Leica R lenses

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Chapter 10: Leica APO-Telyt-R Module System


LEICA FOCUS MODULE
280/400 mm f/2.8


LEICA FOCUS MODULE
400/560 mm f/4


LEICA FOCUS MODULE
560/800 mm f/5.6


LEICA APO-TELYT-R
280/400/560 mm


LEICA APO-TELYT-R
280 mm f/2.8


LEICA APO-TELYT-R
400 mm f/4


LEICA APO-TELYT-R
560 mm f/5.6


LEICA APO-TELYT-R
400/560/800 mm


LEICA APO-TELYT-R
400 mm f/2.8


LEICA APO-TELYT-R
560 mm f/4


LEICA APO-TELYT-R
800 mm f/5.6

__General considerations

Long focus lenses have contributed considerably to the fame and universal importance of the Leica system. The Telyt 400 mm f/5 was introduced in 1936 and captured the imagination of photographers by its ability to magnify the objects by a factor of 8, compared to the standard lens. You should understand that this ratio is related to the inherent magnification of the 50mm lens, and so is different from the 8x magnification you get with a 8 times binocular system: as example the LEICA TRINOVID 8 x 42 BN. With this focal length, the Leica system could cover an unparalleled range of subjects and photographic tasks. This Telyt was a very slow seller, but the Leica system as a universal photographic tool was firmly established. It is an ingrained feature of human nature to try to push the limits of the system a notch farther. During the growth of the Leica system, the maximum focal length climbed from 400mm to 560mm and in 1978 to 800mm.

The image quality of the first generation of long focus lenses is barely acceptable when we relate the performance to current demands, But this is not fair. We have adapted ourselves to the very high quality of modern Leica lens designs and accept as normal what is in fact exceptional. In those days the sheer excitement of being able to use a lens with these specifications far outweighed the lower level of image quality. When designing long focus lenses, several problems became evident. The optical limits (especially the chromatic errors), the handling, the focusing speed and the accuracy of the assembly all put a heavy load on the design specifications. Long lens barrels may introduce flare. The strong pumping action of the focusing mount may draw dust and moisture into the lens system. Atmospheric haze may degrade the image and a lens system with exceptional clarity and penetrating power is required. The bigger size of the lens can obstruct the speed of the focussing action. Several types of sliding focusing mount were introduced and the optical design changed from a telescope type of design (cemented doublets and triplets) to the highly developed eight-element-system of the Apo-Telyt-R 280 mm f/2.8 from 1984 and the eleven-element-system of the Apo-Telyt-R 400 mm f/2.8 from 1992.

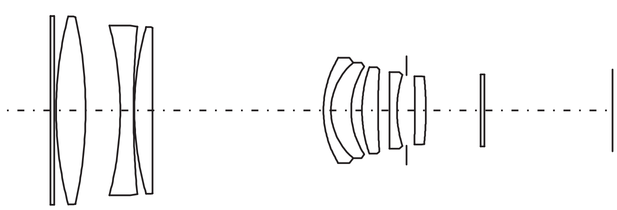
These lenses solved many of the problems mentioned earlier. But in one area there was no easy solution.
The photographer who is active in the areas of sport, nature, reportage or fashion, however will not limit his equipment to one single long focus lens. In many situations different lenses are required. The recording characteristics of these lenses (perspective, angle of view, near focus limit) will match with a specific range of photographic tasks, but they have to be seen as specialist lenses as compared to standard or wide angle lenses. The Apo-Extender solution gives already the possibility to change the focal length with a factor of 1.4 and 2.0, but a certain loss of contrast and therefore image quality has to be accepted, especially at the shorter distances.

If a photographer needs more than one lens in the range from 300 to 800mm, cost and weight may become quite high. The Apo-Telyt-R module system has been designed to reduce cost when investing in a selection of long focus lenses.
This range of focal lengths allows for really exciting and

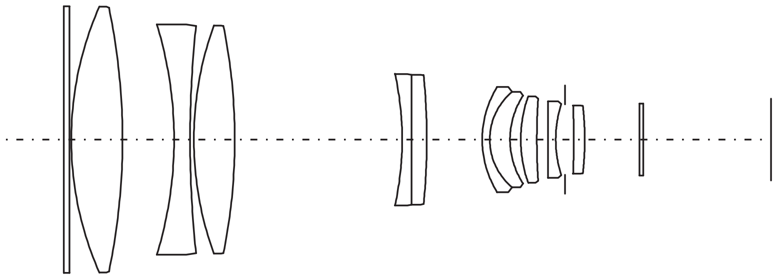
and fascinating photography. Anyone who has used binoculars with a magnification of eight or ten times, will recognize the pleasant chock of surprise when being able to see subjects at a larger distance with great clarity and full of intriguing details. "Impossible" pictures are within reach of the photographer using the module system. As with binoculars, one learns to search for subject details and image composition with a very narrow angle of view, which is a kind of visual discipline one has to appreciate and get accustomed to.

__Optical considerations

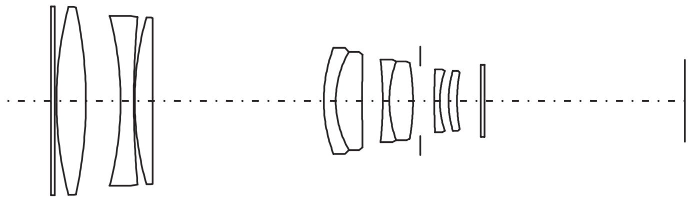
The normal optical system (the lens with a fixed focal length) has a fixed number of lens elements, and all of them have a fixed distance between them. A zoom lens has a fixed number of lens elements, but here the distances between elements can change. A third category of designs is the multi-configuration design. Here the number of lens elements do change, but the distances between them are fixed. The Apo-Telyt-R module system belongs to this last category. The multi-configuration design has nothing to do with the so-called convertible lenses (Satz Objektive). In this latter design we encounter two lens elements or doublets (A and B) with almost identical specification, but different power of magnification, that can be used together or separately, delivering three possible configurations (A, B and AB) and therefore three different focal lengths.
The starting point of the Module system was the layout of the Apo-Telyt-R 280 mm f/2.8 and Apo-Telyt-R 400 mm f/2.8. The former has a front group of three elements and a second group of 5 elements. The 400mm system has a front group of four elements, a middle group of two and a third group of 5 elements, including the lens group for the internal focusing. If we cut both lenses in two segments and regroup the front and middle section of the 400 lens, we see the contours of the module system. The three element front group of the 280mm lens becomes the smaller module head with 125mm diameter. The rearranged first and second group of the 400mm become the larger module head with 157mm diameter. The focus module 2.8/280/400 is derived from the last group of the 280mm lens. And the focus modules 4/400/560 and 5.6/560/800 are derived from the rear group of the 400mm lens.



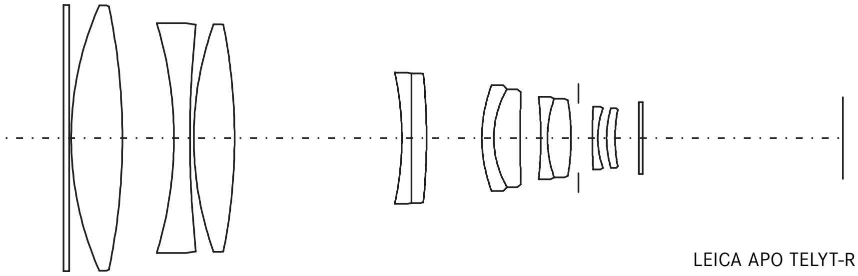
LEICA APO TELYT-R 280 mm f/2.8



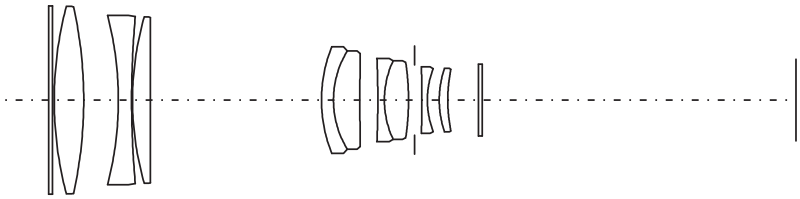
LEICA APO TELYT-R 400 mm f/2.8



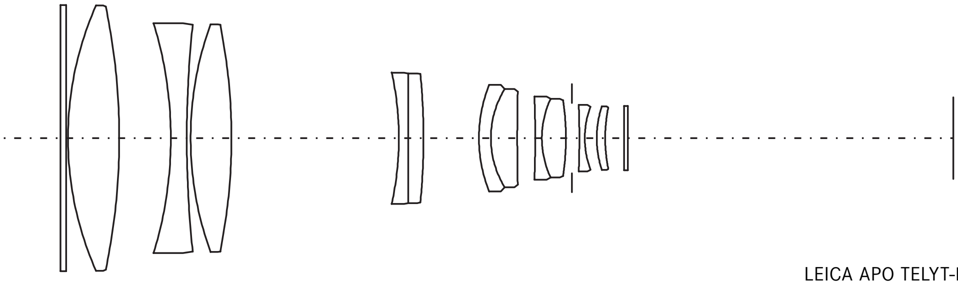
LEICA APO TELYT-R 400 mm f/4



LEICA APO TELYT-R 560 mm f/4



LEICA APO TELYT-R 560 mm f/5.6



LEICA APO TELYT-R 800 mm f/5.6

LEICA APO TELYT-R 560 mm f/5.6 / Photography: Oliver Richter

Compare the module versions of the Apo-Telyt-R 280 mm f/2.8 and Apo-Telyt-R 400 mm f/2.8 with the original 280 and 400 designs and you will discover the close resemblance. The three focus modules have relative magnification factors of 1, 1.4 and 2, a progression that is identical to a lens with fixed focal length and the two Apo-Extenders.

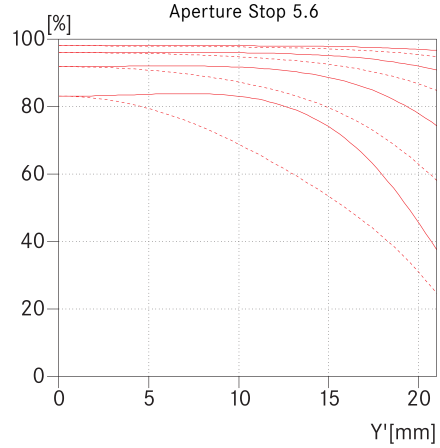
All combinations of the module system can be used with the Apo-Extenders and in theory you could create a 1:11/1600mm lens. But this combination is beyond the usability limit. Most photographers accept a 1200mm lens as the most extreme focal length for photographic purposes. Up till now I have used the generic term of long focus lenses to describe all lens designs with a focal length above 300mm. To be more precise, I have to add that the Module system is a telephoto design and falls in the category of super-telephoto lenses. All lenses with telephoto design have a physical length that is less than the focal length. But in the case of the Module system the lens units are really compact. The 800mm as example has a length of only 442mm. The small size helps making pictures in severe weather conditions as the low wind resistance profile reduces shake and vibrations. The design of a multi-configuration system has been described above as a kind a simple task. In reality this design is exceedingly difficult and must be done for a large part by hand. In this case the computer plays a relatively minor role in optimizing the system. The designer of the Module system had to study and experiment to find the best solution that had to searched for in a long and laborious process.

When studying the MTF graphs, we note an exceptionally high overall quality. You will discover that as a general rule the fine and the very fine tangential structures or lines show a lower contrast than the sagittal structures or lines. If we imagine a bicycle wheel as object, the sagittal orientation corresponds to the spokes of the wheel (also called the radial orientation). The tangential orientation corresponds to the rim of the wheel (also called the meridional orientation). The result of these different orientations implies that if the spokes are sharp, the rim is not and when the rim is sharp, the spokes are not.
Several lens configurations of the Module System show this phenomenon of a lower contrast of the fine subject detail in the tangential orientation or direction. This lower contrast is the result of some small residual aberrations: we see at very large magnifications in projection or prints a trace of lateral chromatic aberration. We are familiar with the fact that the colours of the spectrum do not focus at the same image plane: the familiar chromatic error. If this error is corrected, we may designate such a lens as apochromatically corrected. But we have a related error: when the several colours do not focus at the same image plane, every colour has its own focal length. This is logical. Focal length is defined as the distance from the lens (in fact the nodal point) to the focal plane or image plane. But we also know that focal length defines the magnification power of the lens. If several colours have different focal lengths, they also have different magnifications. The focal length distance is measured along the optical axis (the axial direction). The magnification is measured along the height of the image plane (the lateral direction). The apochromatic correction implies that three different colours are focused at the same image plane (axial direction). There are always some residual errors in the system, the so called secondary spectrum. These may manifest themselves as very small colour fringes in the lateral direction.

A very detailed description of the lens performance of all module combinations at every aperture is beyond the scope of this chapter. It is not necessary to do this. A glance at the MTF diagrams does indicate that at aperture 5.6 all combinations perform at an optimum level. Especially noteworthy is the excellent contrast at the 5,10 and 20 linepairs/mm. In most cases, the values are between 90 and 98% over the whole image frame. This performance will translate into extremely sharp pictures, with very clean and crisp definition of the small subject details. The high contrast at all frequencies and the apochromatic correction can cut through atmospheric haze and heat turbulence of the air in long distance shots. Excellent and neutral colour rendition is guaranteed by the high level of transparency at all colours of the spectrum.

As exemplary we may describe the performance of the Apo-Telyt-R 400 mm f/4. In this case even the contrast of the 40 linepairs/mm is close to 90% over a large part of the image plane at full aperture. At 1:5.6 the outer ones improve and an exemplary performance is delivered.

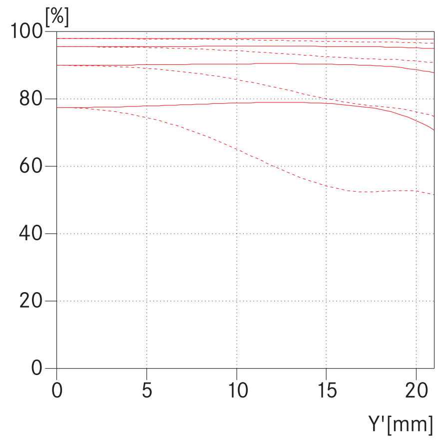
LEICA APO TELYT-R 400 mm f/4
Aperture Stop 5.6



The drop at the outer zones is hardly significant for most type of photographs. As a comparison, we may refer to the original 400mm f/5 lens from 1936. In this case we have a contrast of less than 90% for the 5 linepairs/mm and 20% for the 40 linepairs/mm.

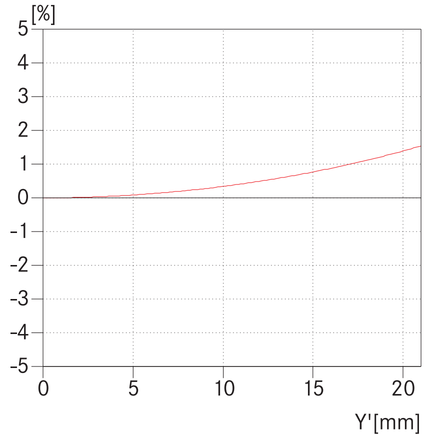
The Apo-Telyt-R 280 mm f/2.8 at aperture 5.6 shows slightly lower contrast values when reproducing the finer subject details compared to the Apo-Telyt-R 400 mm f/4.

LEICA APO TELYT-R 280 mm f/2.8
Aperture Stop 5.6

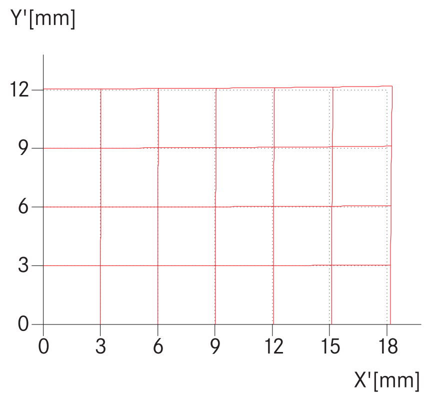


At aperture 2.8 there is hardly a visual difference, indicating the high quality of the lens system. The positive aspect of the provision of MTF graphs is the ability to study the performance one can expect from a lens. But the negative aspect is the possibility of laying too much significance on certain numerical values. A drop of contrast from 80% in the centre of the image to 50% in the corners seems a big drop. Numerically this is true. But a contrast of 50% at the edge of the image is undoubtedly an excellent, if not outstanding result. Lenses with narrow angles of view do not suffer from the usual optical aberrations as coma or distortion. You will search in vain for these errors. The exceptional clarity of the image details over most of the picture frame may be in part attributed to the absence of these aberrations. The module system of lenses in general have hardly vignetting and distortion: the Apo-Telyt-R 400 mm f/2.8 has respectively less than one stop and 1.5%. Identical values we see at the Apo-Telyt-R 280 mm f/2.8.

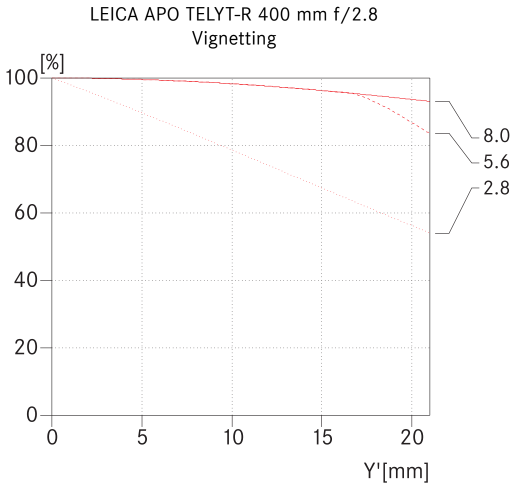
LEICA APO TELYT-R 400 mm f/2.8
Relative Distortion

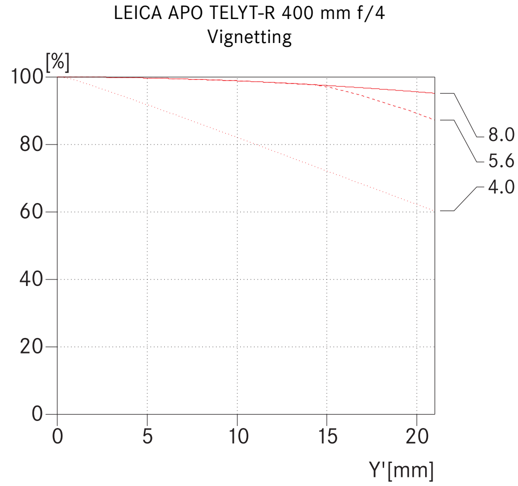


LEICA APO TELYT-R 400 mm f/2.8
Effective Distortion



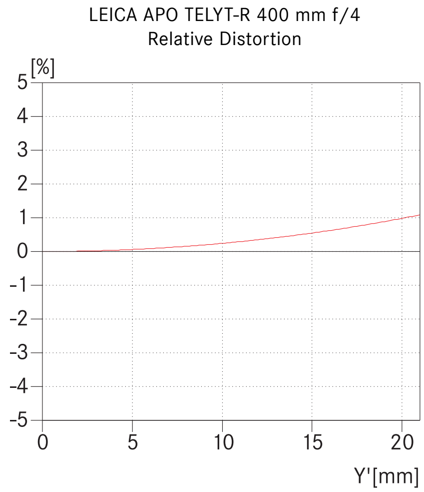
Photos: LEICA APO TELYT-R 280 mm f/2.8
Photography: Oliver Richter

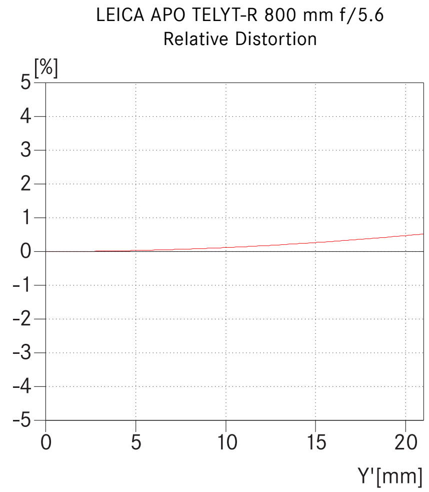


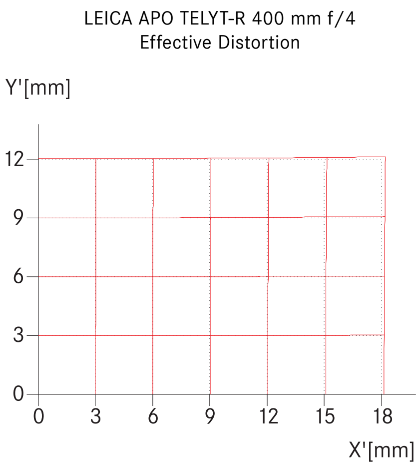


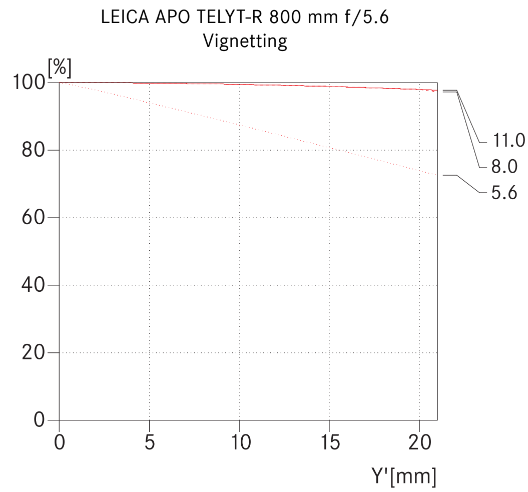
The Apo-Telyt-R 400 mm f/4, Apo-Telyt-R 560 mm f/4 have vignetting of much less than a stop and a distortion of 1%.

The best values are presented by the Apo-Telyt-R 560 mm f/5.6 and Apo-Telyt-R 800 mm f/5.6, Insignificant vignetting and distortion below 0.5%.









Compared to the earlier lenses, the Module system delivers superior performance, especially at the longer end of the scale (the 560 and 800mm). If you only need one single focal length and restrict yourself to the 280 or 400mm, you have the choice to select the current 4/280mm with even better image quality at a reduced aperture or the older Apo-Telyt-R 280 mm f/2.8 does deliver equal performance as the module version. The older Apo-Telyt-R 400 mm f/2.8 has a slightly less crisp image at the wider apertures and here the module system shows a slight advantage.

Leica aficionados will undoubtedly have the original brochure of the Module system, in which the MTF graphs are displayed. If you compare these graphs with the ones now available on the Leica site, you will note that the older diagrams seem to indicate better results. Has the performance changed? Not at all: what has happened is a change in the calculation of the MTF diagrams. Previously Leica calculated the MTF values based on geometrical optics, which is somewhat simpler and will approximate the MTF that can be expected in the case of larger aberrations. Now Leica uses the more exacting diffraction limited MTF, which is better suited to the small residual errors that are left in the lens systems.

__Haptic considerations

Three observations are paramount when using the lenses of the Module system: they feel and operate with the utmost of sturdiness, they exhibit the smoothest focussing that I have ever encountered and they are extremely practical to use. Both aspects support the great precision that is needed when using the system. The depth of focus is very limited at the wider apertures, the ones that will be used most often. As example: the Apo-Telyt-R 400 mm f/2.8 has a depth of focus of 4cm at a distance of 5 meter and aperture f/2.8.

Even at a distance of 20 meters you have a bandwidth of 50cm, that is 25cm at either side of the exact focusing point. These values are of course calculated with the standard circle of confusion, which is simply too wide for the large sizes of the Leica pictures. In reality then he Do must be interpreted more strictly. For best results, the optical and mechanical requirements must match and support each other. Optically the lenses perform at optimum quality. Mechanically, the ability to interchange the module components freely puts a heavy load on the quality and finish of the mating surfaces of the components and the accuracy of the assembly. The price level of the module system

LEICA APO TELYT-R 400 mm f/2.8 / Photography: Oliver Richter reflects the engineering and optical quality you may expect to get. The internal focusing is superbly smooth. The sharpness plane snaps into focus on the screen and there is no insecurity during the focus movement. The many small details of the system show the experience of Leica with this type of lenses. You can set the shortest focusing distance anywhere between the available focusing distance and infinity. You can preselect the shortest distance where you want to focus as a minimum range. During picture shooting you can use the whole range of distances, but when something of interest happens at that particular distance you can jump to that distance setting with the near-focus stop. These lenses will often been used in extreme conditions where they meet more dirt and rain than photons. For these conditions, the lenses are prepared. Protection measures at all sensitive locations are provided. The Module system lenses feel as rugged as a Landrover, with which they will often be transported and they are capable of withstanding every abuse. When the photographer needs to make good pictures in extreme conditions, care for the equipment is the least of his worries.

It is possible to use the 280mm /400mm lenses handheld. It did it with the Apo-Telyt-R 400 mm f/4 system. I was prepared to see only fuzzy pictures. With about 4 kilograms, the lens is no featherweight. I was however amazed at the sharpness of the pictures when used at the more usual enlargements. Handheld shooting is not the best method to get the full quality of the lens, but it is possible. Prefocusing is necessary as you cannot focus and hold the lens stable at the same time.

It is evident that all precautions must be made to ensure a vibrationless operation. A high shutter speed, mirror lock-up and preferably a cable release are basic tools. For the rest (which tripod system, how to balance the system, etc) every one needs and will find his/her preferable solution. There is much conflicting advice in the handbooks and also in practical situations. My advice would be: experiment with several solutions and stop as soon the level of image quality that you want has been reached. Some photographers are always on the search to find an even better mousetrap, but it is the result you want that finally counts. The Module system lenses can deliver whatever quality you aspire to reach.