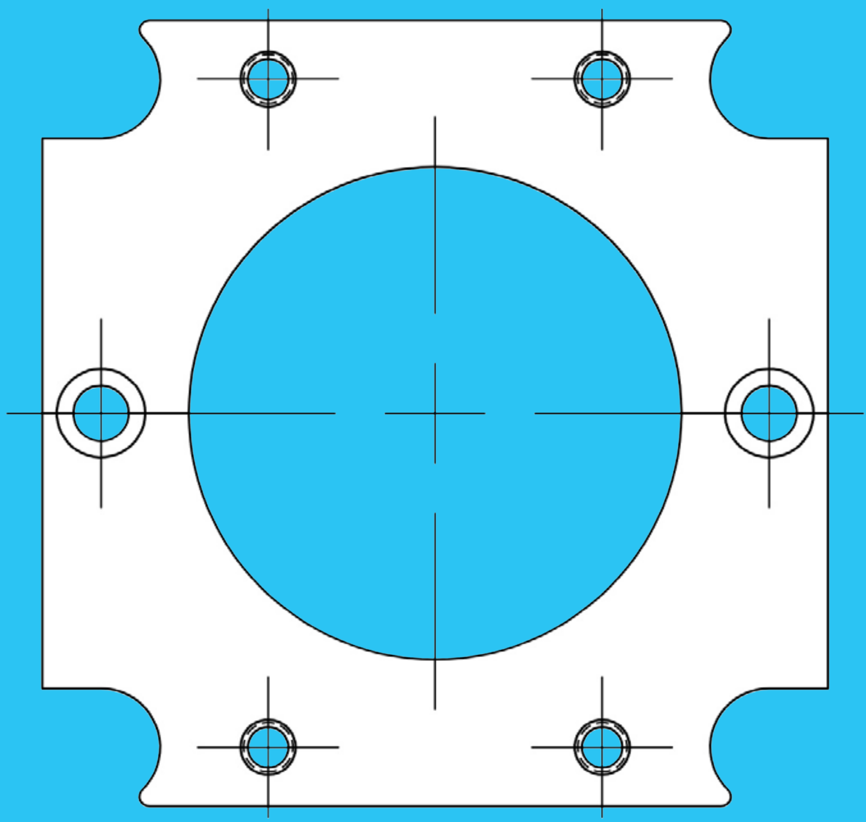
Optomechanix

Jan-April 2019

New Optoform II



PCT Patent Pending

Technical journal of OMiD, Opto-Mechanical Institute of Design

Photonics West 2019 held at Moscone center, San Fransisco

Contents

OSA The Optical Society 100 Since 1916

Member of OSA
Optical Society of America

OMD Opto Mechanical Institute of Design

SPIE.

Member of SPIE
The international Societry for
Optical Engineering

This issue Dedicated to:

Dr. Lotfi Aliasgarzadeh (1921-2017) was an Iranian born research scientist in the field of artificial intelligence graduated from University of Tehran in 1942. In 1943 he and his wife Fey moved to United States. He graduated from MIT in 1946, and received his PHD in 1949 from Columbia University in Electrical Engineering. He worked as a faculty member at Columbia, researching on signal processing applications.

In 1959 he moved to Electrical Engineering Department at University of California in Berkeley, and was the Director of Berkeley Institute of Soft Computing (BISC) since 1991. Dr. Lotfi Zadeh was the inventor of Fuzzy Logic. He first published his work named “Fuzzy Sets” in 1963, and published his important paper: “Soft Computing and Fuzzy Logic” in 1994. I filmed Dr. Lotfi Zadeh when he visited JPL for his presentation of Fuzzy Logic back in 1994, a talk that was so well received. I specially remember him mentioning the use of his Fuzzy Logic in Minolta Autofocus cameras. Dr. Lotfi received many awards for his research work, and teaching. Source: A tribute to father of fuzzy set theory and fuzzy logic by Muhammad Sajjad Ashfaq, Eastern Mediterranean University, Cyprus.

Lotfi Zadeh with his peers at University of Berkeley, and with his wife fay, and children at his home in Berkeley, CA

Web: www.optomechanix.org
Instagram: optomechanix
For digital subscription or suggestions email us at:
info@optomechanix.org
Chief Editor: Ali Afshari
Publicity Coordinator: Smaneh Karimabadi

Optomechanix is a quarterly journal of Opto-Mechanical Institute of Design (OMiD), with technical articles for practical, hands-on opto-mechanical engineers. This magazine is privately founded.

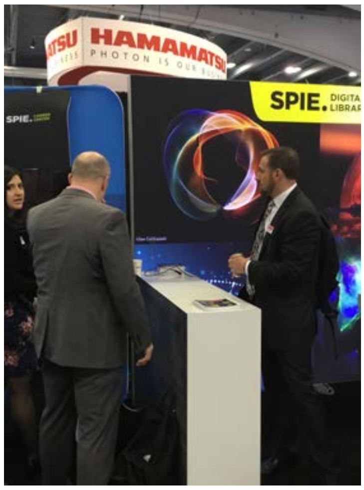
Cover page photo: New Optoform standard mount 40-104
Inside page photo: Front entery of Photonics West 2019 in Moscone caneter, San Fransisco, California

Attending Photonics West Show 2019 (Feb 5-7)

I attended this year's Photonics West, reluctant to visit all the booths because I had my own product which I had promised to display at the show. The show was fully booked before the end of last year so I stayed out of the booths as an exhibitor, and decided to reveal the new Optoform line at Laser World of Photonics this year, in Munich Germany. The show had less visitors than expected this year with 18,768 attendees, 5000 presentations, and 1,350 exhibitors, 70 of which were from Germany alone.

Going down the escalator entry to North Hall E, and F below the registration floor at Moscone center.

The new lower cost LED displays replaced most of the usual back illuminated posters and session entrances.



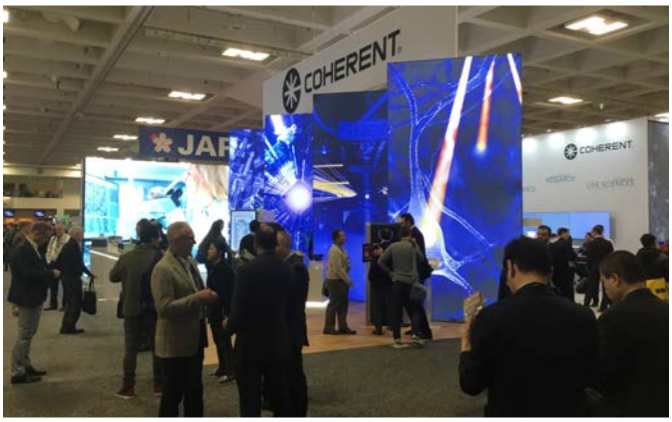
SPIE bookstore displayed new titles at the show (left) the attendees entering one of the two major halls at Moscone.

Unless there is a new product release, exhibiting at shows has become a meeting place to just say hello to customers. Joe Cossman at his business training seminars always said if you are a small company, displaying your product at a big show, your best customers are always the other exhibitors. The first day of a three-day show like Photonics West is when you could find CEOs standing at their booths. They are there to see the show for themselves, and oversee their booth. The second day is when customers are visiting booths to see new products, and get catalogs. The third day is when most sales people go around the show to see the rest of the exhibition, and to see their competitors.

Trade shows are also where international connections takes place. Most companies who have established sales offices in US have found their distributors at trade shows, and vice versa. So there are many eyes watching a product: Those who look for what they need, and those who look to see who sells similar products so they could become their distributor.

Ali Afshari

Registration (left), and the escalator entery to Photonics West at Moscone center (right)



The Leica microscopy group was missing from their usual place, at entrace of north hall in German pavilion this year.

SPIE, and OSA booths had give away toys. The OSA give away toy was a blue injection molded dancing robot!

Displaying the new Optoform line to OSA, and SPIE. William Goodman (right), holds an autocollimator assembly built with Optoform.

Posing with Lutcius Amelong at PI booth (right). He's now at PI Innovation for development for future products.

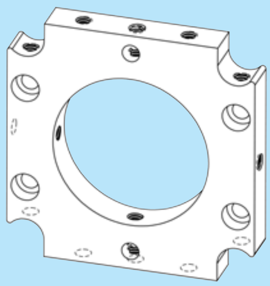
The snack pack concept is picked up by OptoSigma (left). Short couse booklets, and new book releases at SPIE booth.

Release of Optoform II, the next generation of optical Cage System

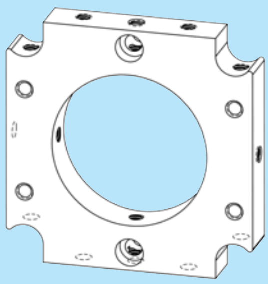
Announcing the new Optoform concept was scheduled to be at the PW show this year but unfortunately the patent process to file the PCT application took more than I had anticipated. The product was only shown to select individuals at the show and the plan for its release was postpone till Laser and Photonics show which will be held this year in Munich Germany.

I have mixed emotions how I would move forward with marketing this bombshell. When visiting trade shows, and observing so many new products, I have always been so blunt about good product design that I have often offended some sales people by telling them their product isn't honest. An optical cage system should bring something new, and honest to its end users. If you think you could just take off one rod, or change anodization colors, your product will not be accepted in the market. People will say no. Although a three rod cage system is as good as a 4 rod arrangement but that's an engineering decision. It is not an innovative one.

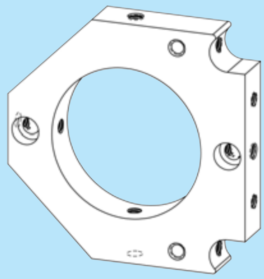
So after nearly 25 years past my original invention of Optoform in 1994, I said to myself this better be something really good or I won't spend my time on it. Luckily, the new idea I had about making them cheaper, and more versatile, led me



40-100

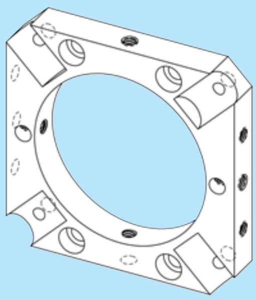


40-104

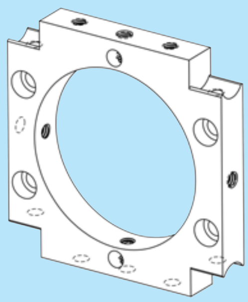


40-102

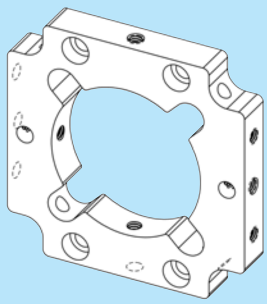
Standard Optoform parts include 40-100, and 40-104. These mounts can be mounted face to face, and are 40x40 mm square.



40-118S

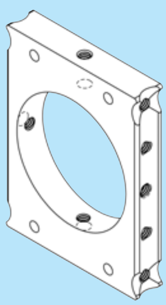


40-108S

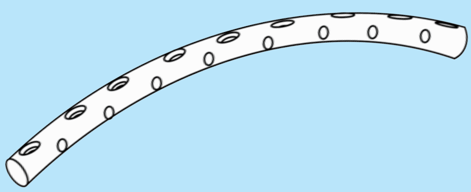


40-30

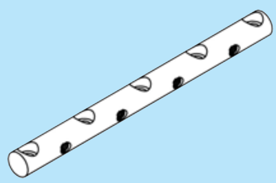
More advanced parts can secure rods in diagonal direction, or inside and out of the mount, etc.



40-110

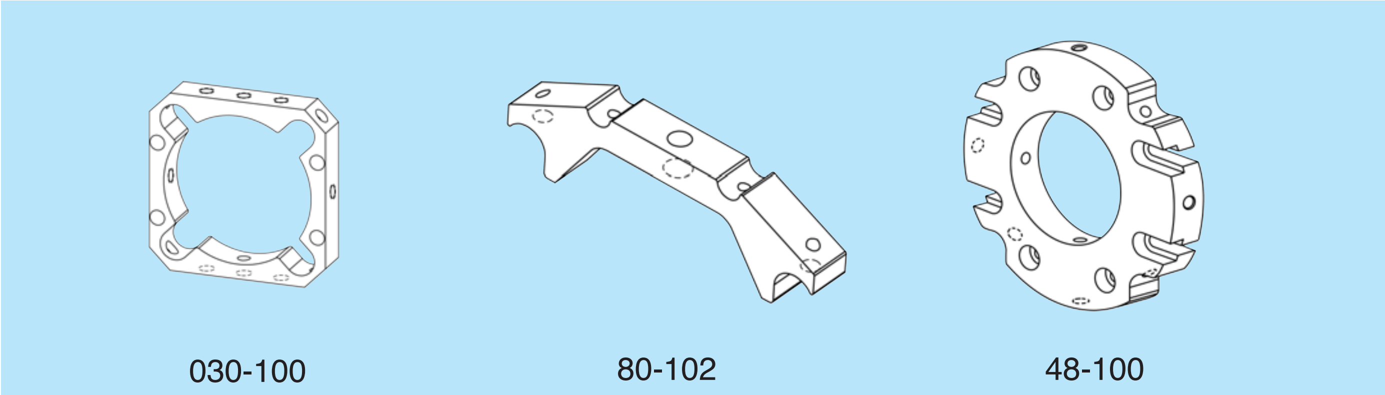


006-90D



006-74

Rods play a central role in new Optoform, and threy basically replace corner connectors. They are made of Aluminum.



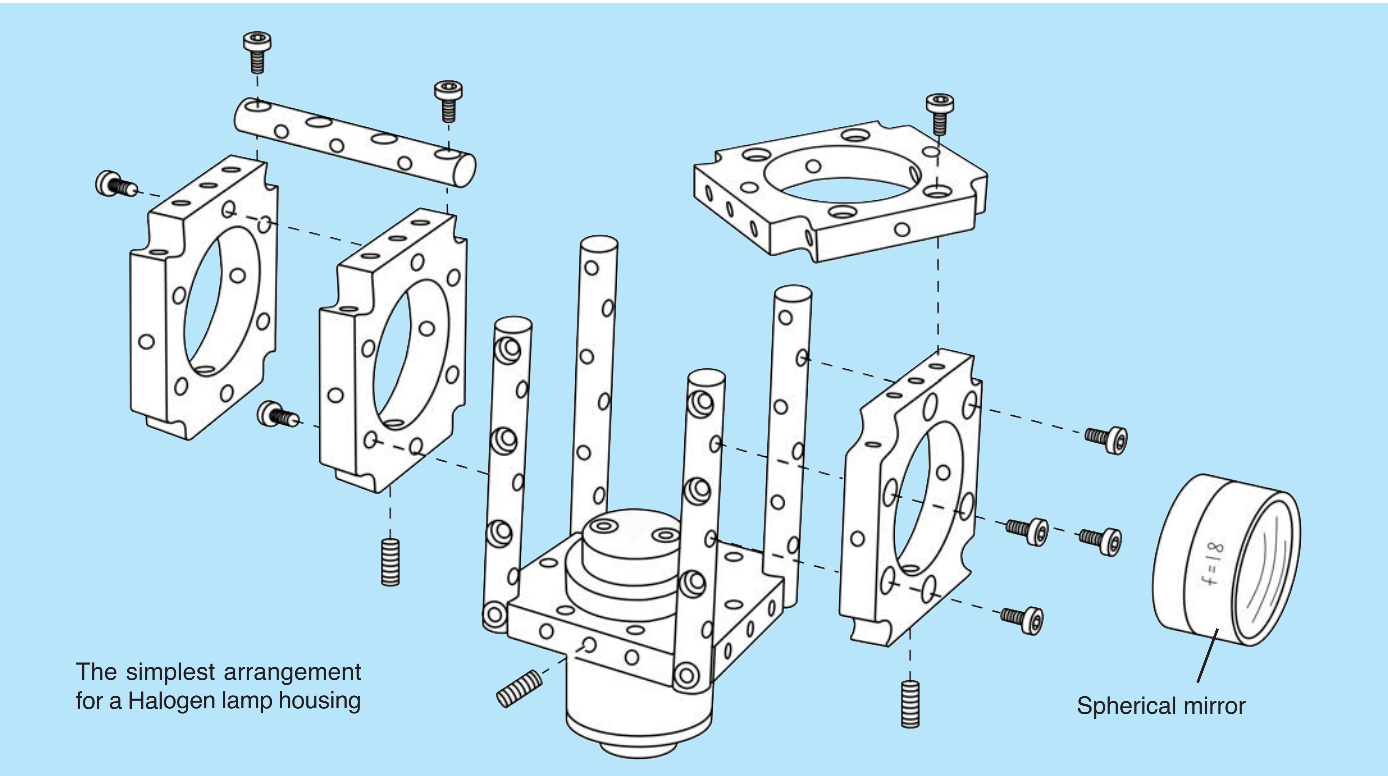
More Optoform parts reveal Micromax plate 30x30 mm square (left), to secure 25 mm lens cells.

to design a new form that it could be produced out of extruded Aluminum, and that would bring drastic reduction in its manufacturing. I manufactured Optoform for 18 years before handing it to Edmund Optics, and I remember it was taking a 5-axis CNC machine 5 minutes to produce each mount. This drove the price to be around $30 each. It was much cheaper to produce than Microbench but I still wished that it could have been cheaper. The new Optoform II can be produced in about half that time.

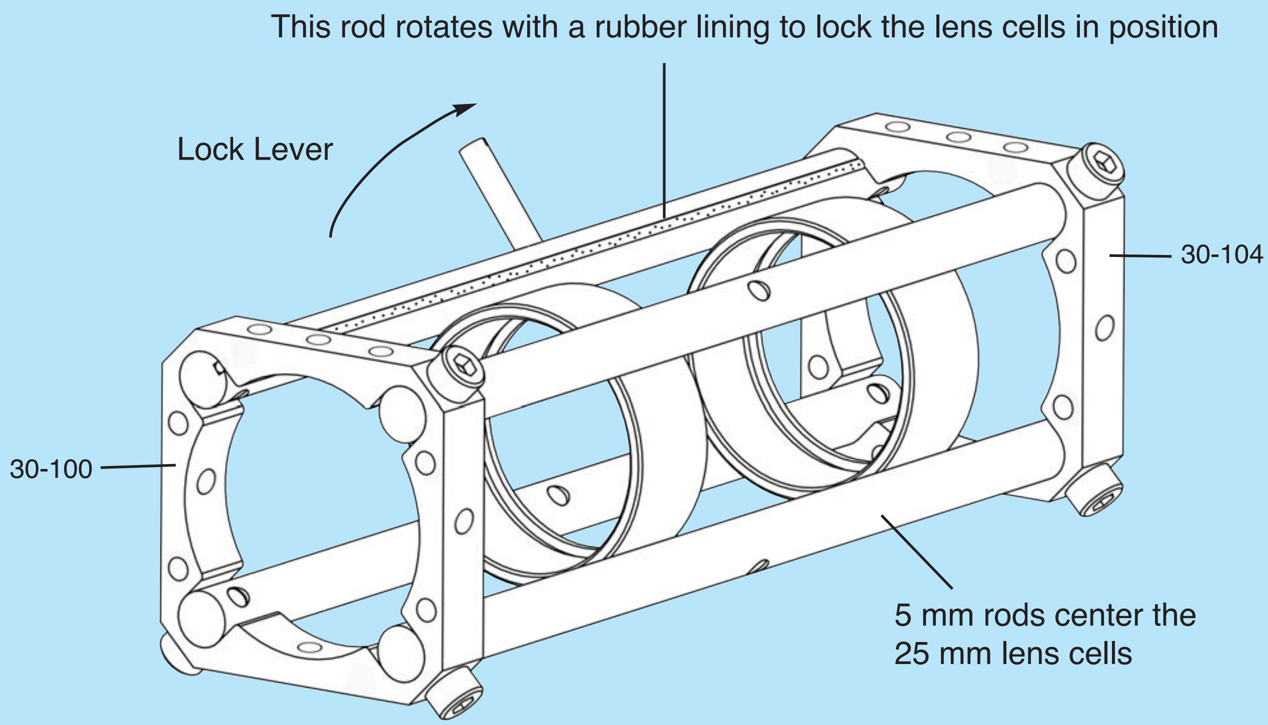
A New Way to Re-think prototyping

If you have ever worked with a cage system, it is like the Erector Set you played with when you were a child. The first lesson in innovation is that you need to set yourself free from limitations. The liberating factor in optical cage systems is you are able to make packaging decisions while setting up your experiments. In other words, you could also make decisions on how you would like your product to look like. This is very liberating, and constructive because what you build will have both form, and function when it reaches the product designer, and he or she could take your set up, and easily convert it to a product.

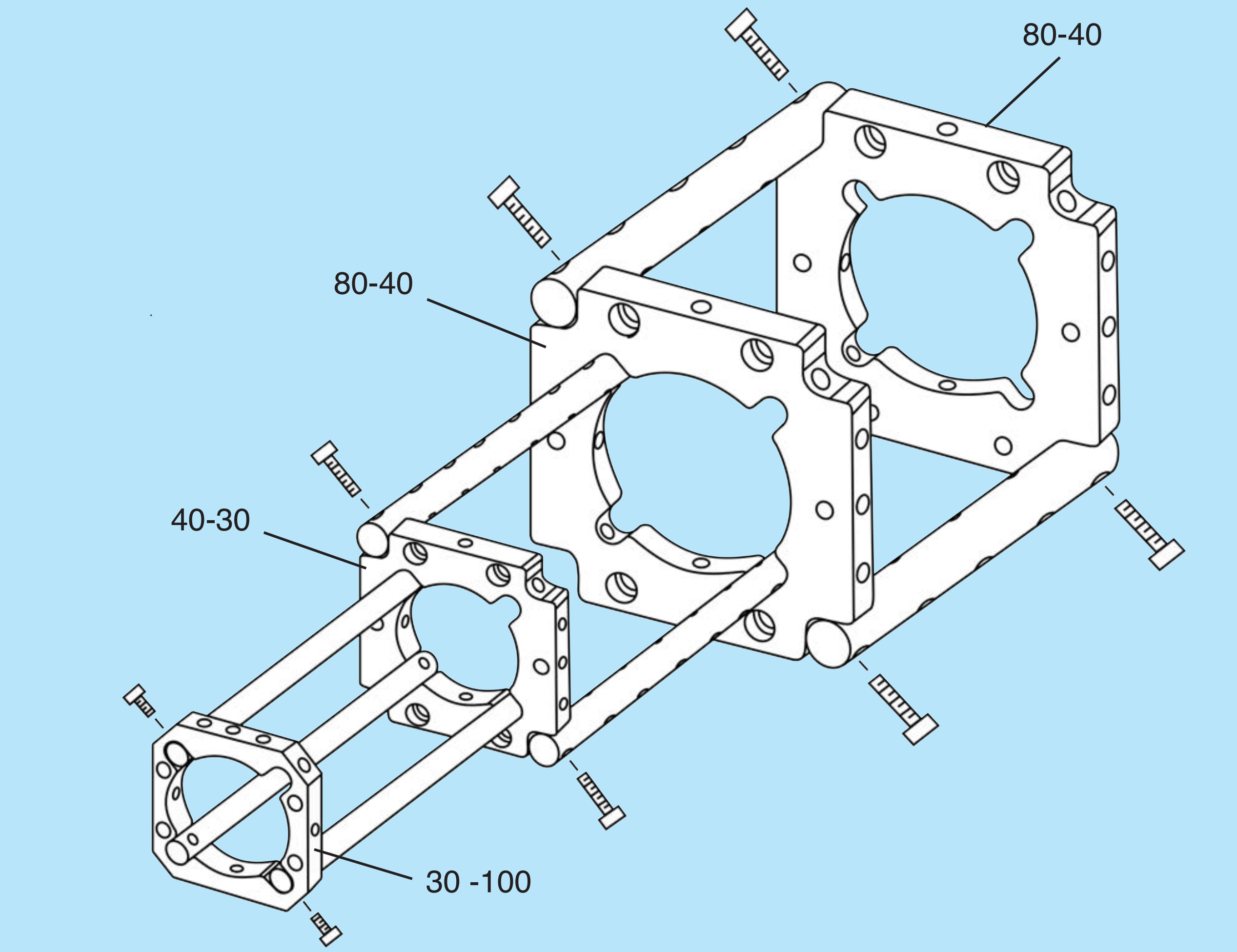
Because Optoform is now more compact, and less expensive, you would work with building blocks instead of discrete nuts, and bolts (see below). Through the lower cost, and more compact geometry of mounting plates, it would be possible



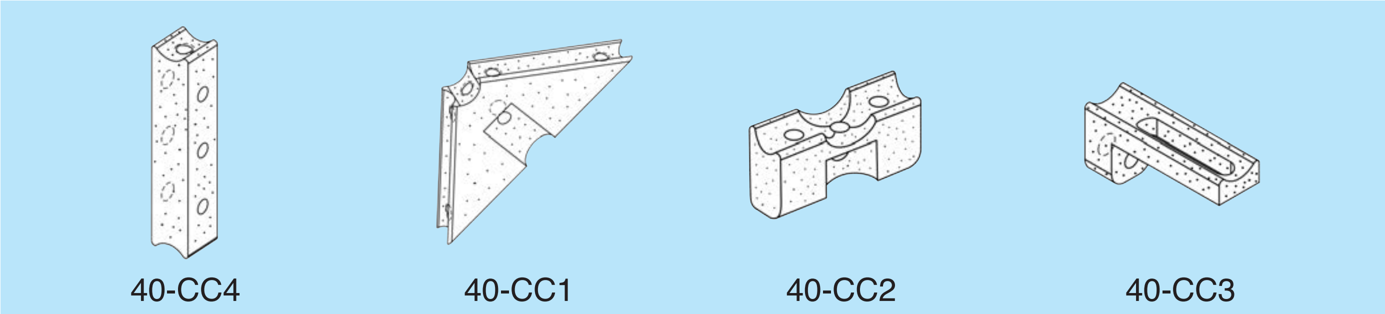
Here is the first assembly we'll build with the mounts: Tall halogen lamps can now be centered by using proper length of rods to center the filament with the condenser optics. Just like all the drawings for original Optoform, I drew this by hand! I don't understand how people can put away free hand design. The computer doesn't force you to contemplate.



The most compact 25 mm lens cell mounting system available: The new Micromax measures 30 x 30 mm square.



Optoform means following the conturs of inner optics as they get bigger in diameter with various size mounts.

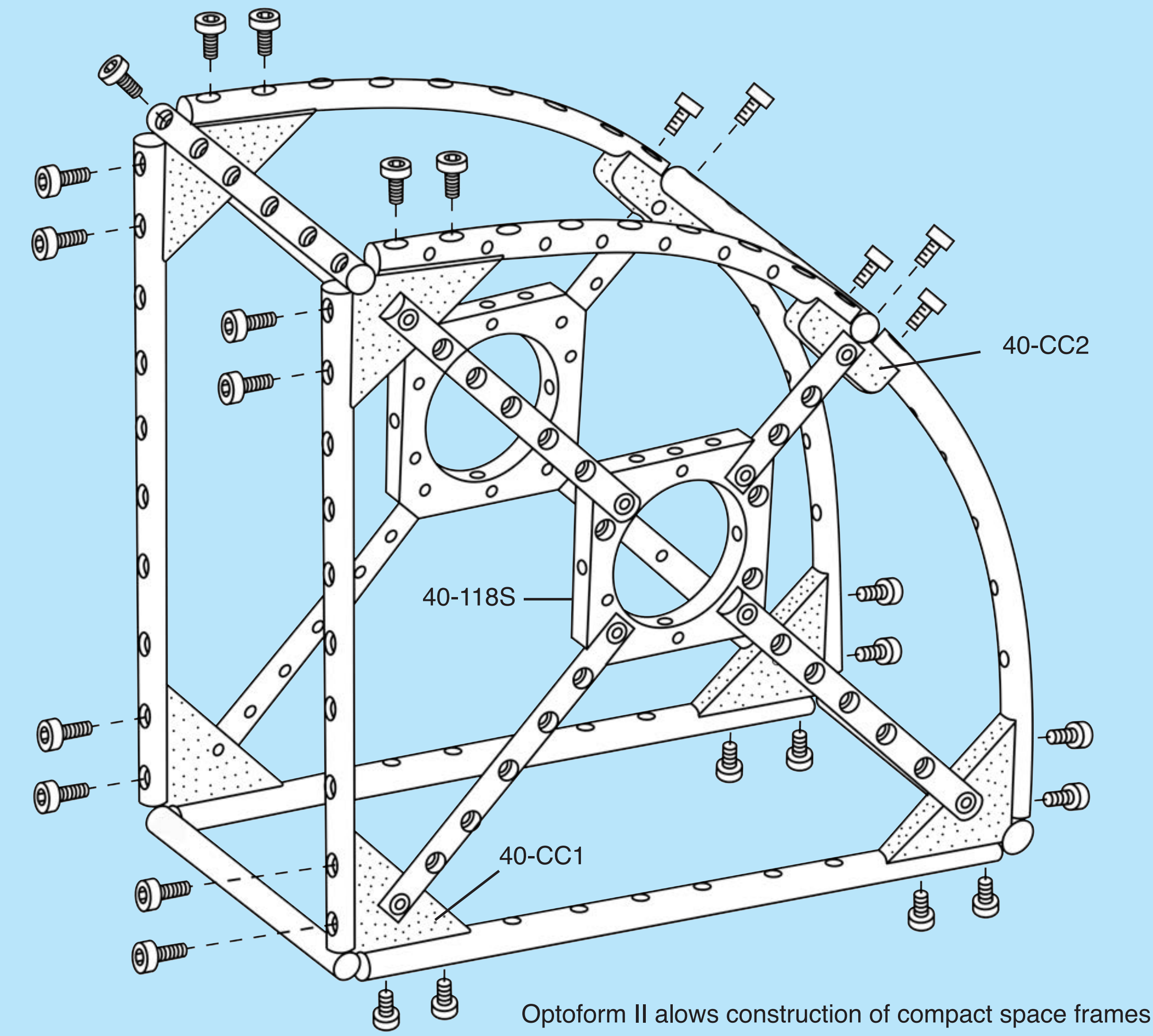


Corner connectors in new Optoform system are intended to construct space frame structures from a 20 cm cube up to one meter.

to work with preassembled modules and to avoid meticulous assembly practices utilizing dispersed hardware pieces. The mounts are now thinner, and lighter so you could divide your setups to sub assemblies. By using space frame components, you could also build complete housings and make portable instruments.

Fields like bio-photonics, and microscopy have long been waiting for a platform to integrate electronics with opto-mechanics hardware. The user interface software in biomedical instrumentation is usually the most time consuming part of the project. Most of the electronics hardware such as flat panel displays, sensors, imaging cameras, off the shelf optics, and filters have been readily available, and now this new line of opto-mechanics hardware can help build your most challenging projects from start to end.

The 20/20 line has been a very successful product to build space frame assemblies in research labs. You can think of Optoform as the new rigid space frame for building optical assemblies. In the next section, and in upcoming issues, we will review some real applications, and how the new Optoform building blocks can be helpful in constructing them.



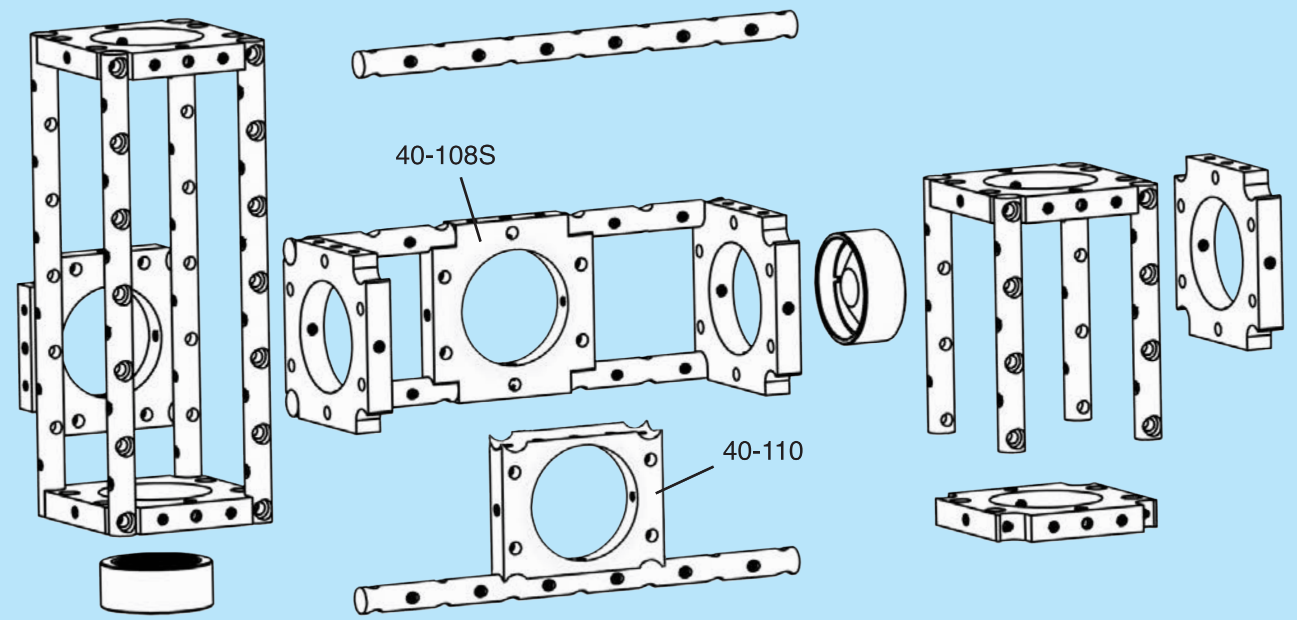
Optoform II alows construction of compact space frames

Designing the next concept for Optoform Cage Sysem

By Ali Afshari

In design, I am very much in favor of the “10 commandments of design” by Dieter Rams: In his view, a good design is: Innovative, makes a product useful, aesthetic, makes a product understandable, unobtrusive, honest, long lasting, through down to the last detail, environmentally friendly, and it is as little design as possible. These guide lines have always helped me in designing a new product. When I first came up with the original Optoform in 1994, I think it had the same qualities as these commandments describe. I am amazed at the number of ideas that came through immediately after its first conception. Back then, the idea was to simplify the square Microbench system to a round shape to achieve more versatility, and easier manufacturing. When I sold the Optoform line o Edmund optics back in 2012, they had me sign a non compete agreement for 5 years. The contract prevented me from re inventing, and almost everyone knows by now that when they tell me you can’t invent something, that’s where my mind gets busy doing without any stopping!

In any case, the idea of new Optoform started with me examining an extruded mounting plate made by Micos, Germany that I had purchased a few years ago. I thought wouldn’t it be nice to be able to mass produce Optoform using Aluminum extrusion process, and simply cut off the pieces redy to use.

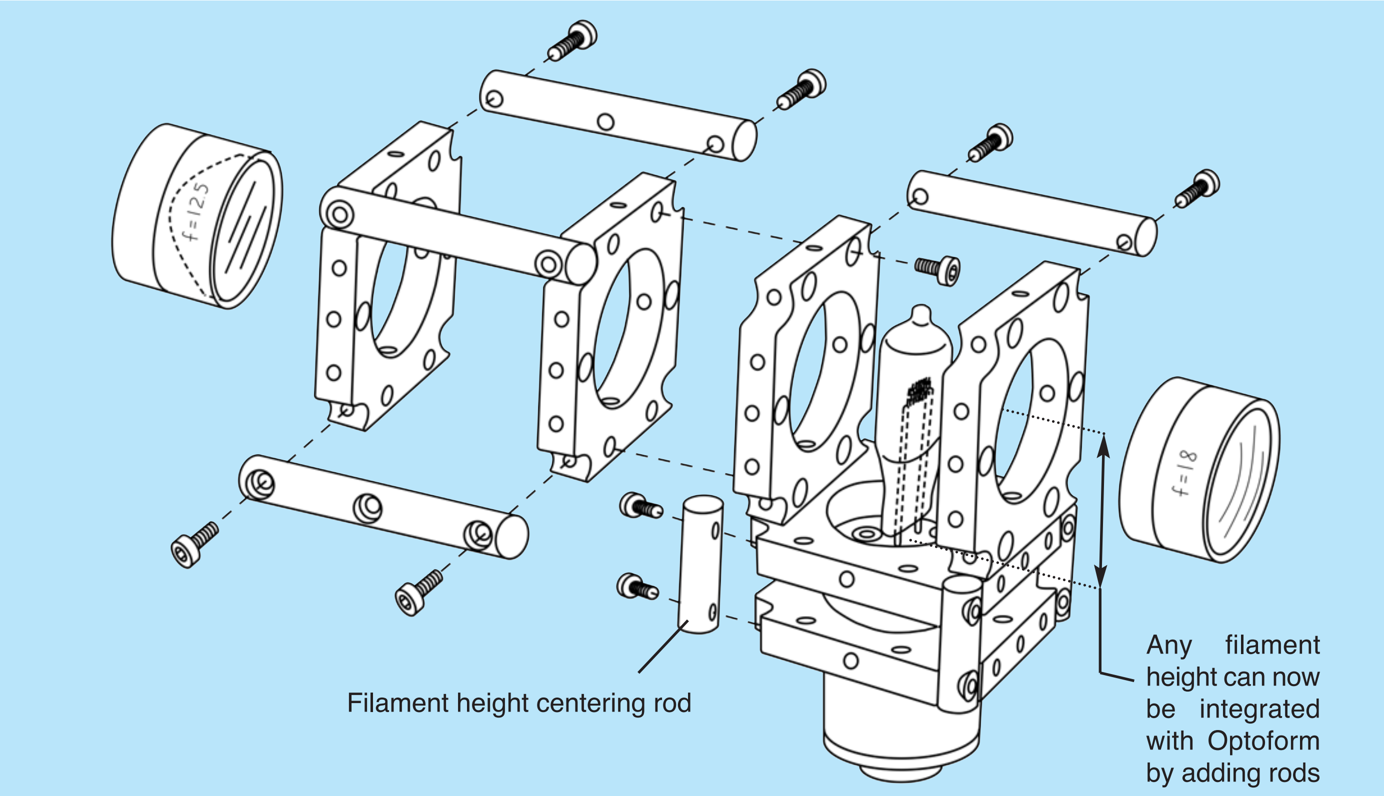


The new Optoform system offers more versatility

What prevents this from happening is the precision bores in all prior art that were not producible in the extrusion process. So I came up with the idea to place the rods on the outer concavities of the square blocks. The new shape enabled producing them using the extrusion process. The CNC machine takes the bars, and would make the necessary threaded bores to the desired specification. The new optical mounts have the following advantages:

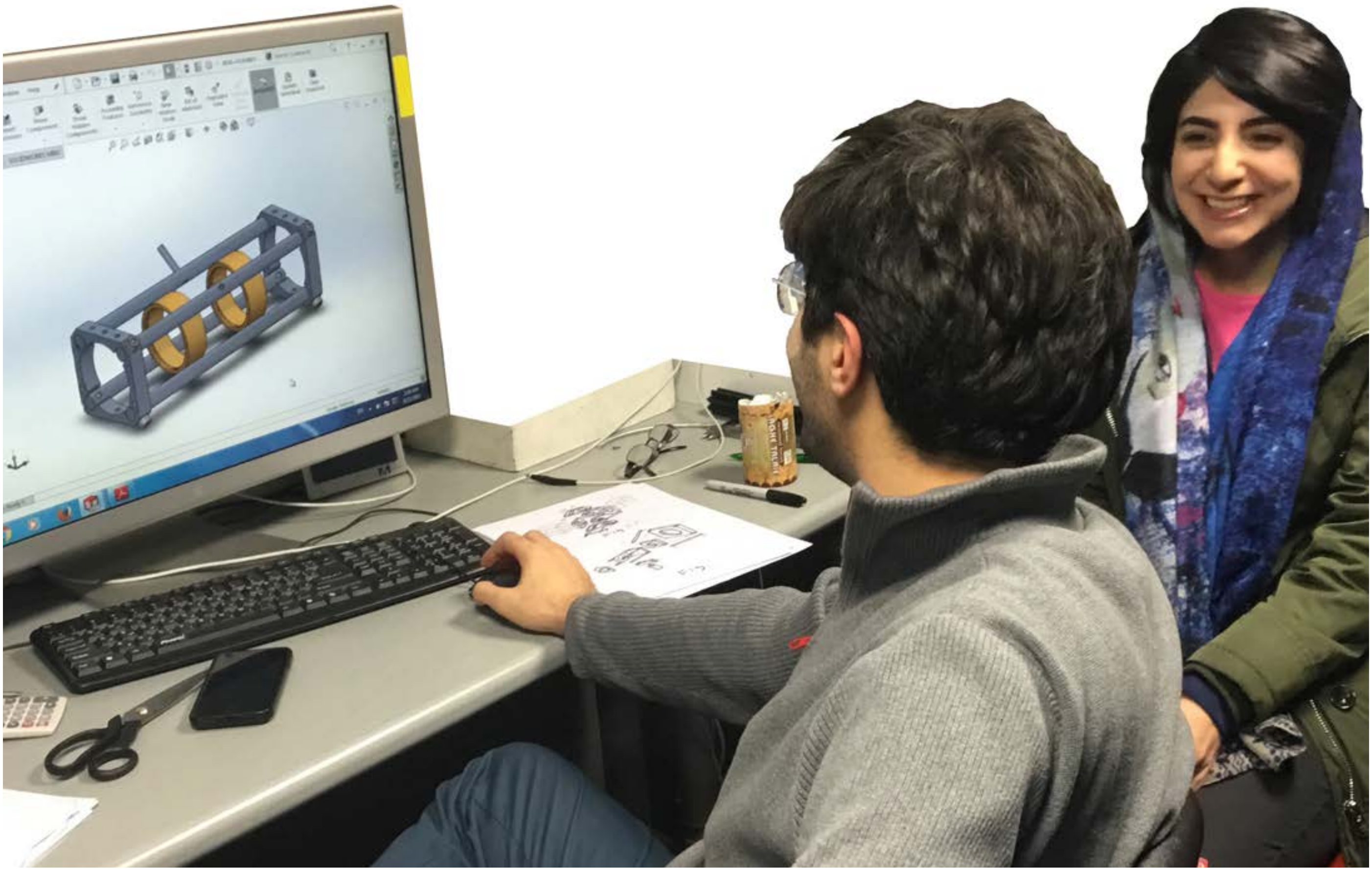
1) More affordable: It costs half the machining time to produce.
2) More compact, and light weight: Has thinner mounting plates, and uses Aluminum rods instead of Stainless Steel.
3) Eliminates connectors: Rods have bore pattern that allows them to be utilized as corner connectors.
4) Accepts larger optics: Placing the rods on outer edges allows mounting larger optics within the rods.
5) Quicker assembly: Allows optical setups to be assembled from pre assembled modules than individual parts.
6) More versatility: Mounting rods on outer corners of the mounts allows them to be mounted at many new angles.
7) More rigidity: Support rods are secured in place with Allen cap screws rather than tiny set screws.
8) Upward/ Downward compatibility: Various size mounts may be integrated together without limitation.
9) Space frame structures: New shapes of rods, and mounting plates offers space frame housing to build instruments.

I think Dieter Rams would be pleased to see his rules can be applied to the new Optoform design, to pass his standards. As usual, I hand made all the initial parts to create my first set. Experience from my first Optoform set was so useful in creating the new set. Back 25 years ago, I came up with so many parts but today, I tried to minimize my parts list, and to make each piece more multi purpose. What I like about the new Optoform is its ability to create sub assemblies. For example, when a lamp housing is made, it can be put aside and never taken apart (opposite page). Same goes for many



Assembly of a Halogen lamp housing as a self contained module.

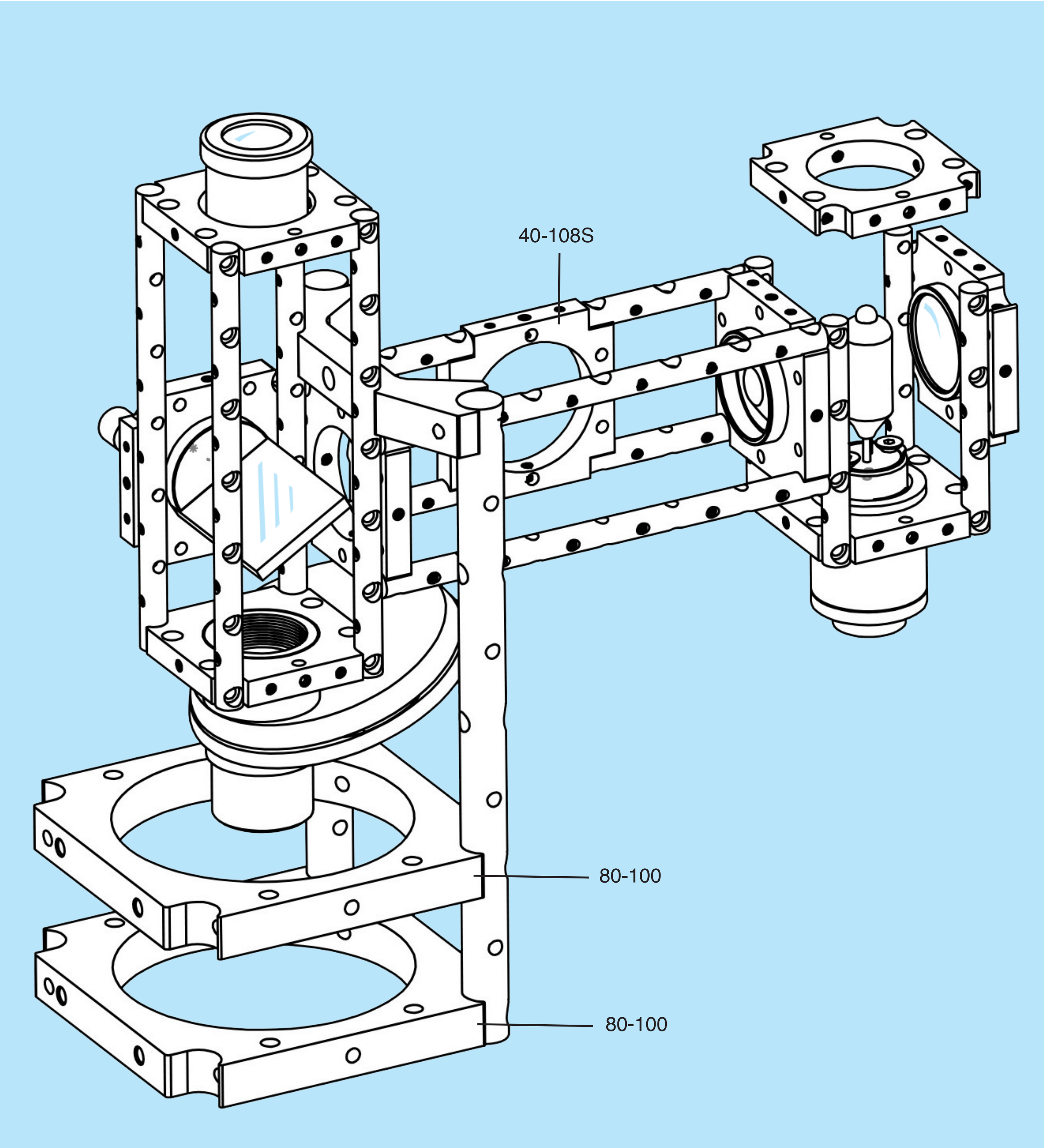
other useful assembled pieces in an optical lab: A swivel platform that is utilized in making a spectroscope, an eyepiece assembly with a beamsplitter, a spatial filter, or a beam expander. All these preassembled units have male, and female plates at their ends so they could be combined together without disassembly.



Navid Asadi, and Melica working on Optoform II assembly featuring a locking mechanism for 25 mm lens cells within four rods.

So what used to be a box full of mounting plates, and screws is now preassembled modules. The lamp housing below consists of a lamp housing, whose detailed assembly was shown on previous page. The ability to mount plates across support rods drastically reduces number of required parts to make a complex assembly like this metallurgical miroscope.

My special care was making it compatible with Micropench, Thorlabs' cage system, and the earlier generation of Optoform mounts all of which currently occupy many labs. That's why I went with the 40 x 40 mm square but was able to reduce the thickness to 6 mm instead of the 10 mm in prior art. Using these new plate thickness was possible because in new Optoform, we utilize allen cap screws in place of tiny set screws to secure the rods. Cap screws assert far more direct pressure to lock the rods in place, and because there is no tiny screws pressing against the rods, they could be made of Aluminum. Therefore, more compact, lighter weight assemblies could be built at almost half the cost that was spent before to get enough of these plates laying around in labs.



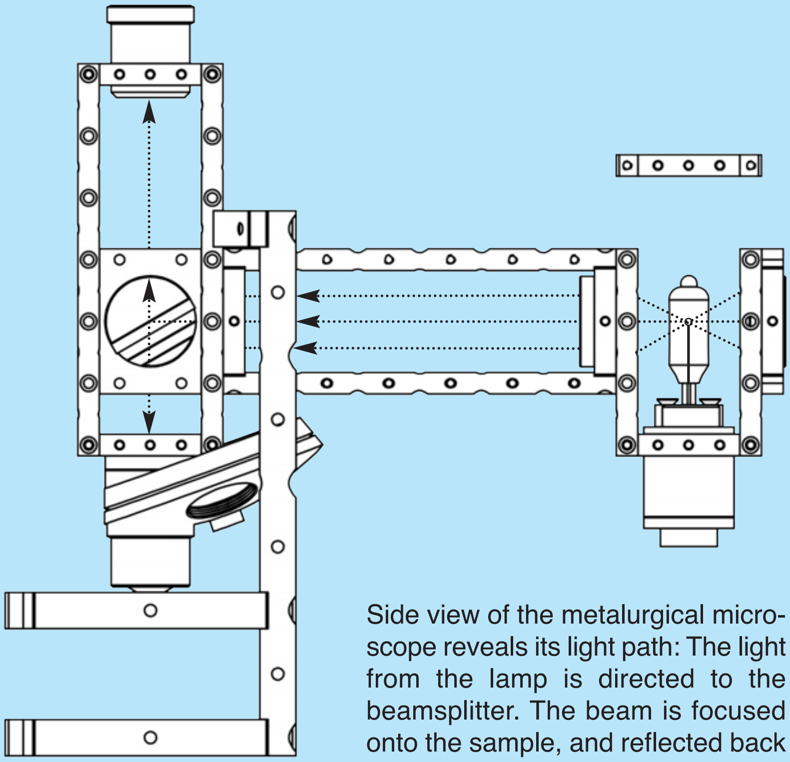
Above is a metalurgical microsope, whose rigid frame structure is built entirely with new Optoform components.

So what we have now is a new erector set to play with, and rest assured they will be much cheaper so you don't have to take them apart to start making something else.

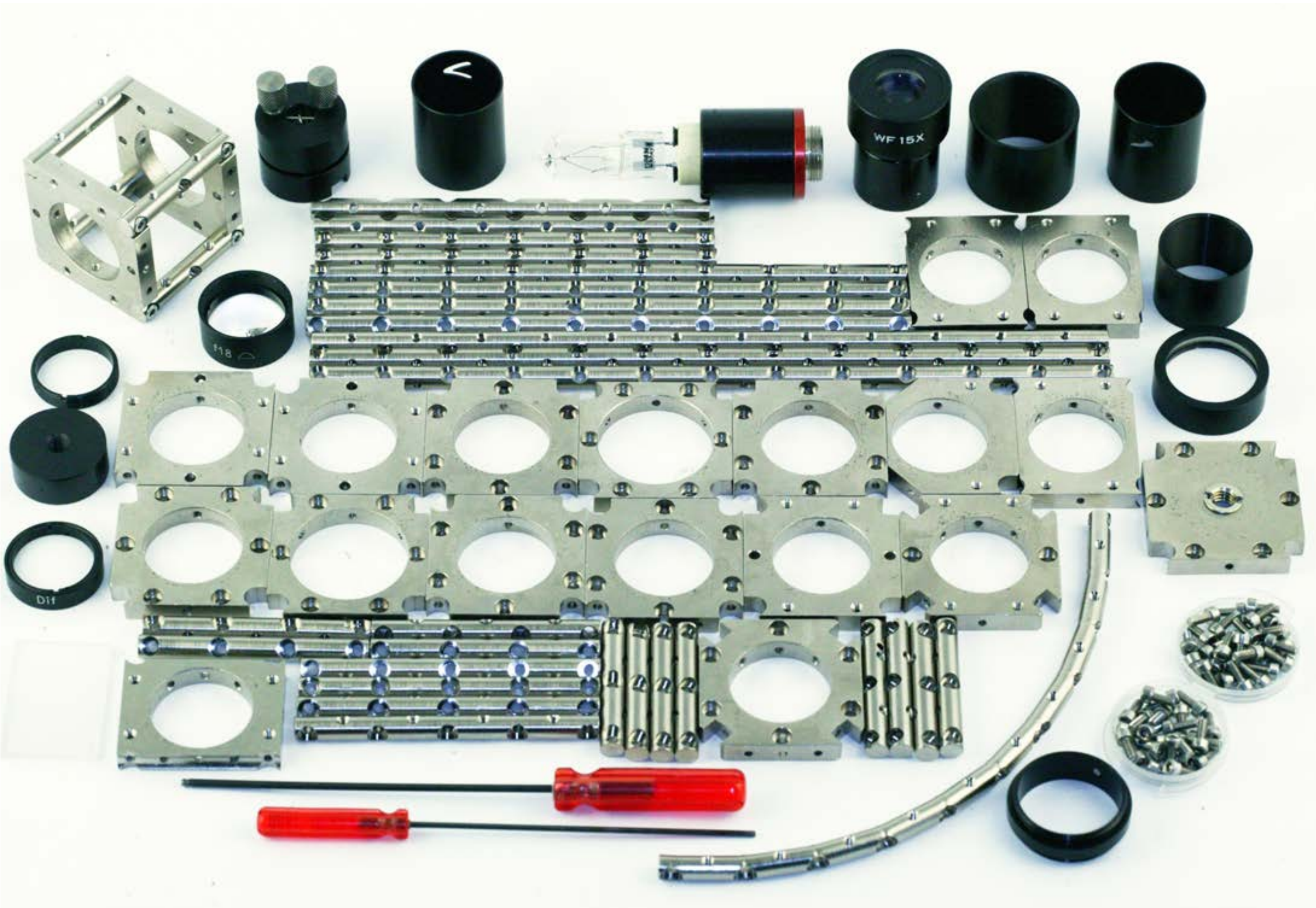
Therefore, we now deal with modules, rather than discrete hardware to build optical assemblies. The fact that these mounts are 40% thinner allows one to add interface plates (male/female) so the modules could come apart without loosing their own identity as a sub-assemblies.

Back in the days when Paul Ware was doing my patents, he told me how he quit smoking. He said I decided to do a little prayer, and the craving just went away. In designing Optoform II, I did the same thing. All creativity is given to us as a gift, and if we get connected with the source, he has so much more to inspire us.

I will never forget the joy I had during the first week of building these parts by hand. They are certainly far more enjoyable to play with.



Side view of the metalurgical microscope reveals its light path: The light from the lamp is directed to the beamsplitter. The beam is focused onto the sample, and reflected back to reach the eyepiece.



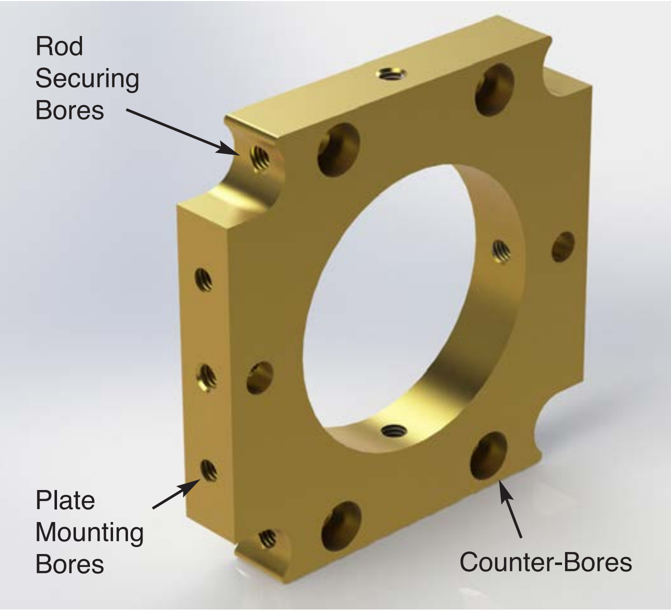
The first run of new Optoform parts last december to write the new PCT patent. You could look up its original patent US 5,828,502

Building an Autocollimator with New Optoform II

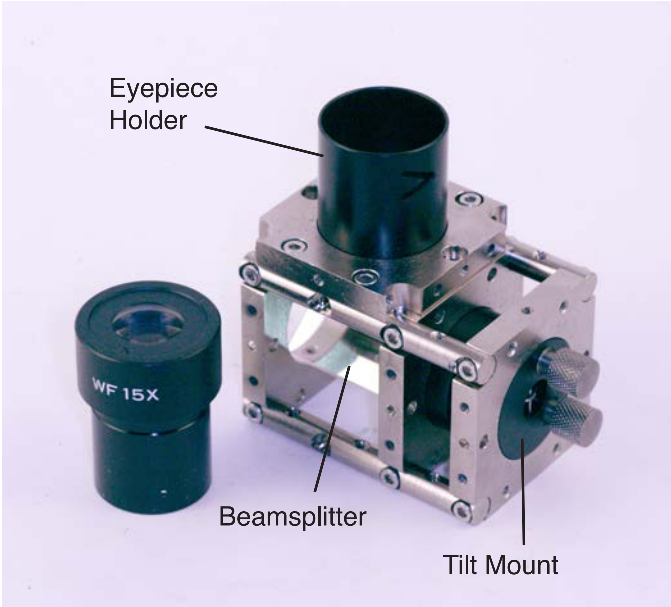
I will show you an example how to build an opto-mechanical assembly such as an autocollimator using a light source, an eyepiece, a focusable target, a beamsplitter, and an objective lens. Instead of starting with a central piece like the beamsplitter assembly, and adding components around it, we'll begin by constructing modules by picking different lengths of rods, and we'll combine them together later.

I would build the halogen lamp first: Halogen lamps come in different filament heights, and we'll pick the appropriate rod length to center the filament, and then would fine adjust it by sliding its socket within the mounting plates (below). The collimation optics consists of a concave mirror, and an Aspherical condenser lens. We can add 25 mm tubing to each one so we could focus them to the filament. Then there are more elements to add in such as the target, and perhaps a diffuser. The beamsplitter,a nd the eyepiece are then added.

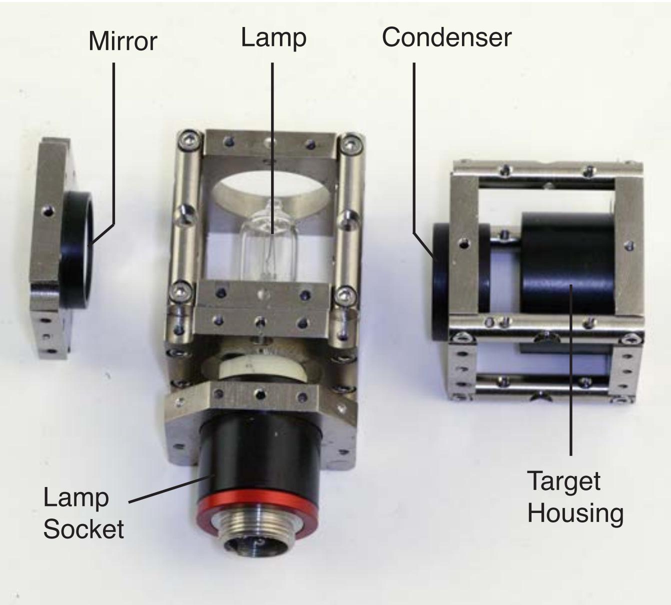
When putting them all together, the filament should be focused on the objective lens surface. A mirror can now be placed in front of the objective lens, and the target can be focused so its image would fall on itself. The beamsplitter angle, and the eyepiece is then adjusted to center, and focus onto the target.



Threaded bores on the sides, and counter-bores on the plates allow direct mounting of mounts at right angles.

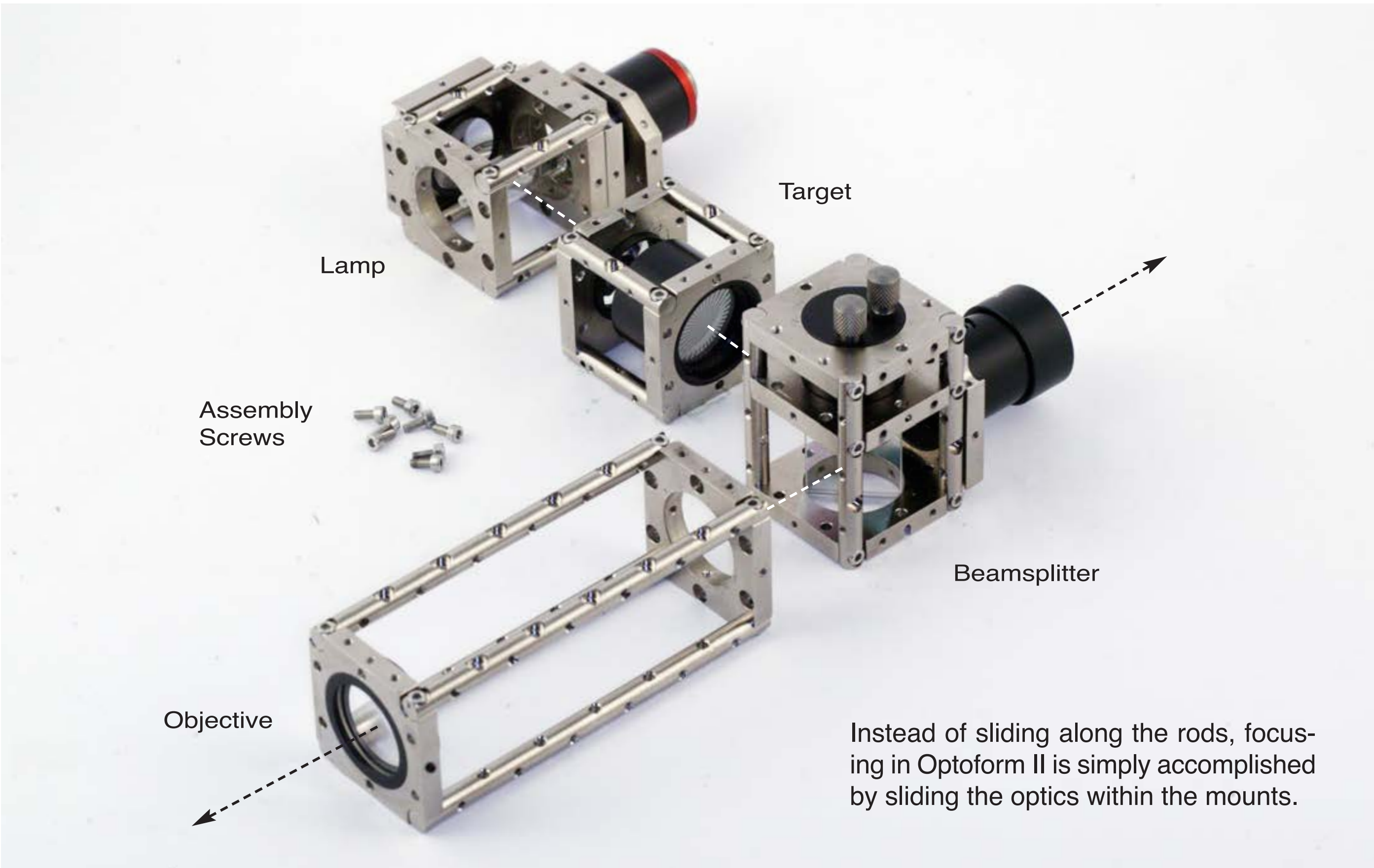


Thinner mounts means you could fit more components in a smaller package like in this beamsplitter assembly.

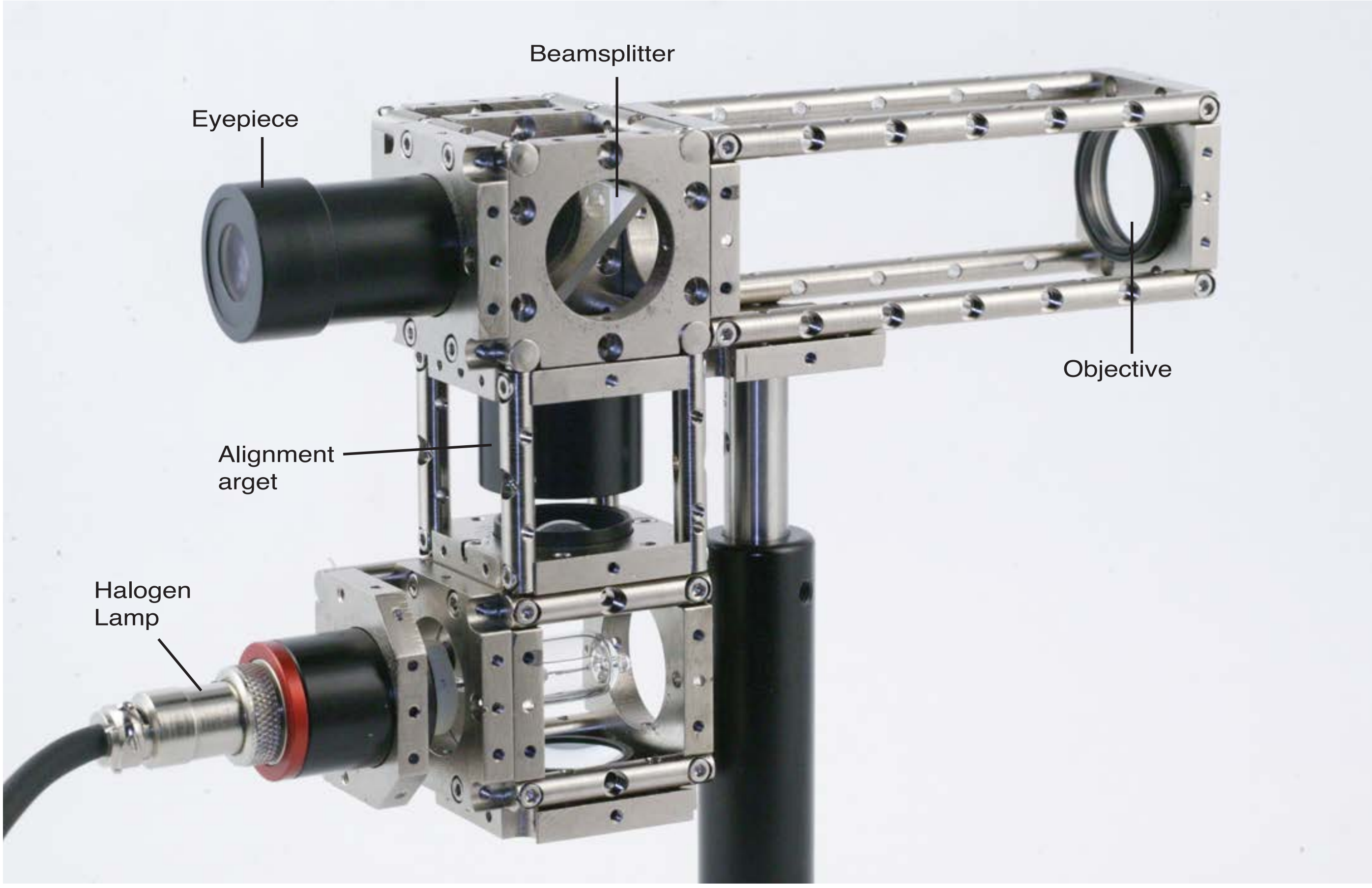


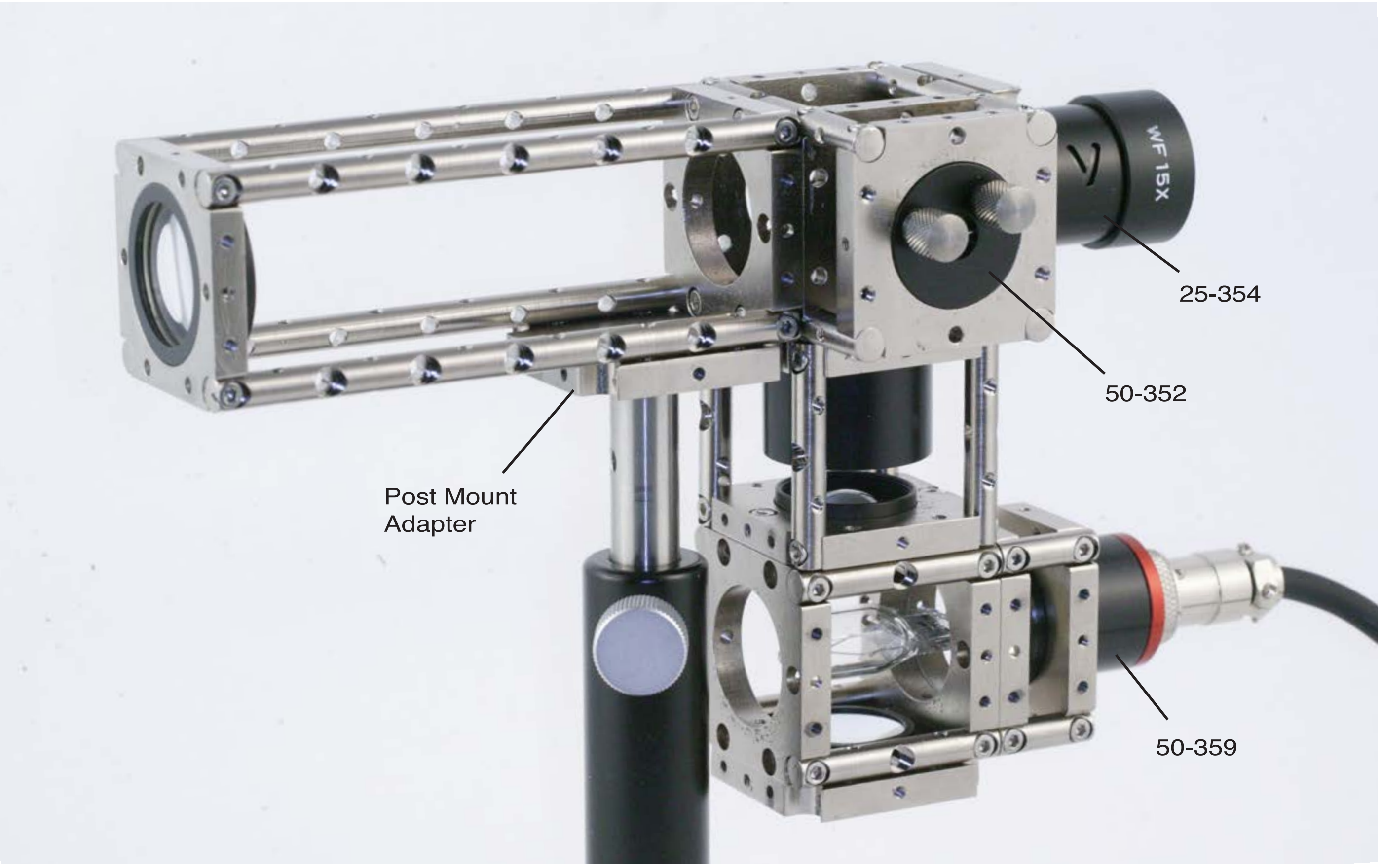
The mounts may be secured on side of rods to construct this illumination assembly for a Halogen lamp.

Here is an example of adjusting the position of elements within the mounts to build this target illumination optics.



The autocollimator before assembly. Here's the main difference between Optoform II, and the prior art: Thinner mounting plates allows you to sub-divide your assembly without redundancy.

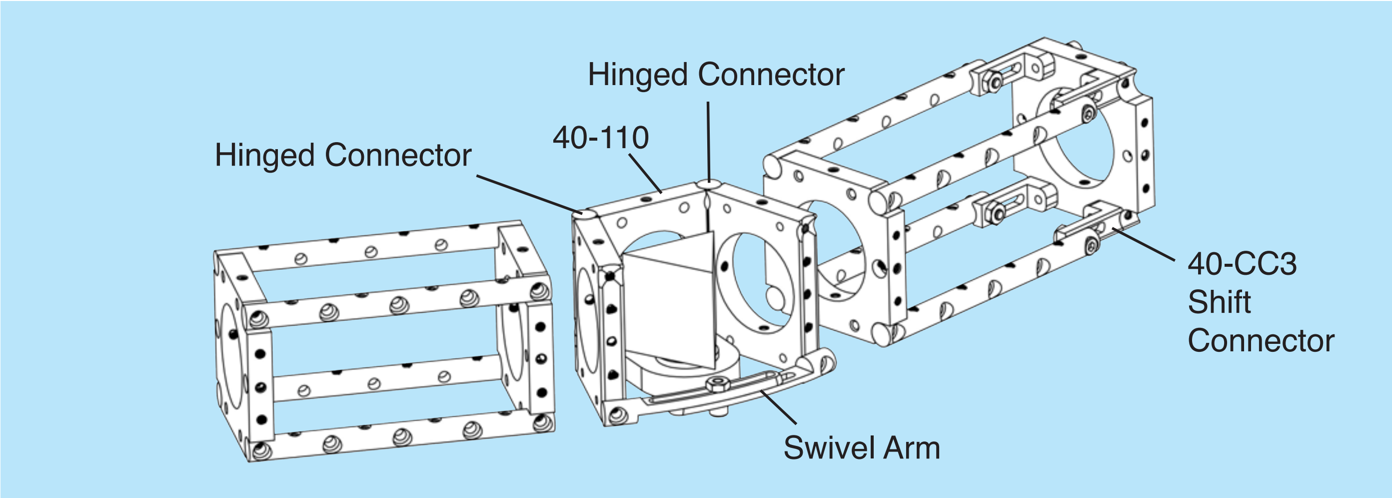




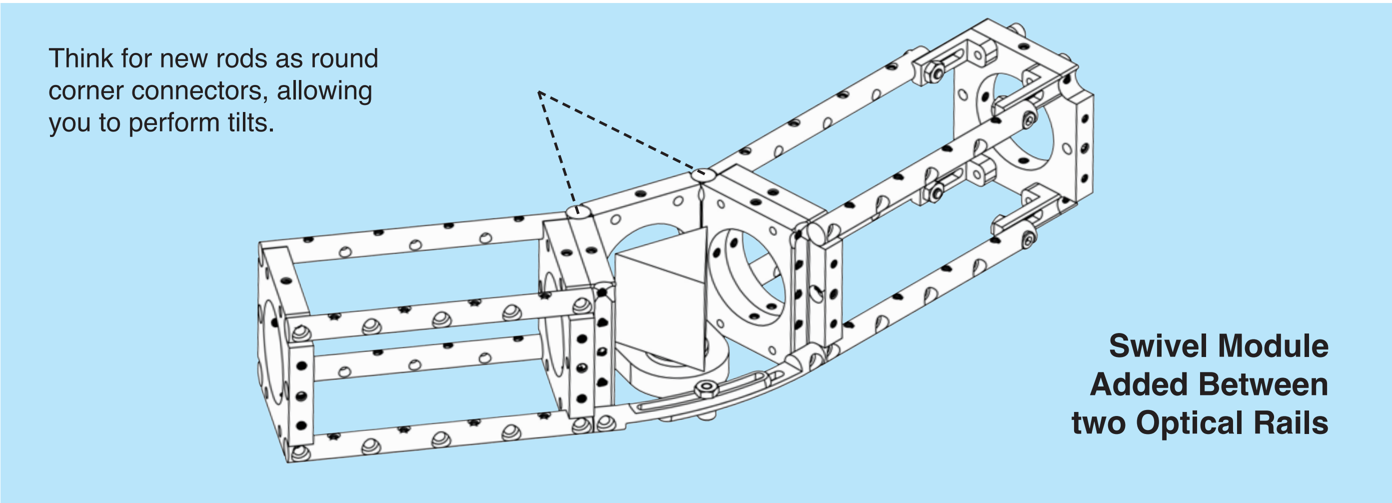
The fully assembled autocollimator on a post mount. Bore pattern on rods simplifies opto-mechanical interconnetions. Instead of predictable assembly routines, Optoform II would challenge you to play.

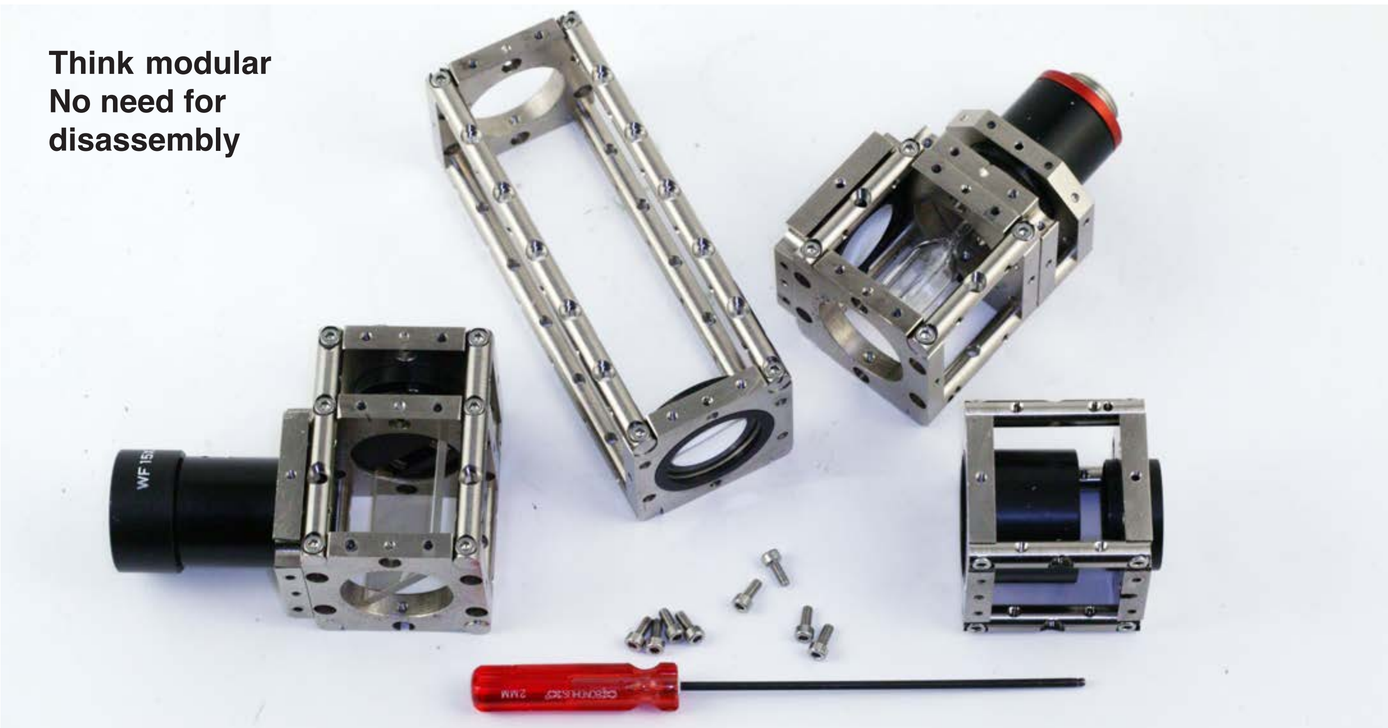
What about Angles?

No opto-mechanical cage system would be complete if it can’t build angular setups. We have a solution for that too.



The Swivel module allows spectroscopy with Equilateral prism or a 60 degree inclined arrangement for Litterow prism.





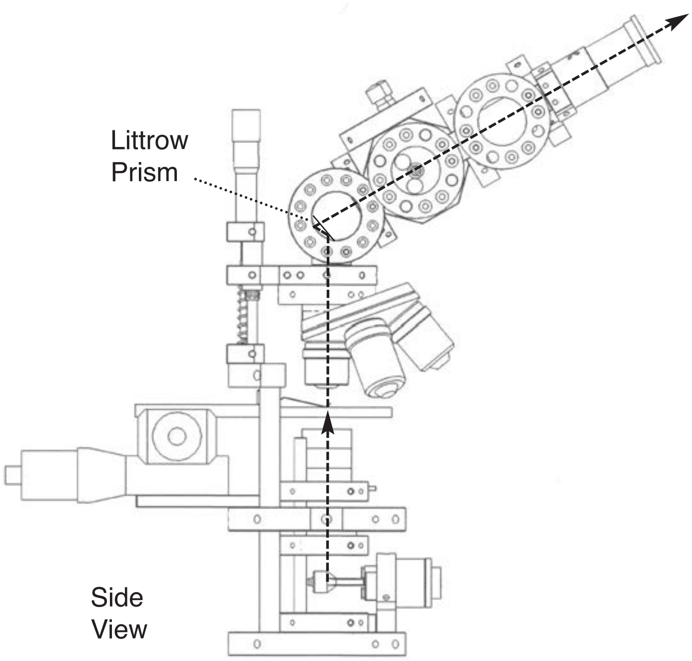
More Advanced prototyping with Optoform II

By Ali Afshari

It has always been an opto-mechanical designer's dream to have a system to build anything they want from off the shelf pieces. When I saw the Microbench system for the first time, it blew my mind how it could do the most complex assemblies with its square blocks. With the invention of Optoform back in 1994, my goal was to make it less expensive for constructing complex optical assemblies.

In case you ever wished to build a binocular head with these pieces, well you can: Both Optoform (Right, below), and Microbench (next page) are shown utilizing horizontal rods to adjust for the eye distance for an every day user. I personally love projects like this because the end user doesn't really care to see how good these mounts are. They just want to use it. So if you can't provide the same level of comfort, and compete with the price of an off the shelf binocular head that can be purchased out there, people will still say who is going to do it one day?

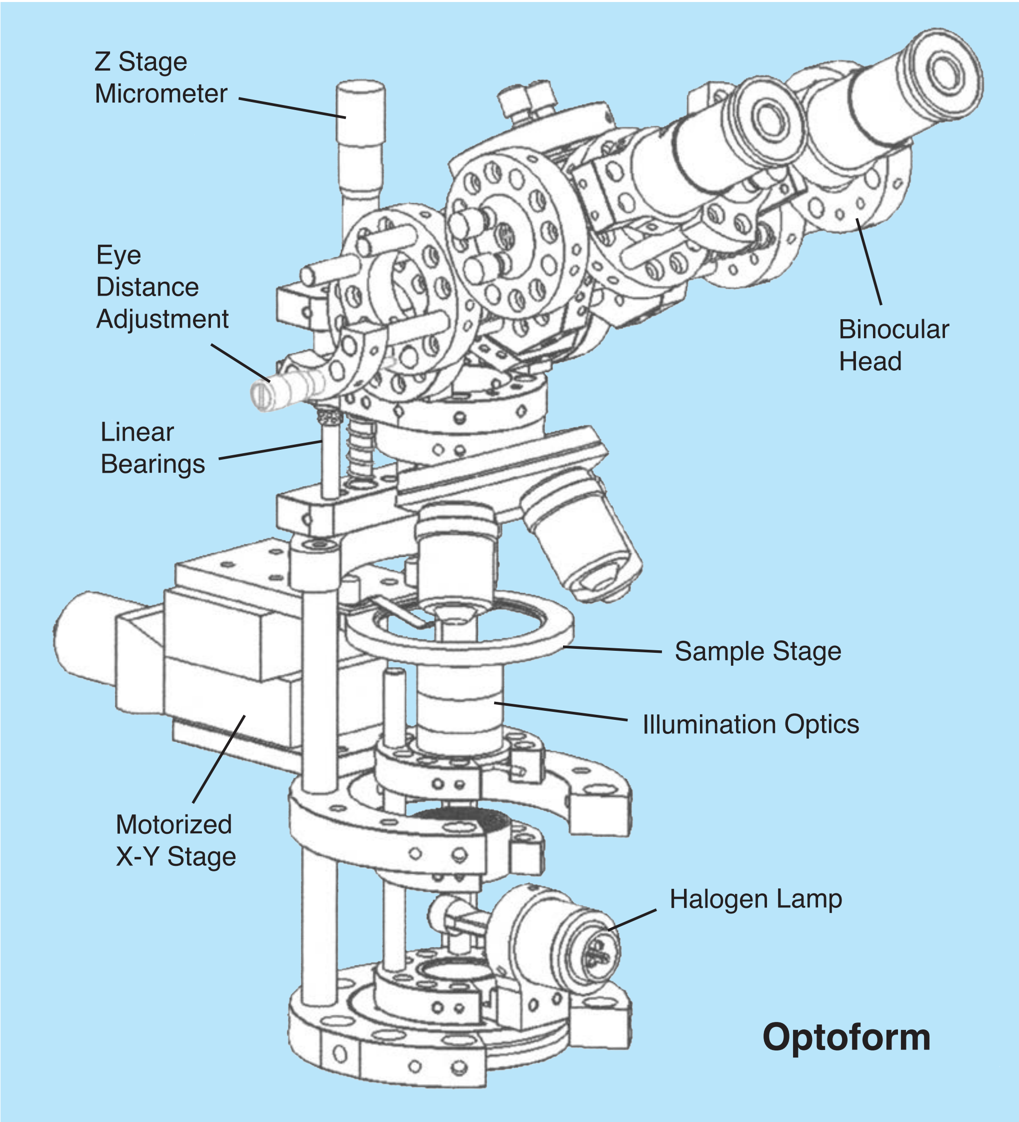
Microscopy is the most challenging application for any optical cage system. So here's what's possible with prior art, and I will show you how easier and more affordable it is to build with Optoform II on the next issue.



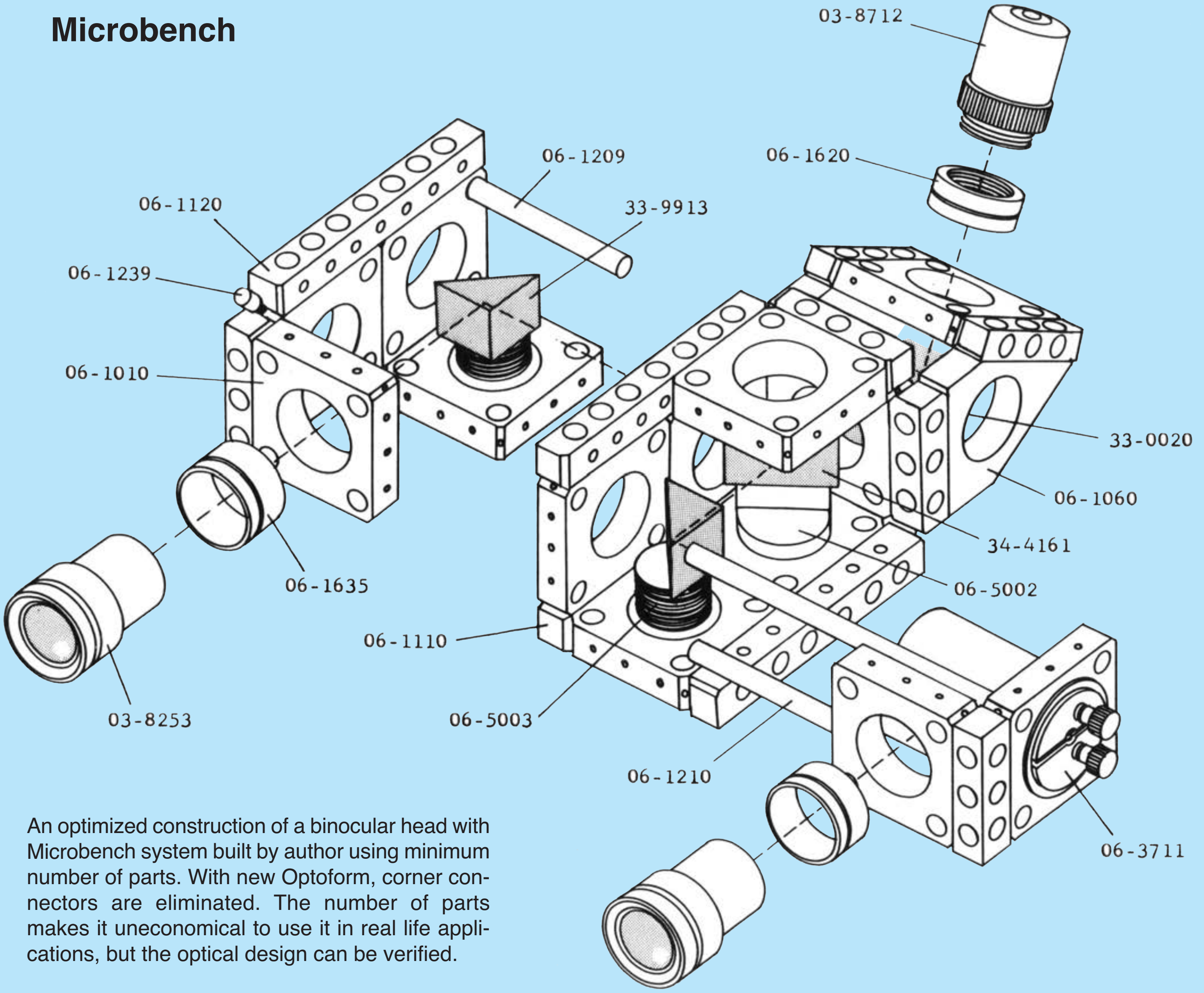
Right, a motorized Biological binocular microscope built with Optoform. It offers concentric building blocks for microscopy from 25 to 150 mm in diameter.

The capabilities of this system have been known by quite a few research centers that utilized it enthusiastically. Complex optical cage systems are as difficult to understand as Shakespeare's poetry. You need Robin Williams to help us have fun understanding it. Once you get in touch with its meaning, you could then learn to stand tall with it on your own.

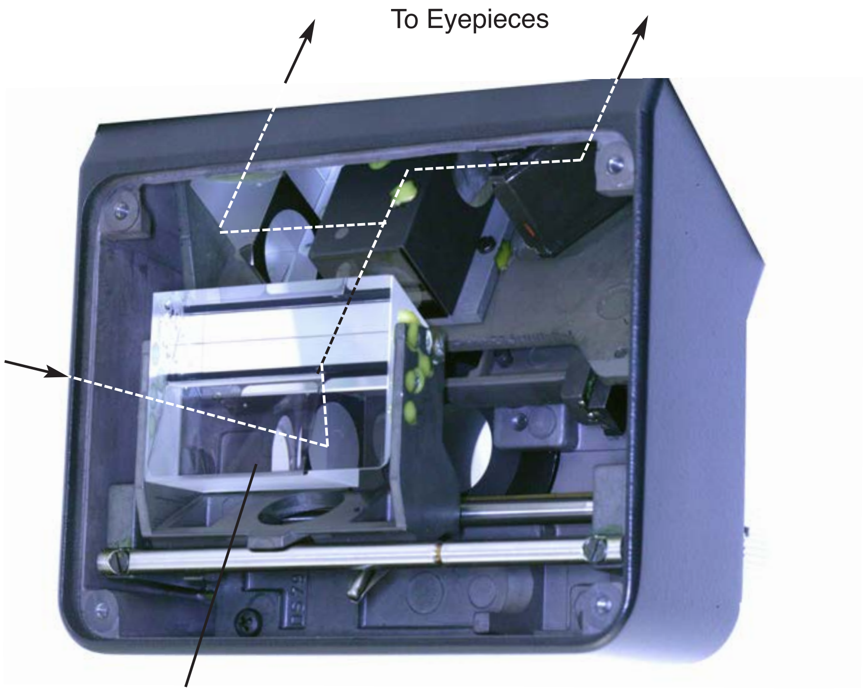
I have always felt Microbench didn't succeed as much as its Thorlabs' counterpart because it lacked an easy to understand user's manual for its end users. Microbench's adaptation with corner connectors makes it capable of solving far more complex problems than its simplified version by Thorlabs could ever do.



Microbench



An optimized construction of a binocular head with Microbench system built by author using minimum number of parts. With new Optoform, corner connectors are eliminated. The number of parts makes it uneconomical to use it in real life applications, but the optical design can be verified.



Binocular Design

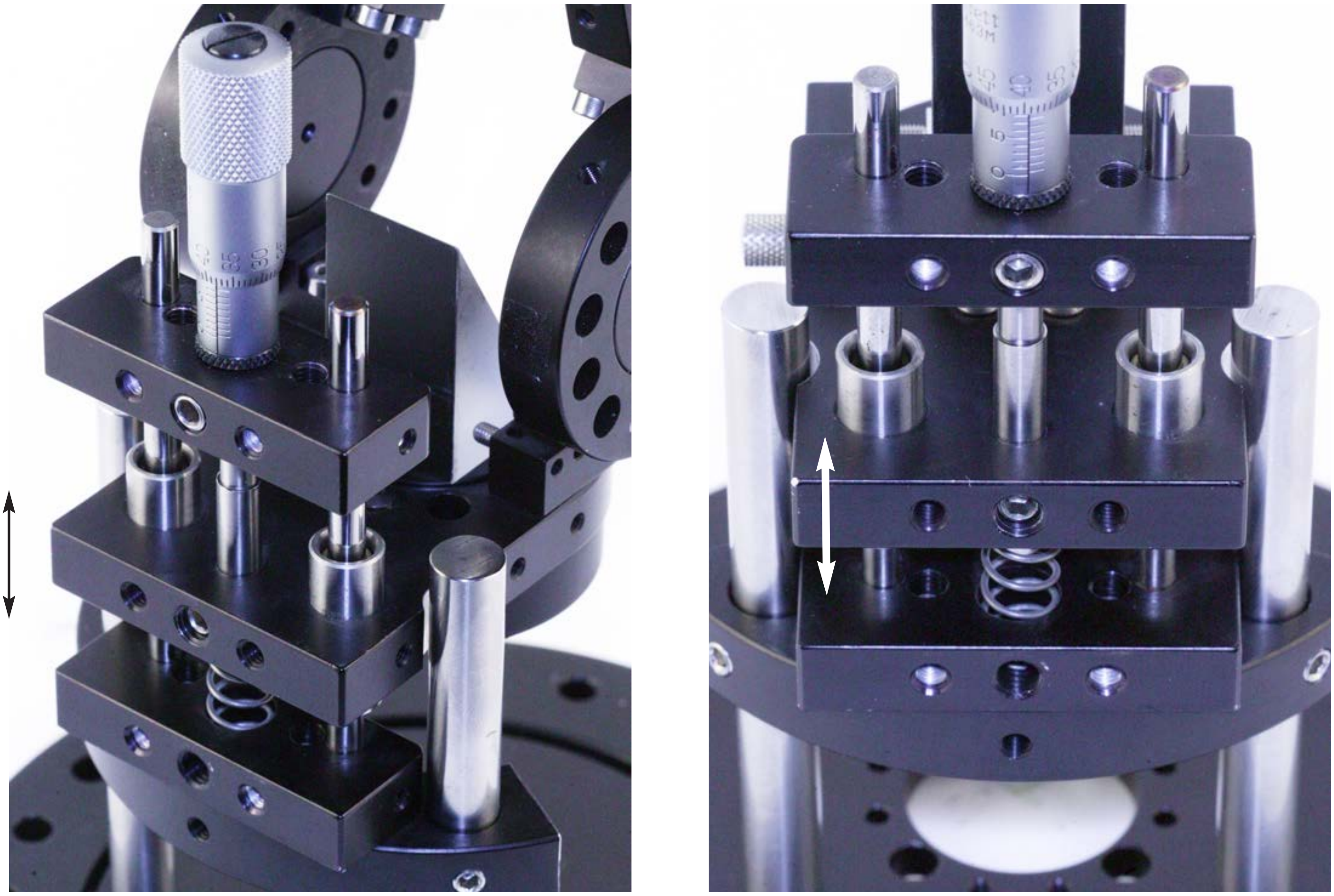
Beam path inside a typical microscope viewfinder shows the 60 degree Littrow prism, and a beamsplitter to divide the beam into left, and right eye.

This is actually the trinocular head designed by Leitz for Diavert microscope discussed later in this issue. There is a belt driven slider for the prim to divert the entire light to the eyes, or directly through to the camera, or a percentage of.

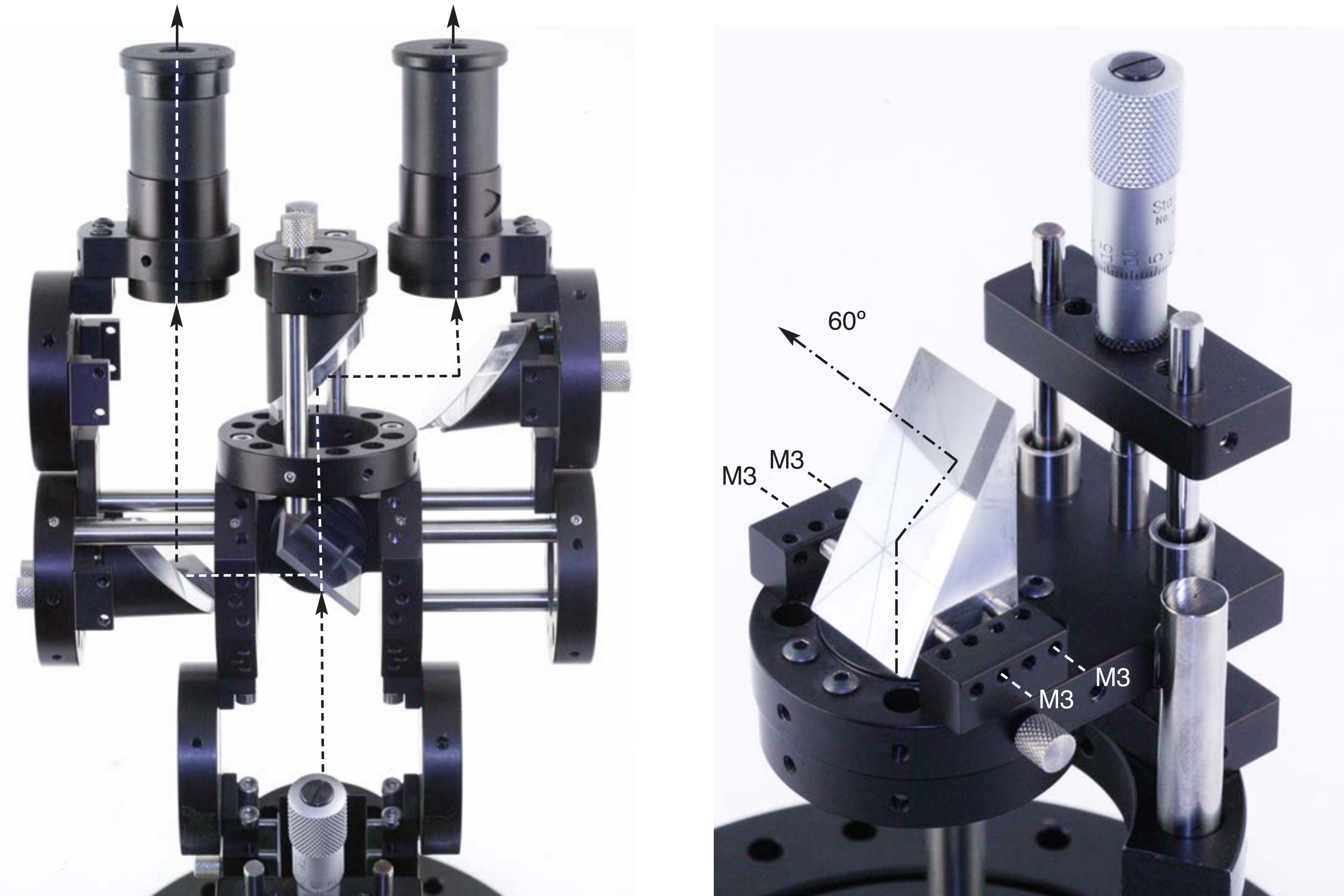
Optical Erector sets such as Microbench, and later Optoform are the only sets capable of building such complex arrangements.

Binocular Observation Head

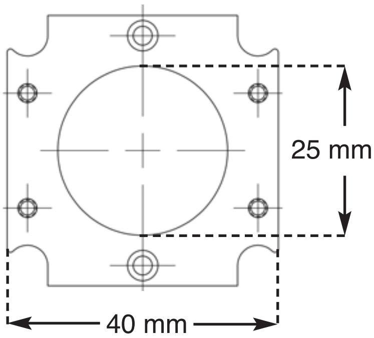
Littrow prism bends the light path for convinent 60º inclined viewing. Linear bearing arrangement is also shown for focusing. Lets take a closer look at this arrangement, and see how it is implemented in more detail.



Close up of the linear bearings: It onsits of a stationary plate, and a translation pate pushed by micrometer.



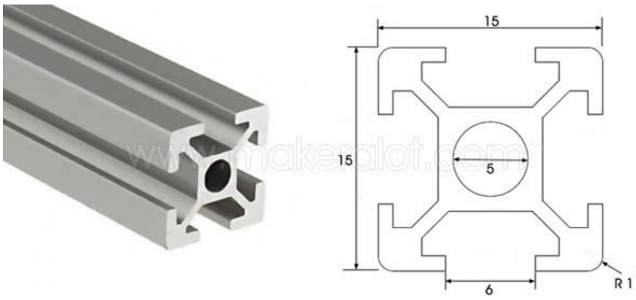
Back view of the optical path, and close up view of Littrow prism mounting screws. Opto-mechanics is all about details.



Substantial cost savings

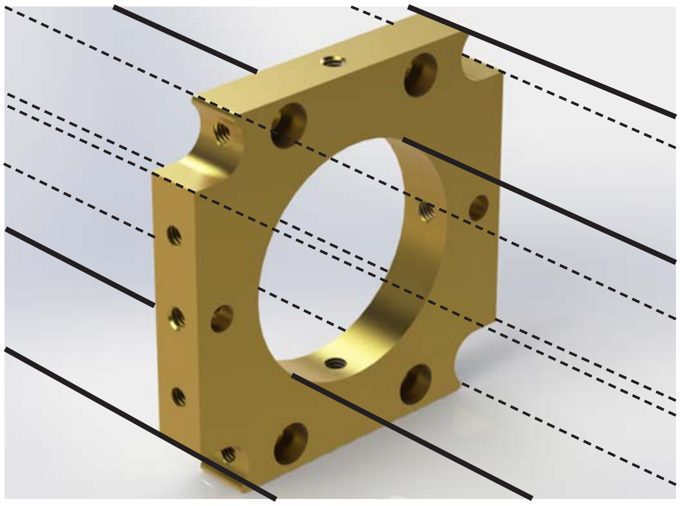
Producing new Optoform mounts will take half the time it takes to produce the original mounts. This is because the bore location of new mounts is on the outer corners and this allows manufacturing through the extrusion process.

We hope to offer the new Optoform mounts at the $10 per piece price range.

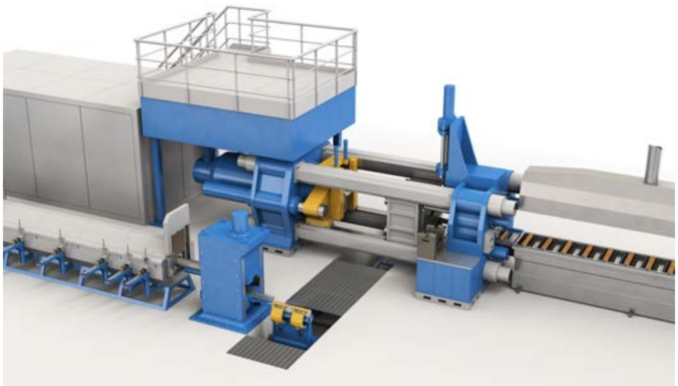


A typical extrusion drawing for an Aluminum profile.

Gradual formation of Aluminum extrusion through dies.



Optoform II: the lowest cost optical mount ever produced for prototyping. Right, exrusion dies for various profiles.



A typical extrusion machine at factory floor

Aluminum extrusions

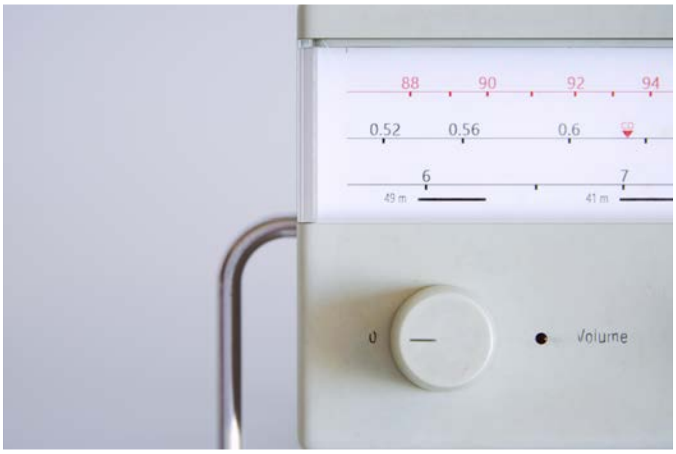
New Documentary film on Dieter Rams covering his Product Designs

Photos Courtesy, Braun, Nizo, and film maker Gary Hustwit

At age 86, he is one of the most influential product designers of the day. We all grew up using at least one of his designs, a household product such as a coffee maker by Braun. Dieter Rams born in Wiesbaden, Hessen is a German industrial designer and retired academic, designed most of Braun consumer products. His belief in "less but better" design generated a timeless quality in his products and has secured Rams a worldwide recognition, and appreciation.

His design of Nizo 8 mm camera (below) carries such pure elegance in opto-mechanical design. The hand grip folds back to give this camera the low profile tripod interface cameras need (next page). He is the subject of recent documentary by film maker Gary Hustwit “Rams”.

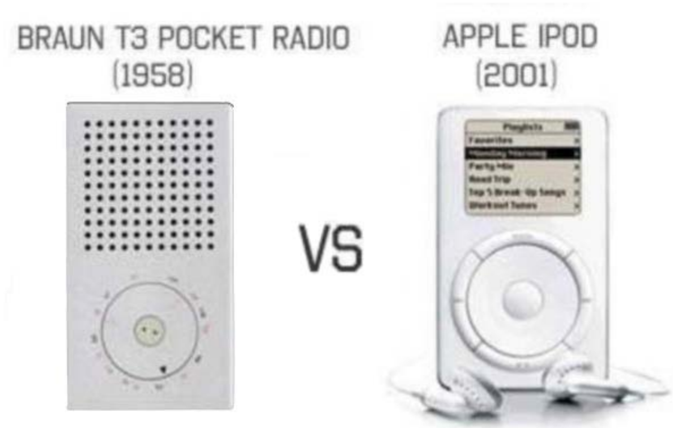
I grew up with the Braun's 8 mm projector (right). Nizzo 8 mm camera was the most elegant movie camera of that era.



Exraordinary attention to detail in Ram's design philosophy is revealed in this less but better design (left).

In this home or office book shelf setting, the audio equipment, and the shelves would be in full balance, and harmony.

The current furniture by Ikea, and elfa distributed by The Container Store in US are heavily influenced by Dieter Rams.



Audio equipment designed by Dieter Rams have influenced designers like Johnatan Ive at apple to design the iPod.

An electronics radio receiver kit designed by Dieter Rams.

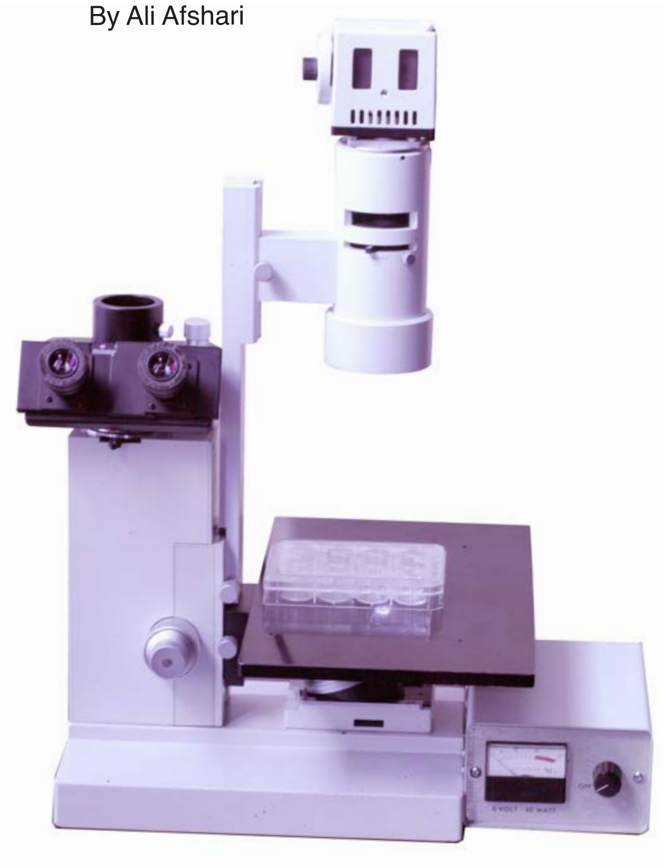
Braun’s radio receiver

Book: Less and More -The Design Ethos of Dieter Rams.

Braun’s classic record player, and radio consule designed by Rams in 1961. Rams received many awards for his work.

Leitz DIAVERT Inverted Microscope

By Ali Afshari

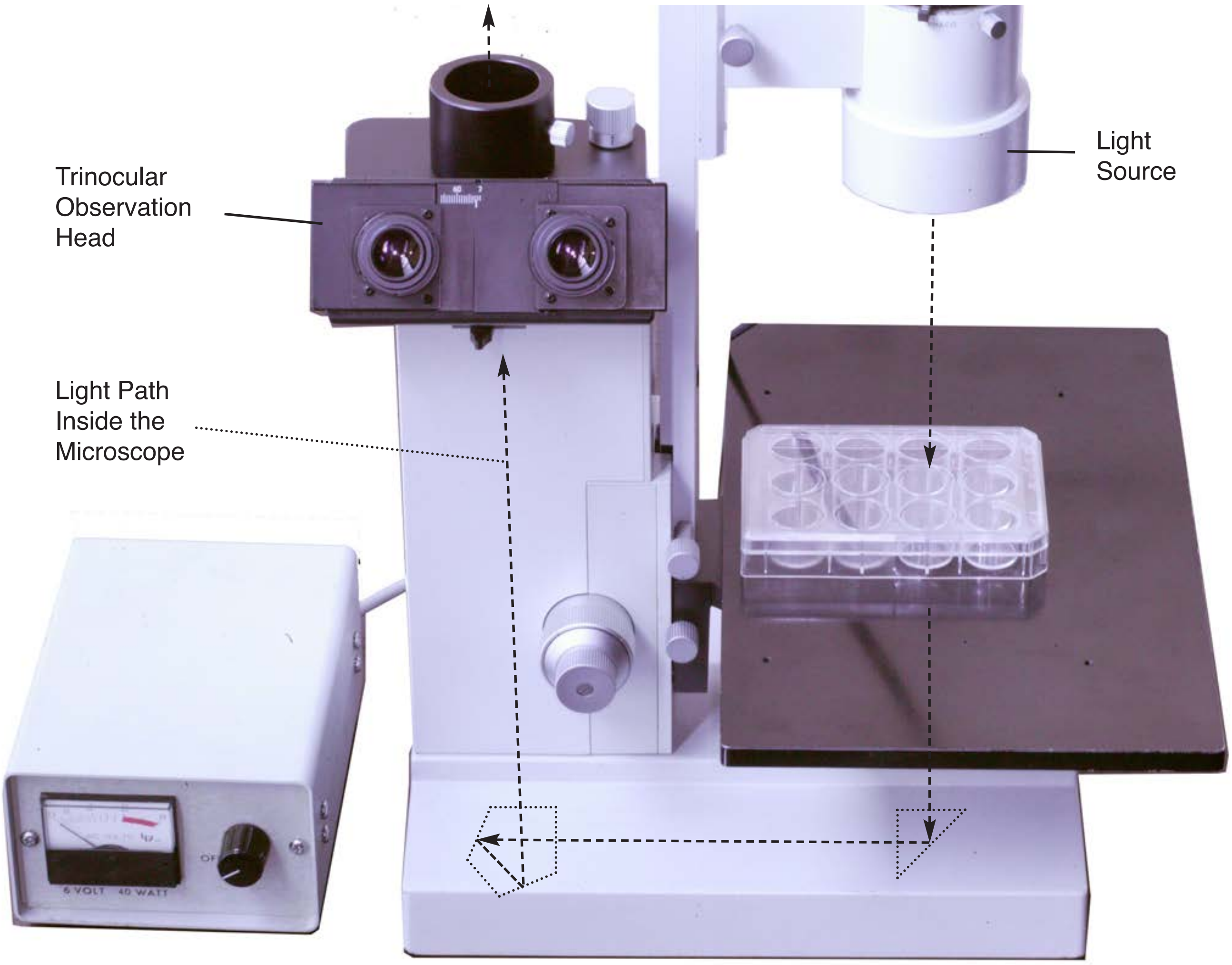


In this issue, I will cover one of the most interesting microscopes I have worked on: Leitz Diavert inverted microscope. One of my responsibilites as an “optical erector set” designer is get familiar with opto-mechanical instruments, and nothing challenges me more than microscopy.

Microscopes are fine opto-mechanical instruments. They are a stationary platform to support everything else like a light source, an observation head, and the sample platform. They can all be added with full interchangeability. This makes the microscope like a vertical optical test bench.

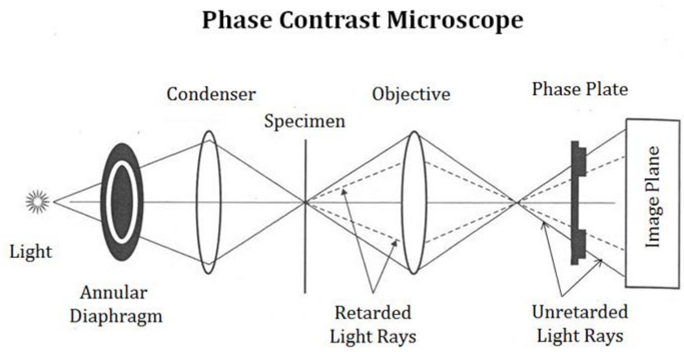
Leica microscopes are always fun to work on. Opposite to Zeiss, Leitz, and Leica doesn’t use a lot of curves. Their design consists of straight lines. In Zeiss, as we’ll see in future articles, they use curved lines. Straight lines look more modern where as curved forms are more found in vintage instruments. Zeiss Axio microscopes look a lot more modern than their earlier models, using straight contours.

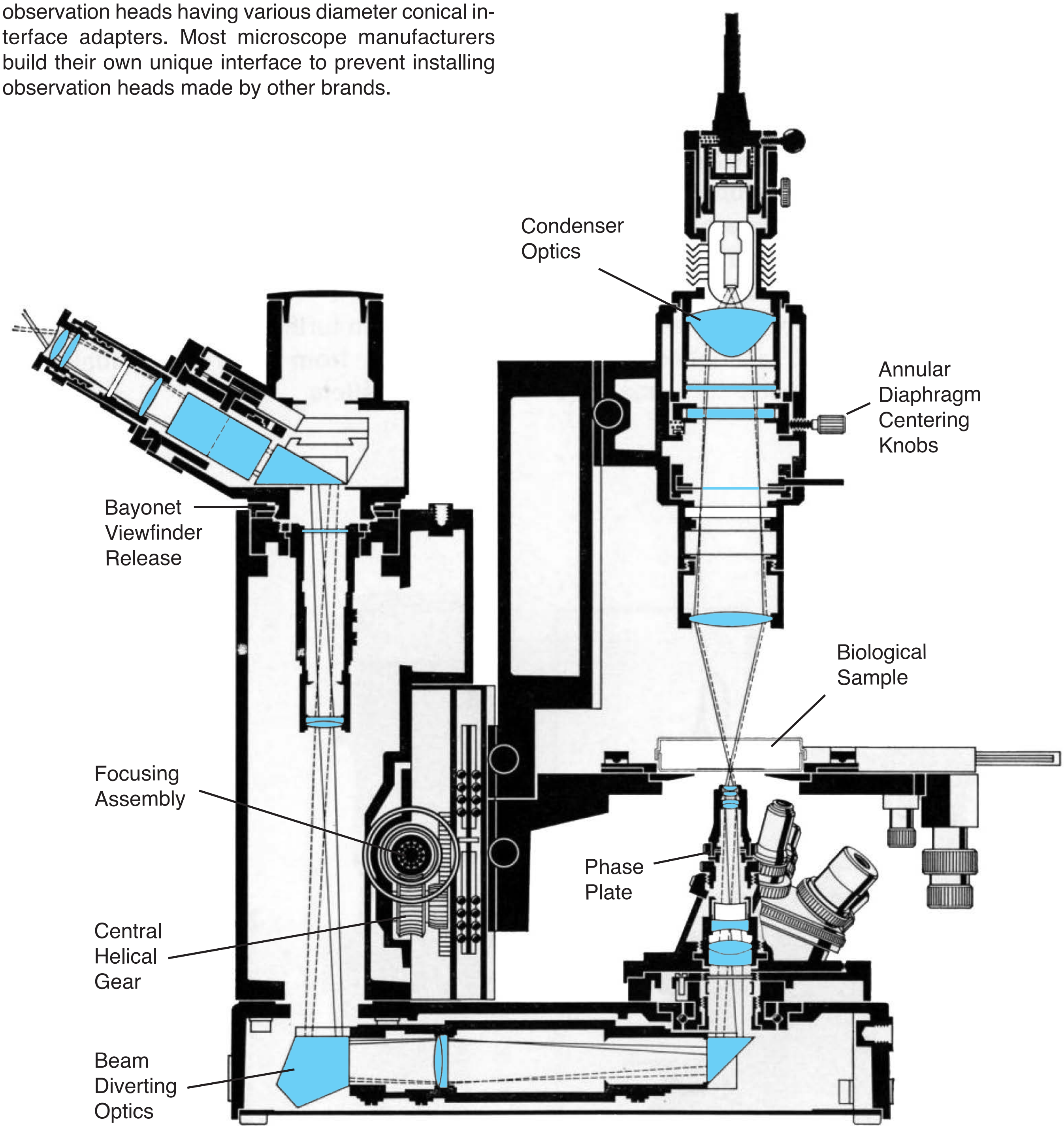
In inverted microscopes, the platform is usually bigger, and the lamp housing is usually completely separate from the microscope body. There is usually an elongated optical rail to allow the light source to be adjusted up and down. These are unique features found on inverted microscopes.



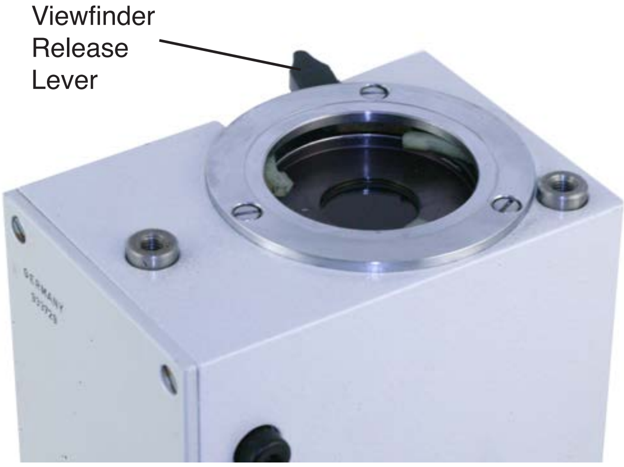
The light path inside the Diavert reveals its compact design. There are two illumination sources available: A 6 W filament lamp and a 6V 20 W, halogen. The low wattage is likely adapted for viewing live samples. We will first disassemble the microscope to its major components, and I will briefly discuss each part, and I would cover the focusing mechanism in more detail.

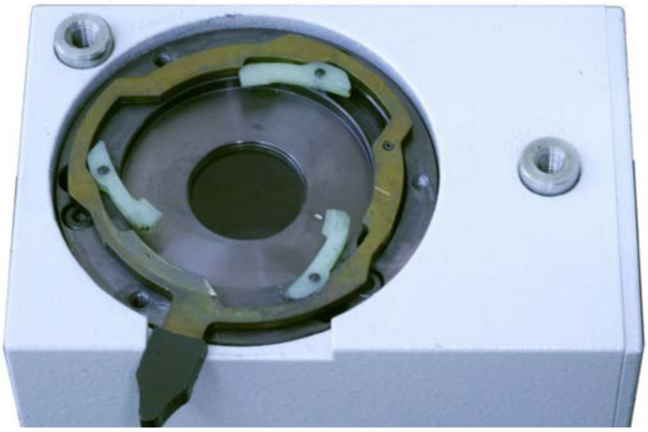
The main housing is a rigid diecast Aluminum housing with medical durable powder coated paint. One notable feature of this line of Leitz microscopes is their bayonet locking mechanism for their viewfinders. Although Leitz went back to the thumbscrew method, one advantage was it could accomodate a range of observation heads having various diameter conical interface adapters. Most microscope manufacturers build their own unique interface to prevent installing observation heads made by other brands.



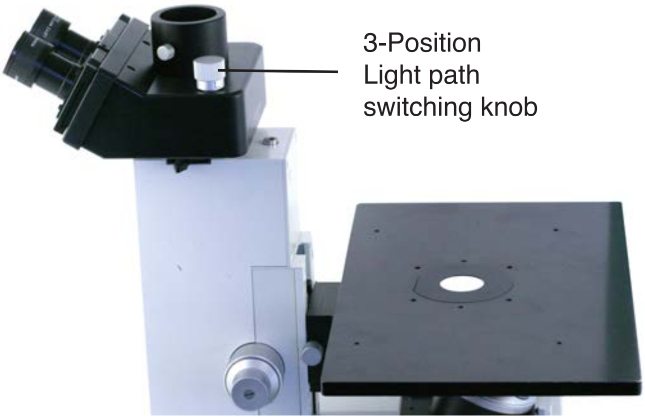


Inner optical path way of Leica DIavert reveals its beam diverting, and relay optics to deliver the image to viefinder.

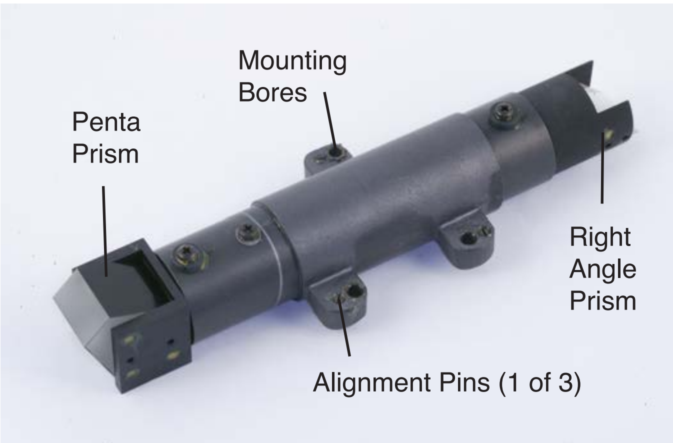




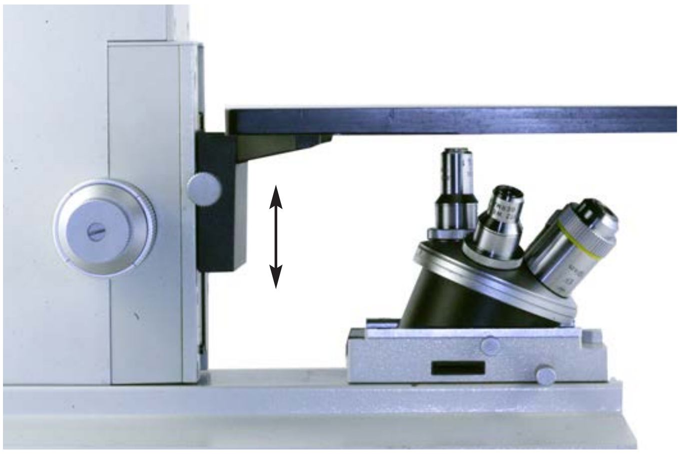
Viewfinder Lock mechanism: The lock lever rotates like diaphragm blades to secure the binocular head in place.

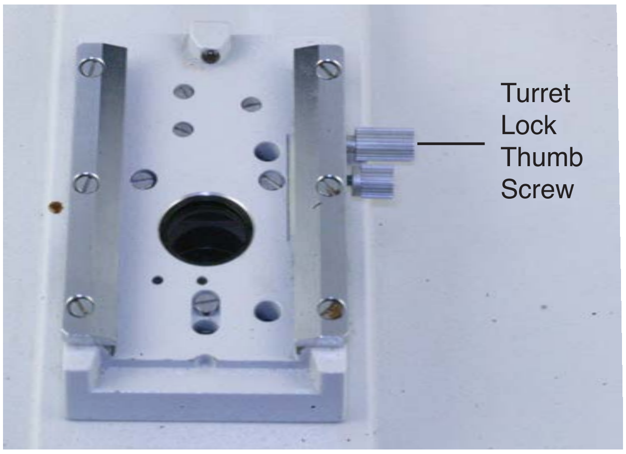


The trinocular head assembly: Belt driven 3-position beamspliter translation for switching viewfinder/video light path.

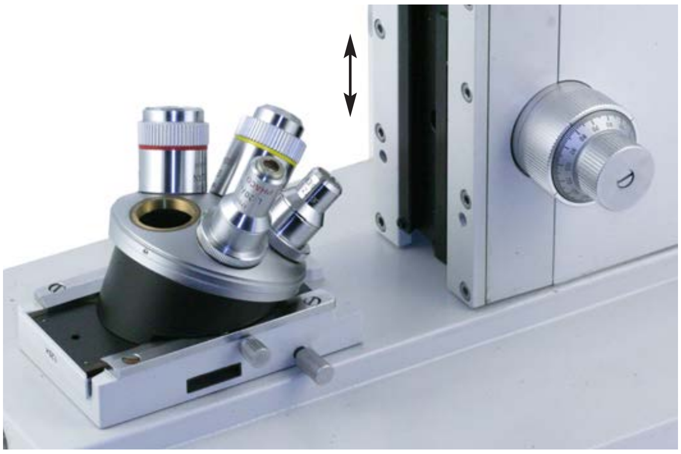


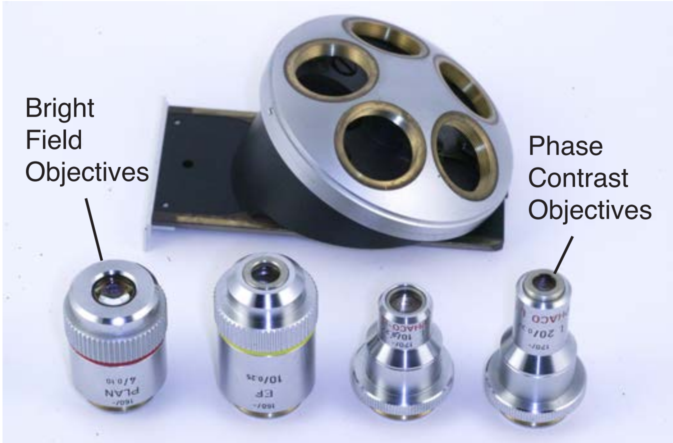
Relay prism assembly: The relay prism uses a pentaprism, and right angle prism for image transfer at the base (right).



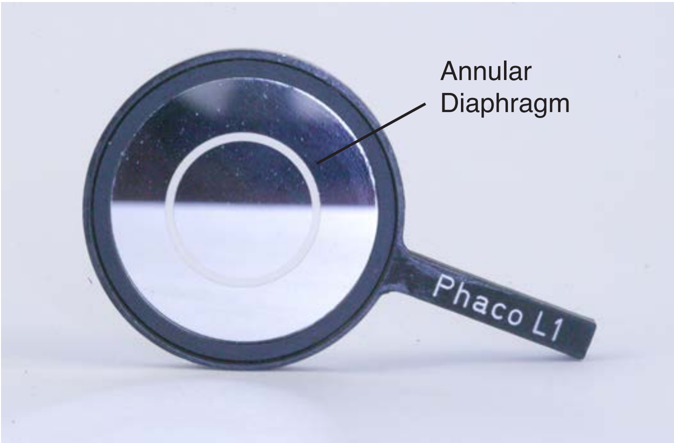


Microscope Turret: Has revolving base with 90 deg. detent. The microsope turret can slide out and is interchangeable.



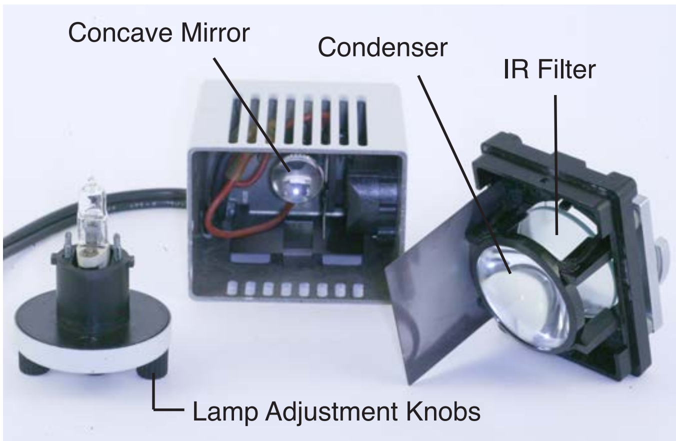


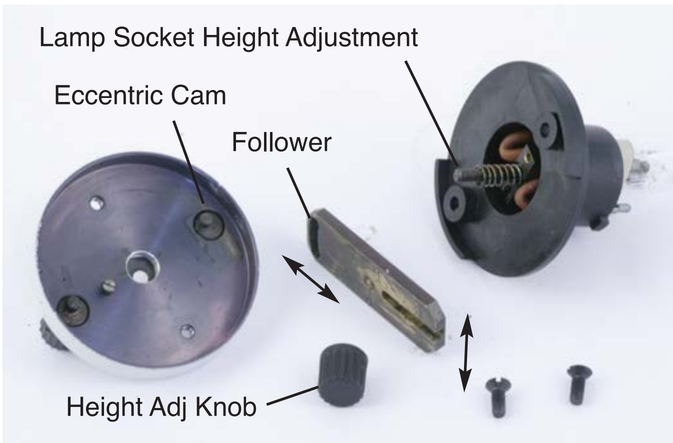
Choice of objectives: Two objectives for bright field observation (Left), and two for Phase Contrast (right).



Phase contrast optics: Annular Diaphragm (left), and phase rings behind each microscope objective (right).

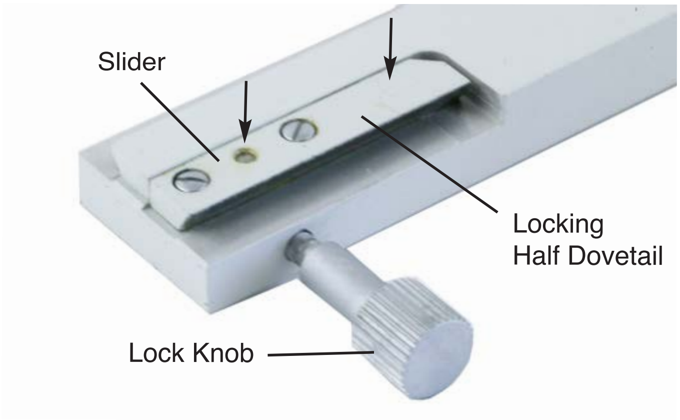
Lamp housing assembly: Huge condenser optics with high numerical aperture perfect for Phase Contrast illumination.



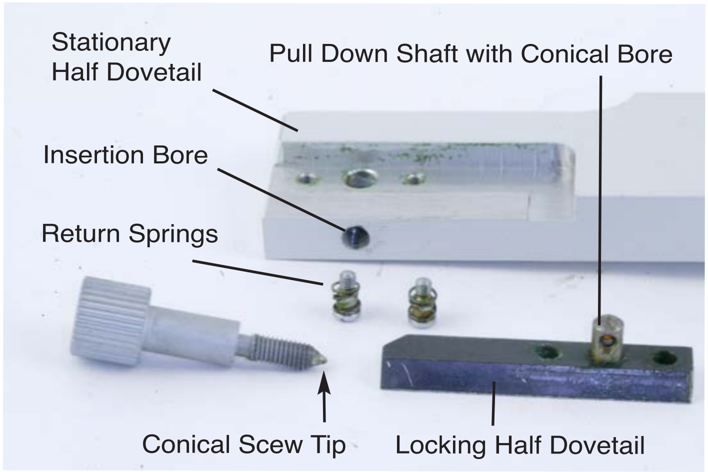


Halogen lamp housing: Compact and modular design utilizes eccentric cams to perform X-Y translation, and focus.

Split Dovetail Mechanism

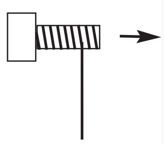


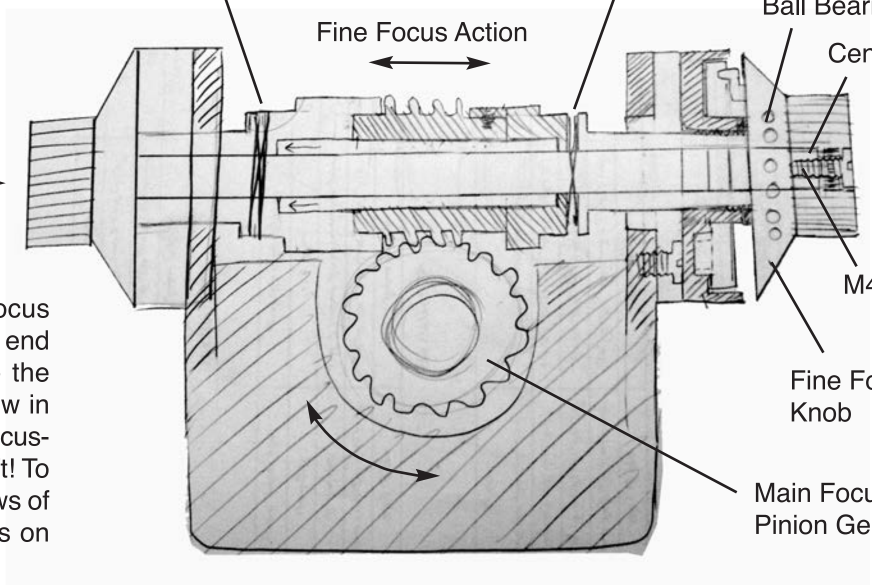
Adjustable rails utilize split dovetail interconnects.



Self Locking Split dovetail lock: By tightenning the coned tip thumb screw, the pull shaft pulls down the half dovetail.

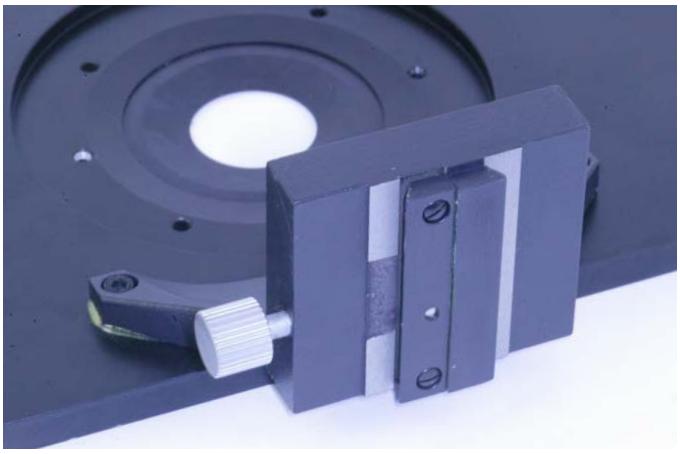
Fine Focus Mechanism



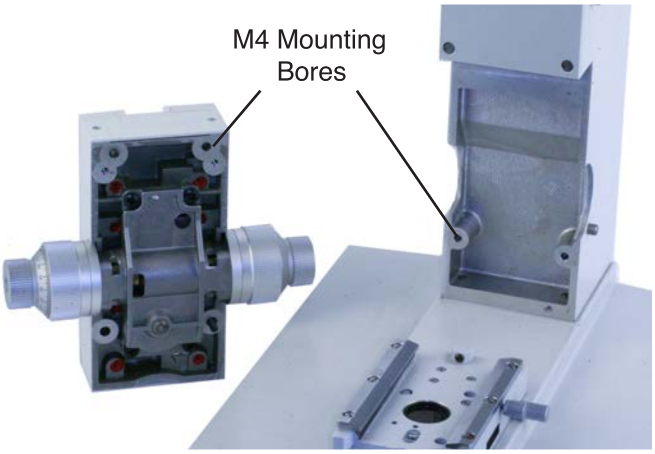


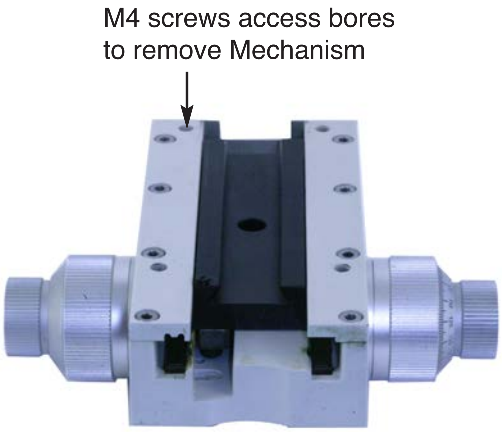
To remove these super tight focus knobs from the spur gear at each end of the center shaft, first remove the M4 screws, then inset a M5 screw in their place, and turn to push the focusing ring out against the inner shaft! To put them back, use the closing jaws of a big vice. Never use a hammers on opto-mechanics.

Hard brass parts, requires good tooling, and careful handling to avoid slippage, and damaging the parts during disassembly. Like in watchmaking, you could always tell how much experience an earlier technician has had when an instrument was worked on before. There are several ways to take apart locked nuts: You could heat it up with a heat gun (being carful not to melt plastic parts), or you could put it in the freezer for a few hours! Never be in a hurry. As a fine watchmaker, you could learn to go inside mechanisms with almost no trace left behind. Almost 30 years ago, California Museum of Photography trusted me to completely disassemble their 2.6 Million Euro Leica 0, and I humbly consider myself lucky that I left no traces behind other than preserving it.

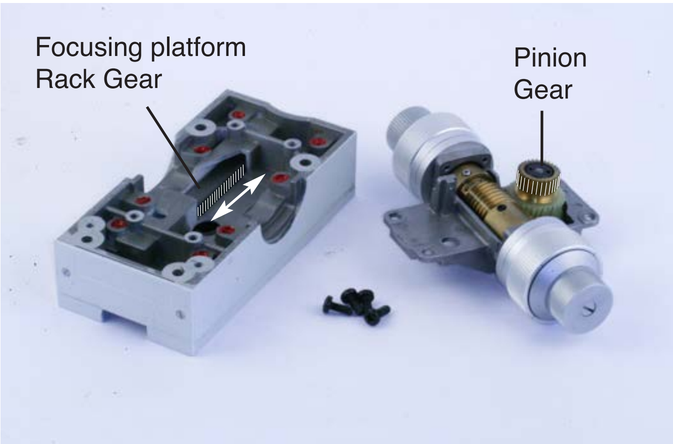


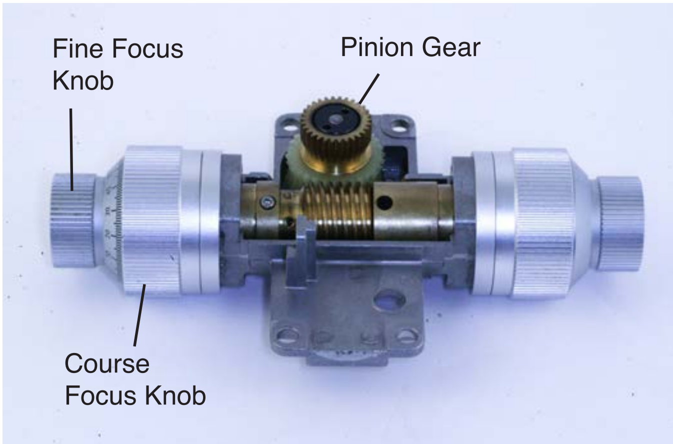
Split dovetails: Dovetail interconnects are so compact, cleverly implemented with minimum number of parts.



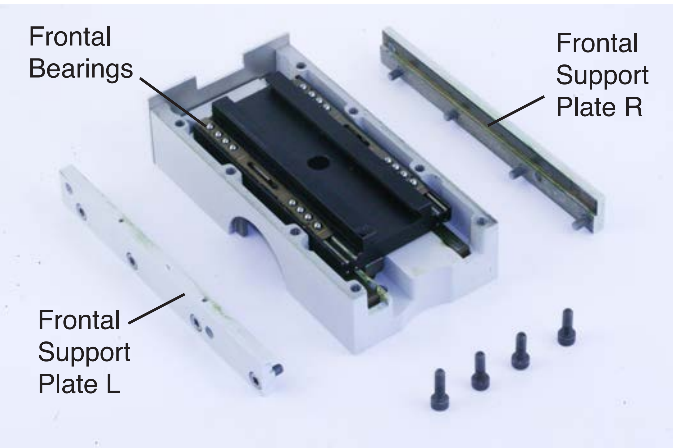


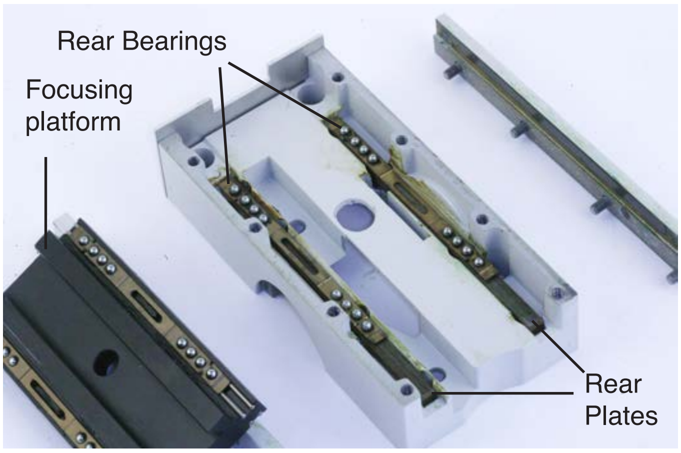
Focusing mechanism could be easily removed by loosening four M4 screws through hidden access bores (right).



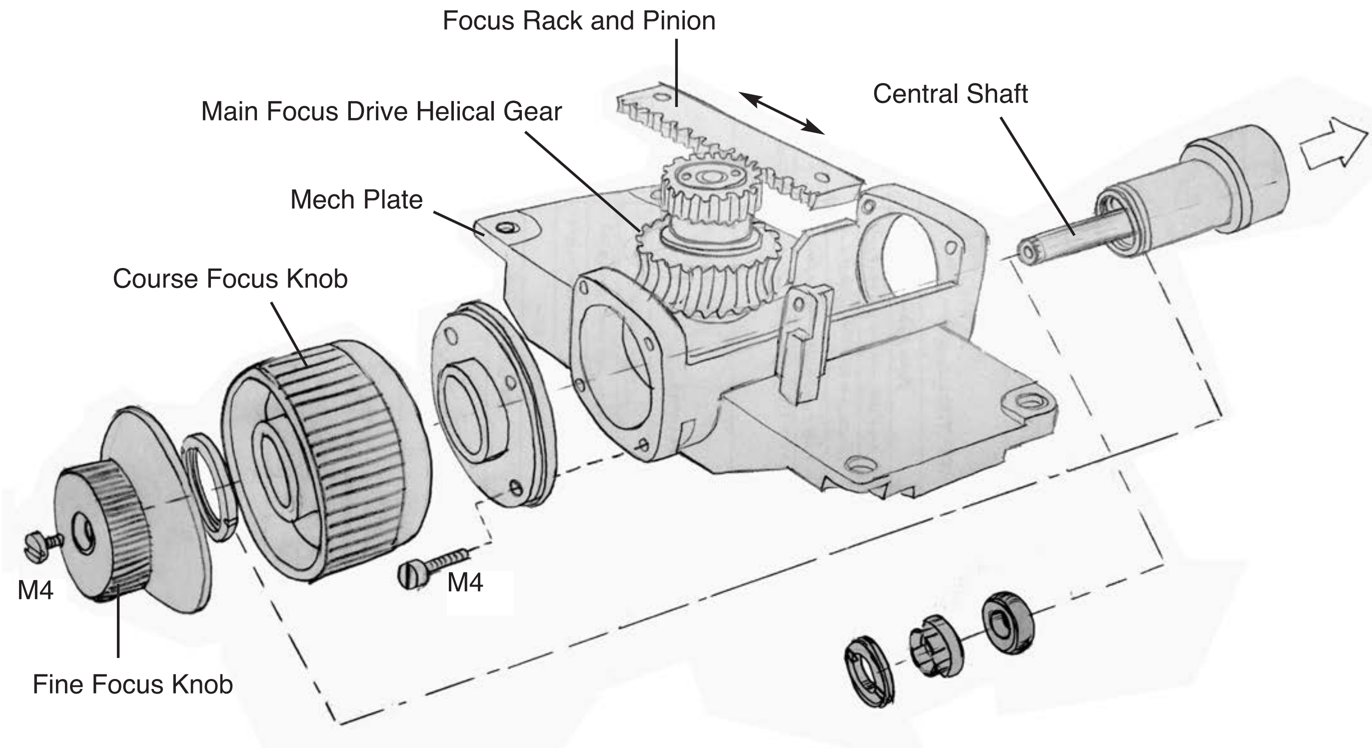


Focusing mechanism consits of rack and pinion gears (left), governed by fine, and course focus knobs (right).

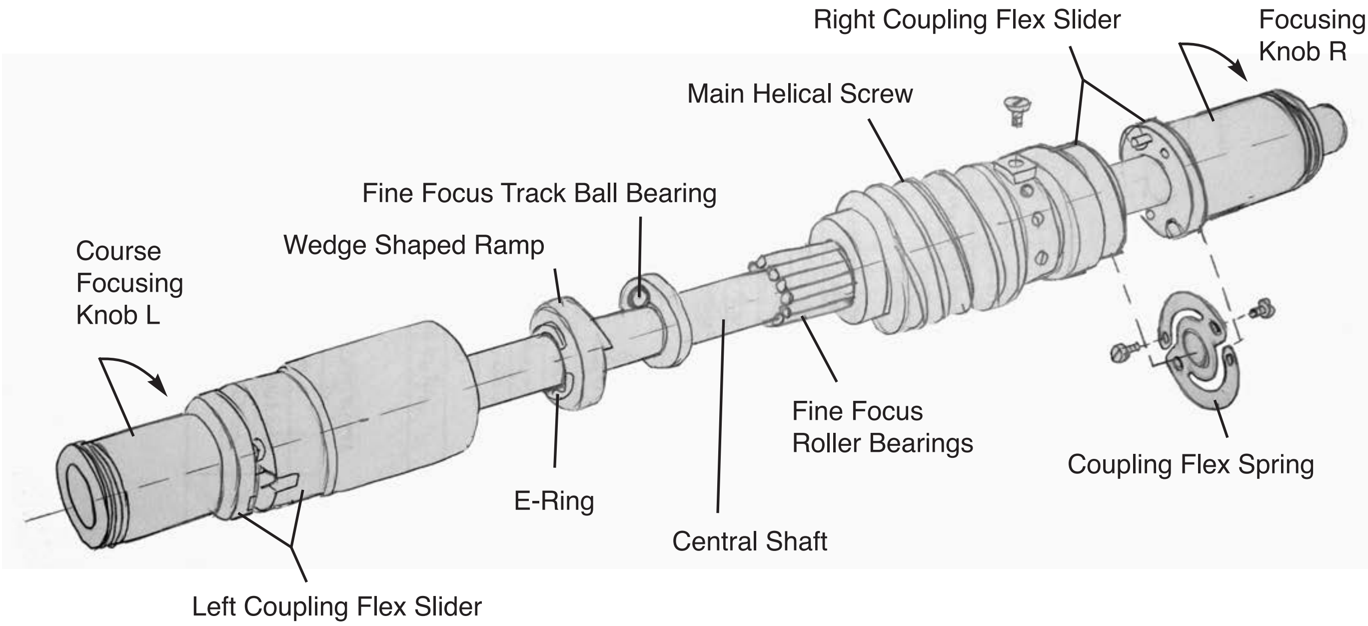




Bearing assembly: Focusing platform is sandwitched between frontal, and rear bearings via frontal, and rear plates.

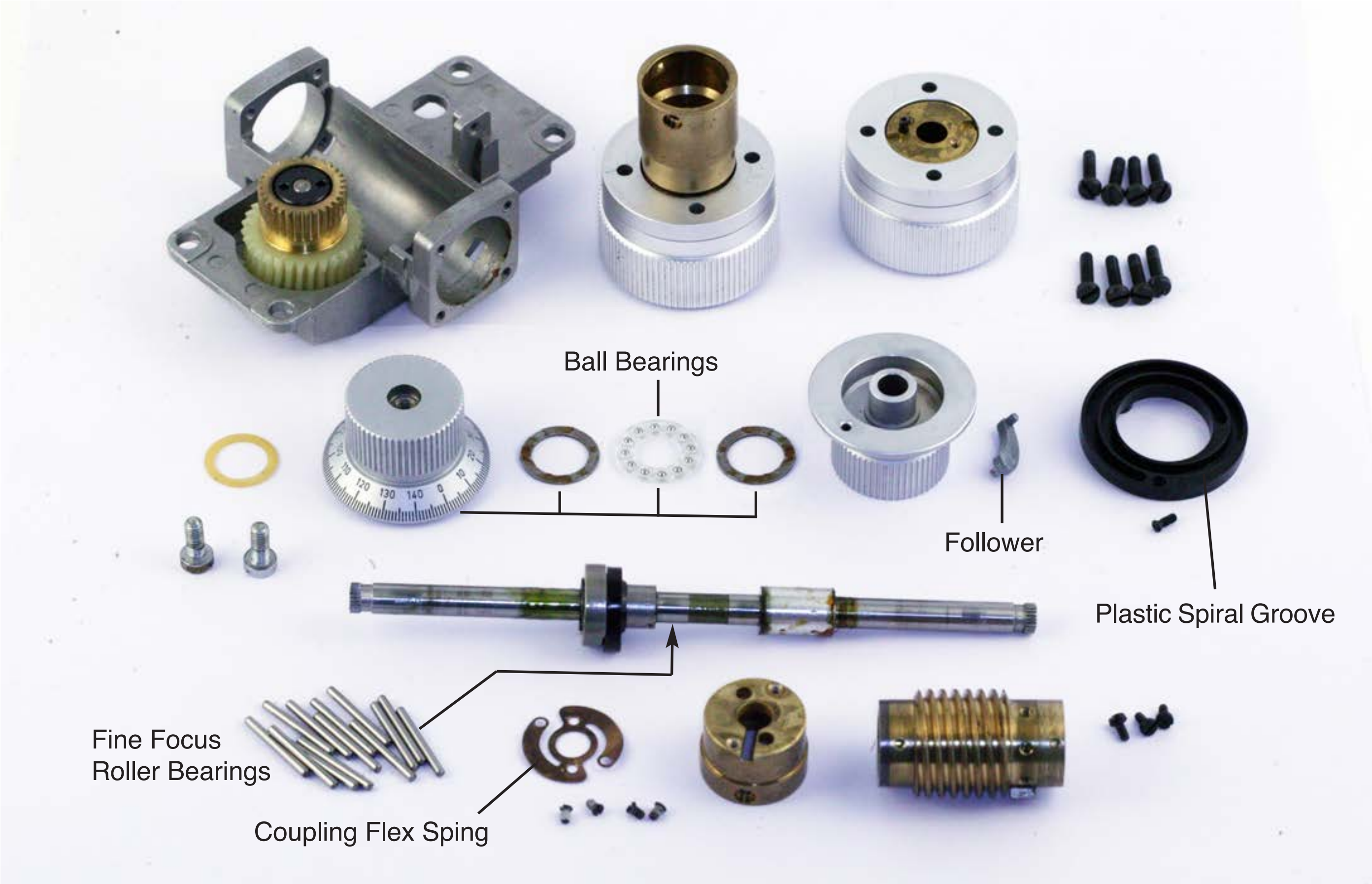


Course, and fine focus assembly in Leica DIAVERT reveals sophisticated mechanism design: The rack and pinion is driven by a central helical gear, coupled to fine focus mechanism below. As the fine focus knobs are turned, the center shaft rotates the wedge shaped ramp (below), and it's changing thickness is transferred to fine focus track ball bearing. This causes the helical screw to shift

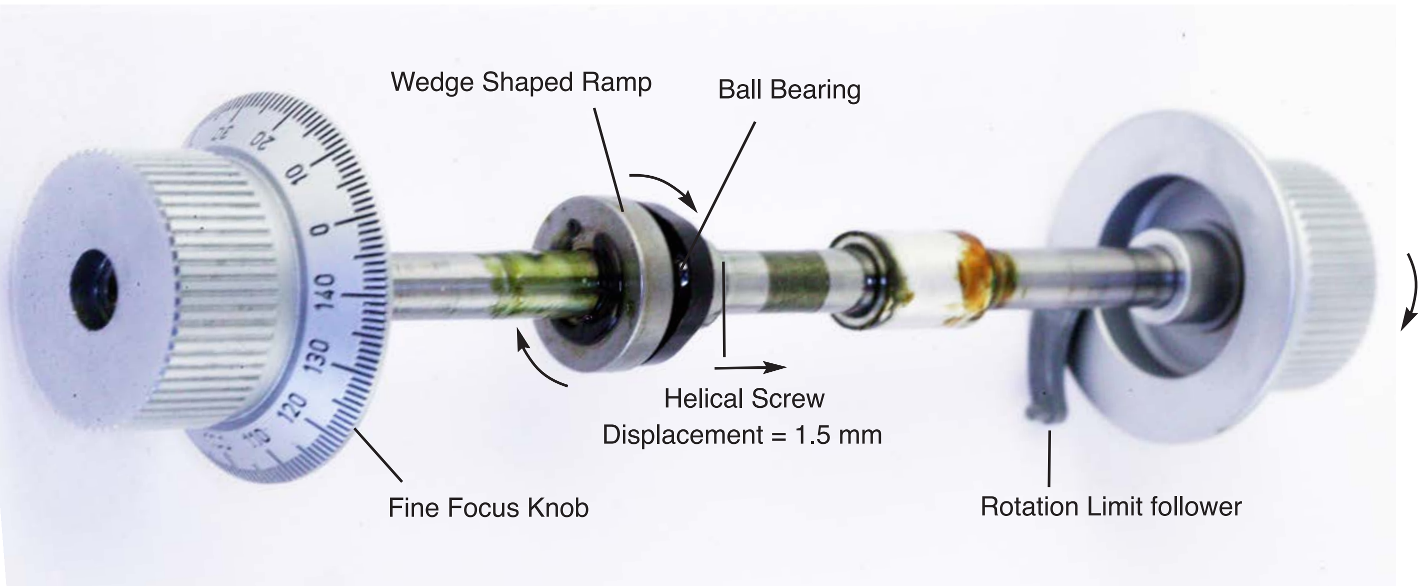


back and forth, translating the drive gear, and resulting in a small focus shift. The helical screw is loaded against the ball by the weight of the microscope stage, and lamp support. The rotation of fine focus knob is limited to 1.5 turns by a plastic spiral groove, and a follower (shown on the next page).

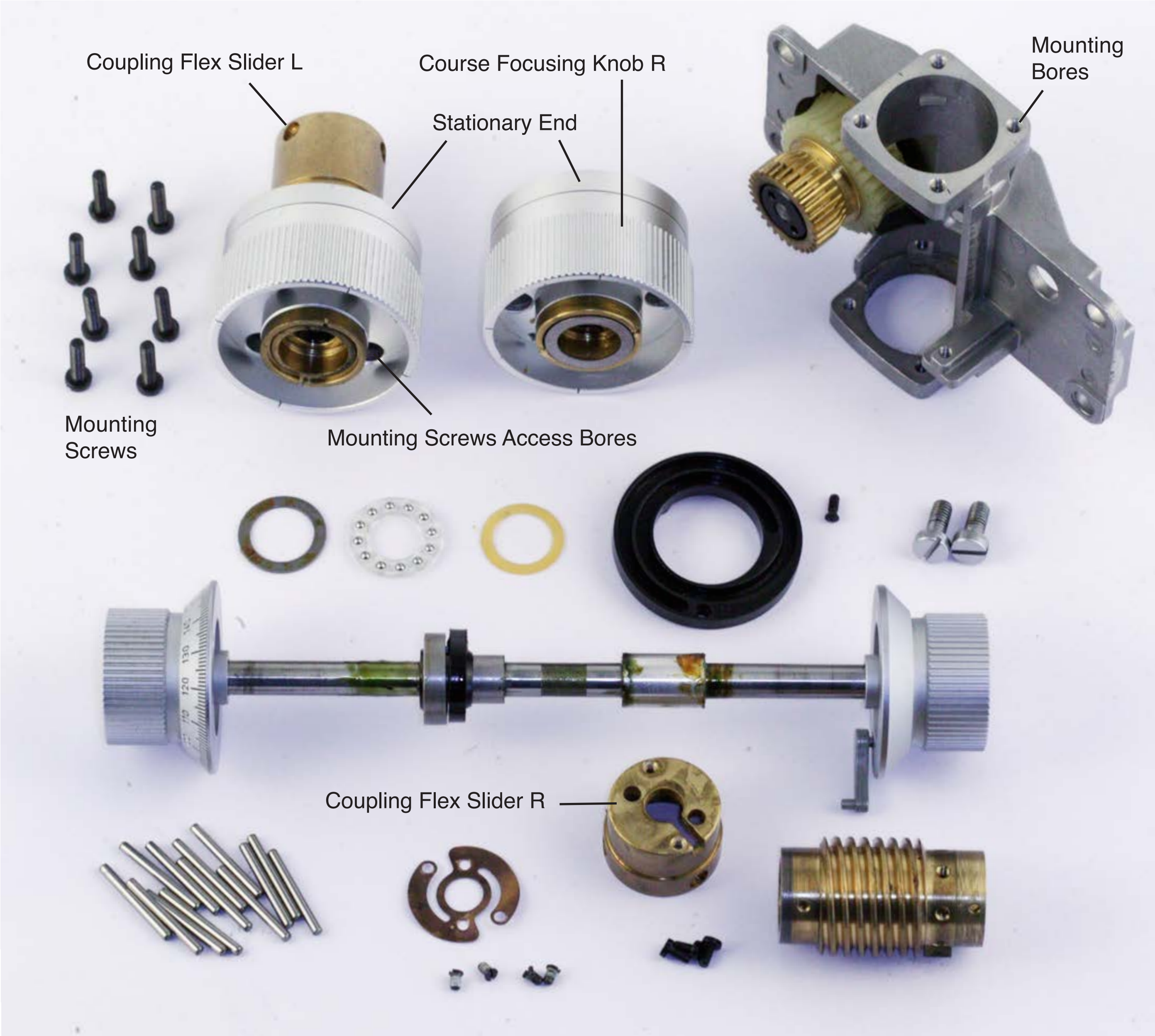
The motion of fine focus track ball bearing (above) is transferred at half the speed because as it rolls, it lags behind. You can visualize this by sliding a book over a pencil on a desk top. The pencil would always travel half as much as the book. It takes high precision machining to implement this design, and its high sensitivity, and smooth operation is achieved by utilizing roller bearings between the central shaft, and the main helical gear. We'll re examine this mechanism by further disassembling.

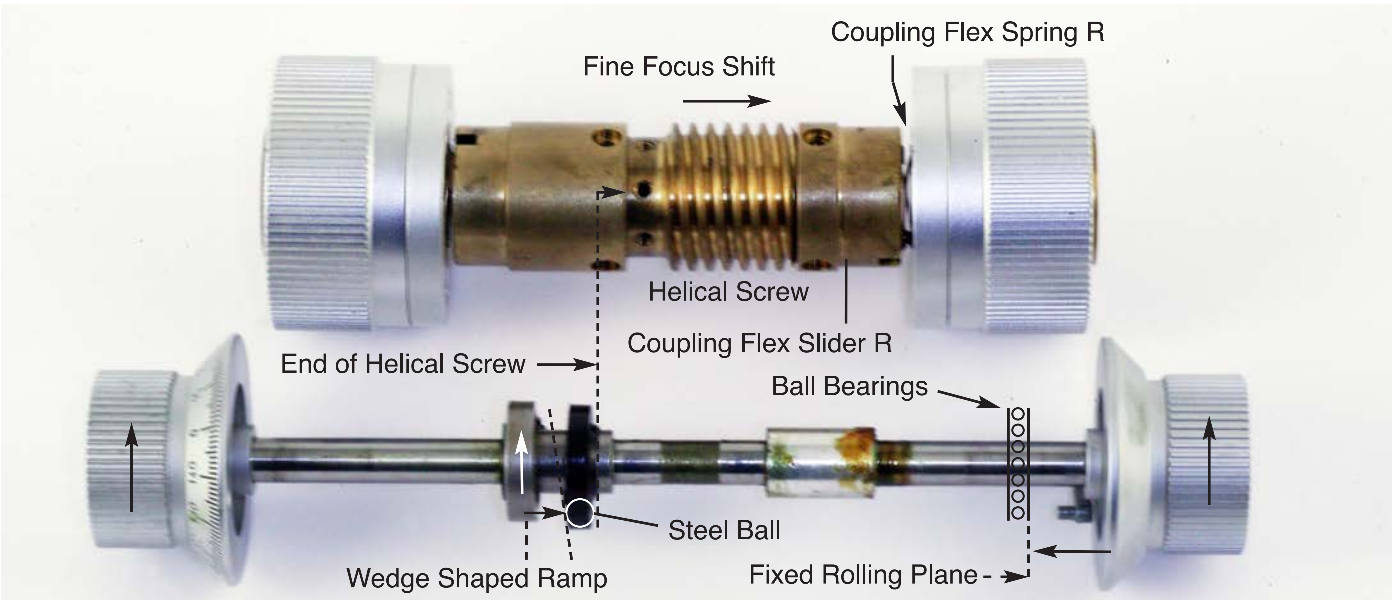


Fine focus mechanism disassembled to reveal its inner parts: The 20 mm long roller bearings glide in between the central shaft, and the worm gear. The worm gear is coupled with the coarse focusing knobs by a pair of coupling flex springs on both ends. While the course knobs control rotation of the worm gear, the central shaft can freely drive the fine focus wedge shaped ramp (explained below).



Rotating the fine focusing knobs counterclockwise causes the wedge shaped ramp to push against the ball bearing, and in turn, against the helical gear to shift it to the right (above). The ball bearing rolls in between the wedge shaped ramp, and the helical screw, but as it was explained earlier, at half the speed. The rotation limit follower rides inside a spiral groove attached to course focus knob (above). When the follower reaches either end of spiral groove, the fine focus knob engages with course focusing knob, and starts to turn it, literally functioning as both course and fine focus knob. This idea is implemented in a more simplified version of this design explained later.





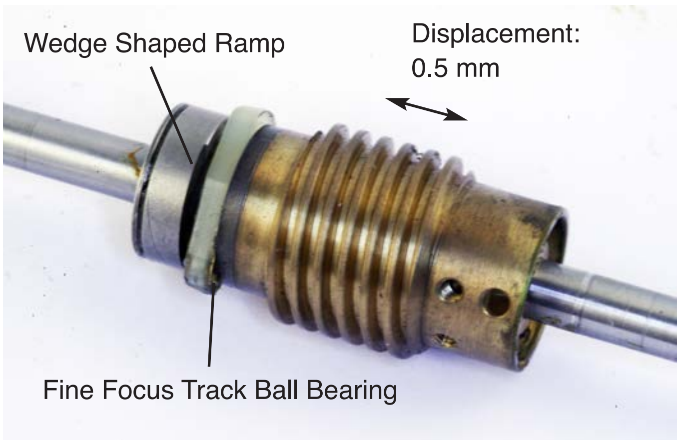
Detail view of fine focusing mechanism shows the Coupling Flex Springs, and how they allow the Helical Screw to shift while it is linked to both right, and left course adjustment knobs. The shift is caused by steel ball rolling in between the wedge shaped ramp, and one end of helical screw. As the ball climbs up the ramp, it shifts the helical screw to the right.

Alternate Micro-Focusing Design without Central Knob

Leica produced a series of these microscopes including the Laborlux brand, and there is a variation in the fine focusing knob as shown below. In this scheme, the fine focus knob is basically embedded inside the course focusing mechanism. The fine focus has a limited rotation (almost half a turn) and it then switches over to course focus mode. When the focus point is passed using the course focus, the same knob may be turned backwards to fine focus the image.

Fine and Course Focus assembly without the central fine focus knob in some of Leitz models introduced in 1970's.

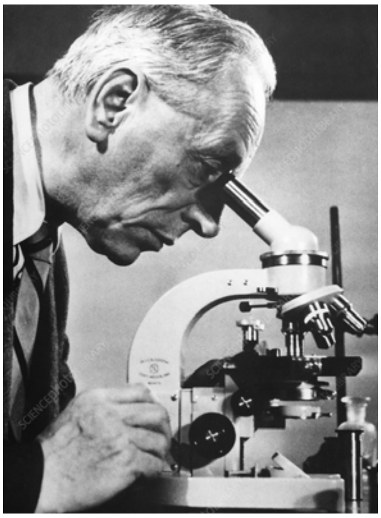
Fine and Course Focus components are reduced in this alternate design by combining them together.

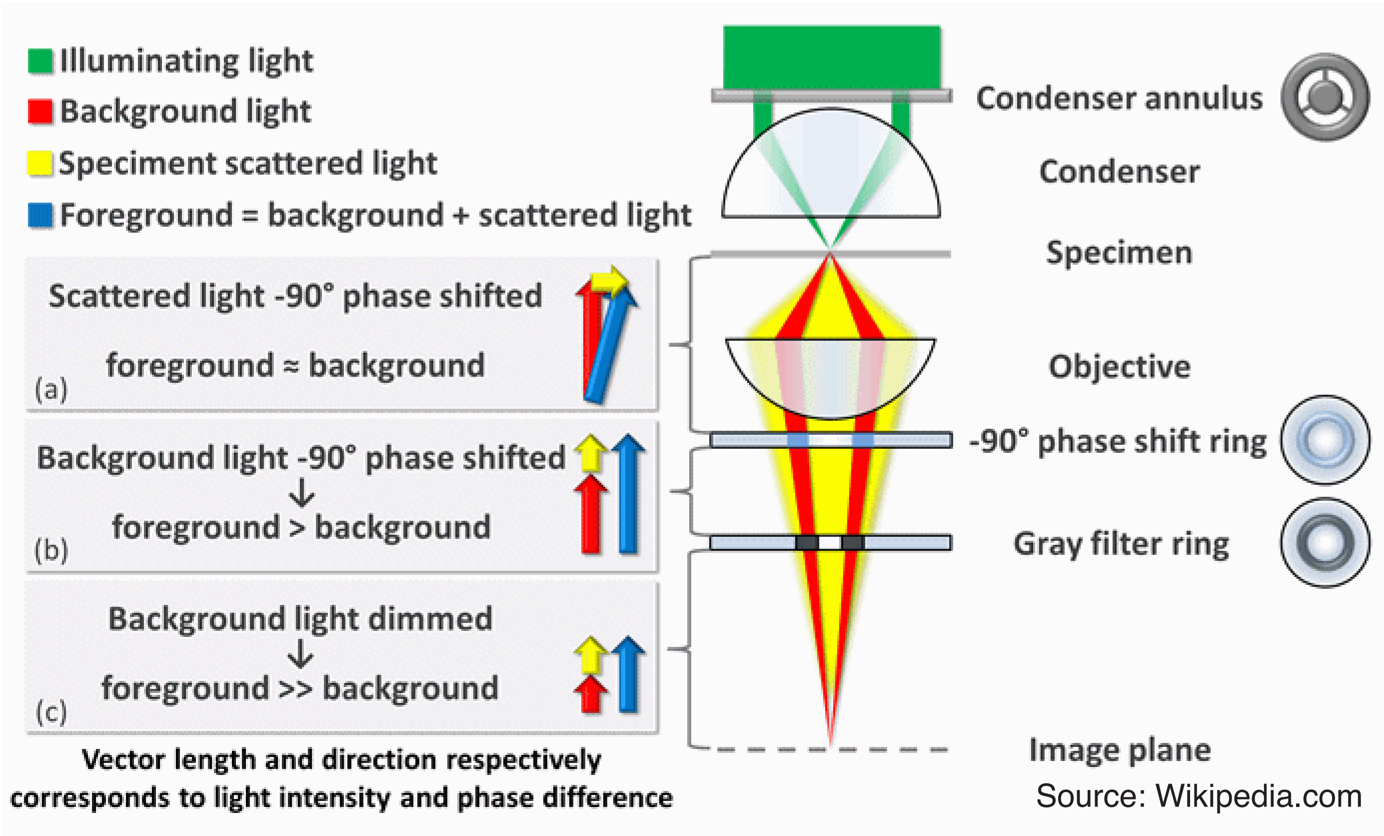


Fine Focus Bearing Assembly: Consists of a single ball bearing that rides against a rotary wedge shaped ramp.

How Phase Contrast Microscopy Works

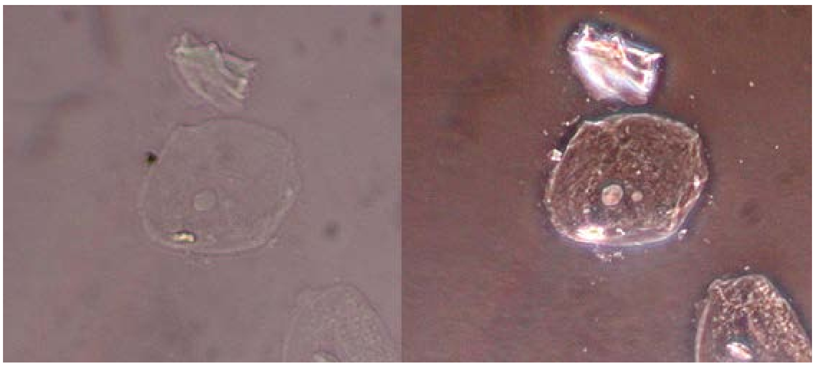
Phase contrast microcopy was first conceived by Fits Zornekie (1888-1966), a Dutch mathematician, and physicist. Phase-contrast microscopy is particularly important in biology. It revealed many cellular structures that were not visible with a simpler bright-field microscope, as exemplified in the figure (below). These structures were made visible to earlier microscopists by staining, but this required additional preparation and thus killing the cells. The phase-contrast microscope made it possible for biologists to study living cells and how they proliferate through cell division. It is one of the few methods available to quantify cellular structure and components without use of fluorescence. After its invention in the early 1930s, phase-contrast microscopy proved to be such an advancement in microscopy that its inventor Frits Zernike was awarded the Nobel Prize in Physics in 1953.





There is a great video on YouTube to learn about phase contrast microscopy by Edward Salmon at University of South Carolina at Chapel Hill:

https://youtu.be/I4ZQm-CAgL8



Brightfield vs phase contrast cell image: The wavefront goes through a setup similar to the darkfield but it's phase-shifted as it passes through the sample, and is interfered with the original beam.

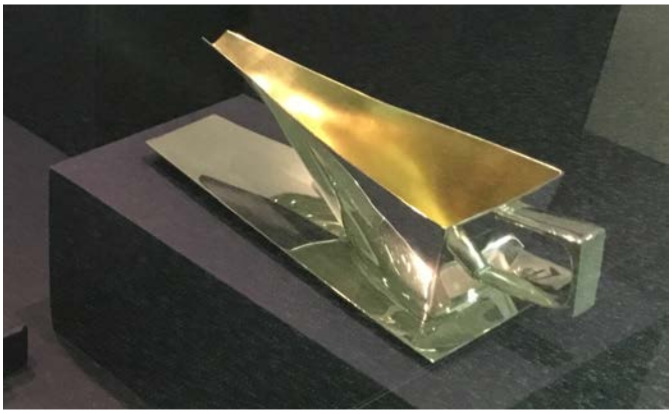
Flower vase made by Ane Christensn, London

San Fransisco Airport Museum

Amazing collection of silver works was at display at SF museum this month in February 2018.

Classical silver art was hand made, and took so much time to achieve reflective contours without wrinkles. The leaves (left) would look more natural when hand made with doll finish, but almost perfect finish is expected for a modern design cone (below). Silver made art work is reflective, and fascinating to the eyes of an optician. Most of this work were limited edition designs. The cigarette box (below) was designed by Tony Laws, made by extraordinary craftsmanship of Ian Calvert with a helical twist with flush hinges that disappear when the box is closed.

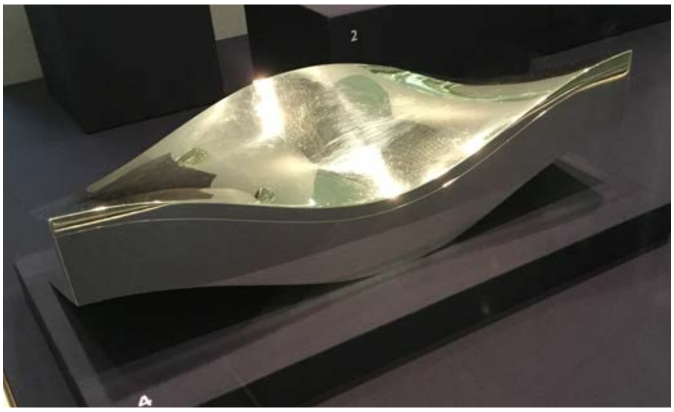
Sterling Silver works by Chris Knight, Sheffield



Sterling Silver sauce boat by Alex Styles (1922-2017), London

Sterlin Silver works / Enamel by Martyn Pugh, Birmingham, known for creating modern forms

Flowered box by Steward Devlin (1931-2018), London



Sterling Silver cigarette box by Ian Calvert, 1975, London

Events Calendar

January 2019

February

Astro Fest Europe (Telescopes)
Kensington Center, London, Feb 8-9

Photonics West, Bios
US, San Francisco, Feb 5-7

March

World of Photonics China
Shanghai, March 20-22

Photonics Moscow
Russia, March 04-07

OFC
San Diego, CA, March 3-7

April

NAB Cinema and Broadcasting
Las Vegas, April 6-11

May

CLEO
US, San Jose Convention May 5-10

Photokina
Cologne, Germany, May 8-11

June

World of Photonics Germany
Munich, June 22-25

Inotex
Tehran, June 24-27

July

August

Photonics San Diego
US, San Diego August 11-15

September

China Optoelectronic Expo
China, Shenzhen Sep 5-8

October

Interopto Japan
Tokyo, October 9-11

Photonics India
India, Bangalore Oct 17-19

November

Leipzig Watch and Clock Fair
Leipzig, Germany, Nov 22

Medica Trade Fair
Germany, Dusseldorf Nov 18-21