope on the roof of Van Allen Hall, operated by students in the lab down stairs and evolved into a telescope out in Arizona (of our construction) that is accessed by about 300 U of I undergrad students per year. We've continued to develop what was formerly known as OCAAS (Observatory Control and

Astronomical Analysis System), now Talon, and apply it to telescopes of our own design and construction. We build a couple of these systems per year and install them all over the world. They range in size from 16" to 40" aperture. We also do custom work for University and government research labs: optics or entire telescopes for things like Lidar (similar in concept to Radar but with laser energy), infrared imaging and so on.



Installing an OMI telescope in the tropics.

As you probably guessed, in addition to an optics shop we have a well equipped machine shop and some engineering expertise.

What percentage of your work goes to Amateurs?

I'd estimate that 50% of our work goes to the amateur community so you folks are very important to us. The rest goes to the professional community.



A large OMI Cassegrain

What's the largest mirror you've made, and how many have you shipped?

The largest mirrors we make on a semi-regular basis are .8 and 1 meter. These are usually Cassegrain primary mirrors at F/3 and they go into our telescopes. We're currently making a set of mirrors for Caltech which include a 48" diameter flat and a 40" F/2.5 paraboloid. The 48" flat will be our record. These mirrors are for a UV imaging project at Caltech. We're supplying the optics and they are building the hardware and instrumentation.

As far as total current mirror total goes, I don't have an exact number but it's over 1000 to the amateur astronomy community. The last 500 or so shipped in the last three years. A good percentage of these went into Obsession Telescopes.



Checking the mirror's progress

I know this is like asking a renaissance master whose style of painting he prefers, but I'm sure there are a lot of readers out there wondering - What's the best way for someone to compare mirrors from different companies?

A good mirror has the following traits: good correction for spherical aberration, a smooth surface and a good edge (no TDE). We use an interferometer to measure the mirror's correction for spherical aberration (among other among other optical errors). This is where the quantitative results for our mirrors are generated i.e. the Peak to Valley (P-V) and RMS wavefront errors and the Strehl ratio. The other two, smoothness and edge quality are more qualitative features of a mirror (but very important nonetheless) and they are checked using the Ronchi test and the Foucault knife edge test.

Each of the three tests we use has its strengths and weaknesses. I think it's important to use each of the tests where its strengths come through. We use the combination of quantitative (interferometry) and qualitative (Ronchi and Foucault) tests to qualify a mirror.



Testing equipment

We post a Ronchigram, interferogram and the P-V, RMS and Strehl for each Newtonian mirror we make to our web site. The Ronchigram shows the quality of the mirror's edge and surface smoothness. The interferogram and numerical results give you the quantitative measures (P-V, RMS and Strehl) as well as a wavefront contour. I know of a few mirror makers who do something similar so you could visit their web sites to compare results.

A quick comment on the numbers: when comparing numbers, it's important to know how they were generated. In most cases they come from interferometry or the zonal Foucault test. There's an important difference between the RMS and Strehl ratios calculated by zonal Foucault testing and interferometric testing. The Foucault test measures a few points across one diameter of the mirror to generate a 2-dimensional cross section of the mirror's wavefront. The RMS and Strehl calculations assume that the mirror has perfect rotational symmetry. Because of this assumption RMS and Strehl based on Foucault test data are always over optimistic.

The interferometer takes data points over the entire wavefront and uses them to generate a 3-dimensional representation of the mirror's wavefront. Each interferogram contains roughly 300 data points from which the RMS and Strehl are calculated. We average at least five interferograms to produce the final results for a mirror so you have roughly 1500 data points in the calculation.

You can make an excellent mirror using either of the quantitative test methods, interferometry or Foucault. It's just that the numbers will be a little different in the end and I think people should be aware of this when comparing. Of course, as mentioned above, the numbers are only part of the package. A good mirror should be well corrected, smooth and have an excellent edge (no TDE). If a mirror meets these basic criteria and has a true Strehl above .80 (or an RMS wavefront error below about .07) it will be an excellent performer.

Another big question many purchasers have when they go to get a premium mirror is always about the coatings - and there's been a lot of debate specifically about enhanced. I'm curious as to what kind of coatings you personally recommend?

We use enhanced aluminum coatings on all of our mirrors. There's been a lot of debate over the subject of enhanced vs. standard aluminum coatings but I think any side by side comparison will show that both types of coating are fine with the exception that the enhanced is brighter. I've read a couple of reviews that compared like apertures, one with standard aluminum and one with enhanced aluminum and this was what was found in the comparison. I think you co-authored one of them.

I'm not a coating expert but I have learned a lot about coatings and the coating process in the last few years. Regardless of coating type it's important that the process be done properly. You can screw up a standard coating just as well as you can an enhanced coating. The process is basically the same either way but the enhanced coating has more overcoat layers on top of the aluminum.

For coatings, we use Flabeg in Pennsylvania. They do a lot of coatings for the automotive industry (rear view mirrors and such) but they also coat large aperture mirrors for professional observatories.

What does the future hold for OMI?

In the short term much of our energy will go into process refinement and further improving our QC processes. I'm a real hands on kind of guy so I do a lot of experimenting with different process and test setups. I'll get something working in a prototypical sort of way and use it for a while to get some work out the door. There are lots of the prototypical things still in use throughout the shop. We'll revisit these one at a time to design and build something more refined. Once you have a good process working most of your energy goes into refinement making it more efficient.

I have some longer range visions that include some vertical integration. Adding things like glass machining capabilities and coatings. I have a grander vision of building a shop in a good dark location away from the lights and activity of the typical light-industrial zone. I'm looking into it now but its at least a couple of years down the road.

We've talked about OMI so,lets turn the tables a bit - Who do YOU admire in the astro community?

I have to give Dave Kriege at Obsession alot of credit. It's partly because of Dave that we have the production process working so well. Without the opportunity to make the mirrors in some quantity I think our process might look a lot different. In the beginning we had some misfires but Dave stuck with us while we worked out the bugs. That takes guts. I jokingly tell people that Dave is my best friend because he buys so many mirrors from us. I genuinely like Dave and it's a privilege working with him. Dave's had such a great impact on amateur astronomy. He's put a lot of large aperture Dobs into the hands

of amateurs. I'm really proud of our association with Dave and Obsession. He makes a great scope and I couldn't think of a better home for one of our mirrors.



James Mulherin, Don Wyman, Dave Kriege and John Crilly

Umm - that particular Obsession looks a little familiar... I will admit, I'm very pleased with it - and the OMI/Torus mirror it houses. I've not met Dave in person yet, but he's invited me to several get togethers - I do hope to get together with him (and you) at sometime in the future at some star party - small or large. I guess that leads into the next logical question - Do you consider yourself a hardcore amateur astronomer?

I'm an amateur astronomer, but not a very good one. I spend most of my time on business stuff. The wheels are always turning. Like the old saying goes: "The cobbler's kids have no shoes." I don't get out observing much but I have plans to remedy that. I attended Astrofest and the Okie-Tex Star party this year. I'm signed up for this year's Winter Star Party too. I've had a good time this year hanging out with Dave Kriege of Obsession telescopes and our mutual customers.

When I do observe I have a 15" Obsession that suits me just fine. I like it for it's size and portability and it has plenty of aperture for my casual observing style. Since I don't get out much I haven't developed any sort of serious observing program, or strong interest in any particular class of objects. There'll be time for that after I retire in about 25 years. In the 15" F/4.5 Obsession my favorite object is the Andromeda Galaxy in a 35mm Panoptic. It's just the perfect combination to frame Andromeda and it's companions. Otherwise, I enjoy the Messier objects and the brighter NGCs, and of course the planets. I even look at the moon once in a while. (Apologies to Don Wyman for this bit of heresy.)

I think that's about it for me James, anything else you'd like to comment on?

Our mission is to make our customers happy. That's what makes our business thrive. Quality, price, delivery, support. Ask anyone at our shop and they will know exactly what these four words mean to us. We talk about them all the time. As a company we believe that following some basic principles will help us win and keep customers. We are always

working on refinements to our production and QC processes. The goal is to produce consistent quality, improve efficiency and shorten delivery times. Customer support and service, before and after the sale are also critical. I am extremely accessible. If you call you usually get me on the phone or someone will bring me the phone. If I'm at the shop you can talk to me. If I'm not there you'll get a call back within 24 hours. I check and answer my E-mail at least twice a day. I even participate in the some of the internet news groups. I am an aggressive customer supporter, for lack of a better term.

Growing a business is a lot of work but when you get it right it's really rewarding. I'm frequently told that we have the most responsive customer service in the business. It's really nice to hear this because we do work hard at it. It feels good when you get it right.

Thanks James, we appreciate you taking time out of your busy schedule to sit down with us today.

You're most welcome. I appreciate your giving me a chance to introduce myself and our company to your readers. I'd like to invite your readers to contact me directly if they have questions about our products. You can find my direct E-mail and telephone number on our web site www.opticalmechanics.com. You can also join us on the Torusmirror Yohoo group <http://groups.yahoo.com/group/Torusmirrorgroup/>



All Pictures Courtesy OMI.

Readers: Got a question you'd like to ask your favorite manufacturer? Submit it to: tomt@cloudynights.com Please include the question, and indicate if the question is manufacturer specific. If so, please indicate the manufacturer you'd like to see answer the question. Please put Suggestions:Behind the Scenes in your subject line.

Vendors / Manufacturers: Would you like to be included in Behind the Scenes? Please

contact: tomt@cloudynights.com for consideration. Please put VENDOR: Behind the Scenes in your subject line.

Article Author: Tom Trusock