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c't Digital Photography

The in-depth quarterly for the photo enthusiast

Authentic Travel Photos

How to Avoid the Usual Clichés

Handheld Light Meters

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Full-frame Champions

Sony a7S, Nikon D810 Tested

Infrared Photography

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The Best 50mm Lenses

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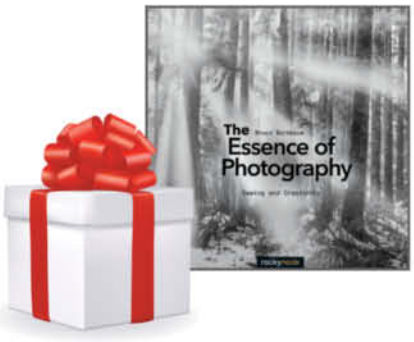

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What do soccer fans, Tokio Hotel devotees and hobby chefs have in common? They all get quite emotional when discussing their favorite subject. Even standard lenses can cause hot debate among photographers – a tendency that definitely spiced up this issue's lens test.

When I asked our in-house photographer to take some shots of our 50mm Sigma Art-series test lens, he protested that we would never get him to mount a Sigma lens on his camera, even though I only wanted him to photograph it! He uses manufacturer's own-brand or Zeiss lenses only and simply couldn't believe that Sigma now creates lenses of comparable quality. He picked up the 50mm and looked at it from every angle, twisted it, tapped it and checked it out in detail until he finally discovered that if you press really hard on the barrel, the focus ring becomes less easy to rotate. If you look hard enough, you are sure to find something you don't like, and he assured me this would never have happened with a Zeiss lens. But let's face it, Sigma cannot hope to duplicate decades of Zeiss lens-making experience within a couple of years of starting its new quality initiative.

Prejudice disappears completely in the lab. We had to look hard to find the differences between the Zeiss Otus and the Sigma, but they do exist and you can find out all about them in our test on page 20. I have now added another third-party lens manufacturer to my list of those to check out when I am on the lookout for high-end lenses, and I am curious to find out whether experienced pro photographers end up feeling the same way.

Have fun with this issue, whichever brand of lens you prefer!

Sophia Zimmermann

Sophia Zimmermann

Portfolio

The last rehearsal, the final premiere and the last dance. Photographer and journalist Insa Cathérine Hagemann portrays the end of a professional dancer's career.

Standard Lenses

Sigma, Zeiss and Sony all make their own high-end standard lenses, but are they really better than the competition? We take some of today's best 50mm glass for a spin.

Camera Tests

We test a selection of high-end compacts, the latest version of Nikon's high-resolution full-frame baby and the Sony a7S with its unparalleled ISO sensitivity range.

Travel Photography

Capturing an authentic portrait of a foreign country is a real challenge. Our workshop explains how to create images that avoid the usual clichés.

Trick Tripods

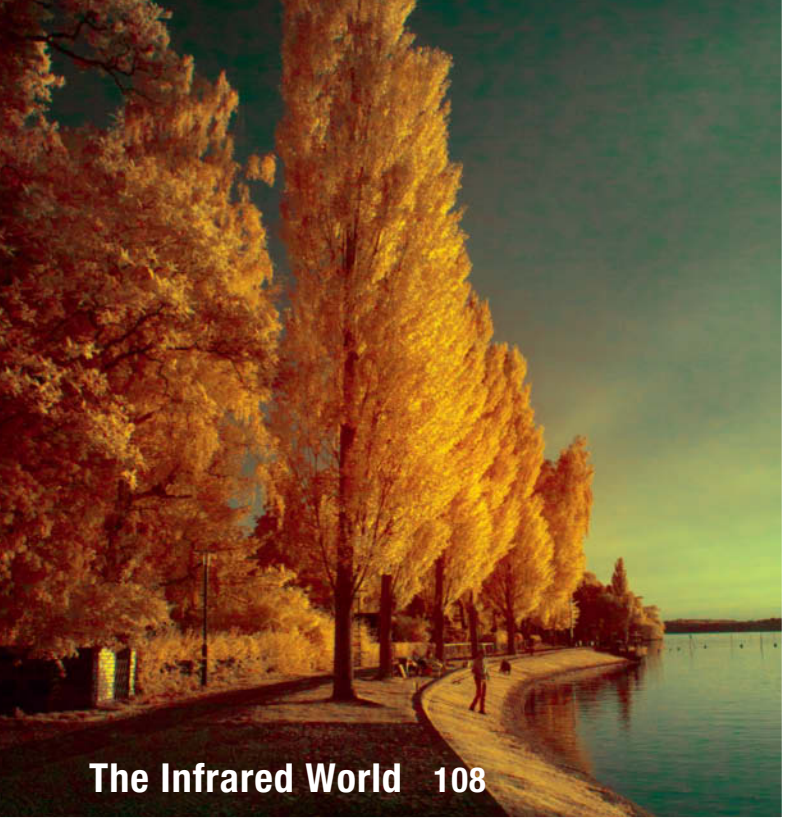
Sometimes, a standard tripod isn't enough to get the right view of that special subject. We test some unusual camera supports.

Handheld Light Meters

Why use a separate light meter when your camera has metering technology built in? We explain how handheld light meters work and test a range of meters and apps.

The History of Digital Photography

Digital photography evolved through a complex sequence of historical events. We fill you in on on the origins of today's technology.



WordPress Tuning

We show you how to use dedicated plug-ins to transform the popular open source WordPress CMS package into a high-end photo blogging tool.

Infrared Photography

Infrared shooting techniques show the world in a new light. We explain how to capture and process infrared photos using standard and modified cameras.

Lightroom Plug-ins

Lightroom offers a wealth of powerful image processing tools, but plug-ins are still the answer when it comes to performing unusual editing tasks. We introduce some of the best.

DVD Download

If your copy of the magazine contains no DVD, navigate to www.ct-digiphoto.com/dvd182015 to download the DVD content for free.

About Us

Free DVD

Full Version Software: Photomizer Retro

Photomizer Retro provides you the tools you need to give your photos a cool old-school look

Videos

- X-ray Photography with Nick Veasey
- Creating an Analog Look Using Continous Light
- Old Lenses on Modern Cameras

Readers' Letters

DSLR or Camcorder?

Is there a single camera (DSLR or Camcorder) that can produce both digital still photos and videos that are high quality (equal to or close to full frame sensor quality) that can also be manually controlled for both still photography & videos? I'm an advanced amateur (on a fixed income) but consider myself a "creator" not a "techie", hence the very basic questions… I know what's important for a DSLR and still photography but not certain what's important for a camcorder. Apart from frame size, frame rate and bit rate, what other items are important for control and quality in a camcorder? Should I consider something like the Sony Cyber-shot DSC-RX10 (marketed as a still camera) for still and video or the Sony HDR-CX900 (marketed as a camcorder) for video and still? Both have fairly large 1-inch sensors so I'm wondering if either will be able to deliver "output & control" that is equal to the other for both still images and video. Is this a dream or does this type of camera exist at this point in time?

Edward Michael

'All-round' cameras always involve compromises, but overall still and video image quality is improving all the time. A camera such as the Panasonic Lumix GMC-GH4 (see page 38 in Issue 17 for a review) includes true pro-grade video features while preserving high-end still image control and quality. Such features are quite expensive and the inclusion of high-end 4K video signal processing means that this particular model is no bargain. If you don't need true HD video, the previous GH3 model is a feature-rich camera that is nevertheless capable of capturing 60 full 1080x1920 frames at high bit rates.

Test Charts for Readers?

I just picked up my first issue of ***c't*** *Digital Photography* at a bookstore and I was very impressed. The in-depth reviews are well detailed and documented but are not so technical that I couldn't understand them. I didn't feel as though certain aspects were being "overlooked" in order to serve more as an advertisement for the company whose products were being featured. (That's the impression I often get when reading mags like Popular Photography.) I have yet to delve into the DVD, but I'm eager to do so. I noted several of the test charts used in the articles, like the Siemens stars TE 268 lens resolution chart but, when I searched online, I saw that such a chart goes for over €830, so I began to wonder. Could ***c't*** *Digital Photography* include a test chart which readers could print up on their own? Or would the resolution/color be too difficult to reproduce on users' printers to make it practical?

Joel Brondos

This is a fine idea that is unfortunately extremely difficult to execute. The test charts we use come from a certified lab called Image Engineering and, to ensure maximum resolution, are produced using a special printing technique on an approrpriate substrate. It is simply impossible to achieve similar quality using a conventional inkjet printer. Additionally, the charts only work properly when utilized in conjunction with custom analysis software, and the shooting conditions (especially the lighting) have to remain precisely constant. However, there is nothing to stop you creating your own test chart for home use using the sample images and test shots on the DVD we include with every issue of the magazine.

Image: George Lepp

Micro Photography

Your recent article on micro photography (*see Issue 16 - Ed.*) caught my interest but I am unsure where to find the RMS thread adaptor for my 77mm Nikon f/2.8 zoom lens. I want to buy the Nikon microscope objective mentioned in the article, but it is not clear where I can acquire the RMS adaptor to fit. Do you have more specifics on what I am looking for and where I may find it?

Richard Bryant

RMS thread adapters are available from a variety of sources through Google and on eBay. Your search should include the words "RMS adapter" and you need to purchase the thread size that fits the filter of the lens you wish to mate the microscope lens to. This may take two adapters – one for the RMS and another to step up from the lens filter size to the opposite end of the RMS. Most of the RMS thread adapters I came up with were 42mm to RMS, which means you would then need an adapter from 42mm to your lens filter size to finish the setup. (George Lepp)

c't Digital Photography Now on Android

The ***c't*** *Digital Photography* app for browsing and reading our top-notch content is now available for Android. The new app includes search, bookmarking and sharing functionality and is virtually identical to the iOS version. You can use your subscriber login details to access all issues, regardless of when your subscription actually began. The app is compatible with Android 4.0 and higher and is available on Google Play.

Tell us what you think:

We are always happy to receive your comments and suggestions in a letter, an e-mail (editor@ct-digiphoto.com) or at www.facebook.com/ct-digiphoto. We reserve the right to abbreviate your input for publication. Our comments are printed in italics.

Focus Stacking

I was about to order the *StackShot* software referred to on page 57 of Issue 16 when I read Randy Lund's reader letter in Issue 17 describing how he used *Photoshop* for the same task. First, I was wondering whether he would have had 100% success had he used *Helicon Focus* or *Zerene Stacker*? Secondly, he does not state the length of the lens he used. I would have thought that the problem he had would be reduced had he used a 180mm or 200mm 1:1 or 1:2 lens.

Stanley Robinson

It's not an issue of focal length per se but of ratios. Consider a scene with a near focus plane A and an object of height X located at it, and a far focus plane B with an object of height Y in it. At close focus (i.e. at A), X has an image height of N, and Y an image height of M. The ratio of the sizes on the sensor is N/M. As you move the focus plane toward B, the value of N/M changes. The effect is different depending on whether you move the focus plane by adjusting focus or by moving the whole camera/lens assembly to keep focus constant. In either case, you cannot adjust the image size such that AX, BX, AY and BY completely align. In theory, this could be corrected only by using the appropriate thin slice of image as you move from front to back, thus eliminating the offending material. In my experience, Photoshop does not do this adequately.

A longer lens would help in some cases, as it impacts the apparent perspective and the ratio of initial sizes. If that is not an issue with the desired image, a longer lens helps. The math used to develop my earlier the arguments is based on optics equations and idealized targets, and the subject plays a role here too. The factors that impact how software renders a result are a) Subject clarity/contrast, and b) The 3D nature of the subject. Unfortunately, my test subject comes up short on both. Most stacked images are of naturally sharp, quite high-contrast subjects such as watch internals etc. My lily had quite low contrast and I can see how Photoshop may have had some issues finding 'best focus'. A lot of the pictures (like the watch) are actually fairly flat even if not aligned with the sensor. My flower was seriously 3D in that there are places all over the frame that would be in focus in a number of different planes. The complexity of the in-focus plane may have contributed to the issue. Final point: the math part is correct but we don't photograph equations. This is an issue that I think you need to be aware of and may require a bit of experimentation to get around if it becomes a problem. However, I don't think it's a killer and I plan to continue working with the technique. *(Randy Lund)*

DVD Highlights & Contents

Photomizer Retro

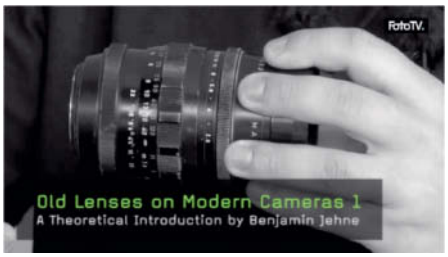
Full version software: Photomizer Retro gives you the tools you need to give your photos a cool retro look.

Why not turn things around and add some of the imperfections that characterize analog images to your digital works of art? *Photomizer Retro* offers a wide range of preset looks for simulating images produced by historic camera models and films. If you are not satisfied with the effect of the preset profiles, you can use the built-in filters to add grain and vignette effects. The program's interface is simple to use and enables you to select the desired filter effect with just a couple of clicks. A slider then enables you to compare 'before' and 'after' versions of your image. You can save your settings as default profiles that you can then apply to other images or sets of images in batch mode.

Use of the full version software requires registration from within the installer interface. Once you have registered, you will receive a free serial number from the manufacturer via e-mail and an upgrade offer for the *Photomizer Pro* image editing suite. This offer gives you a US$40 discount and is valid until April 30, 2015. (tho)

Old Lenses on Modern Cameras

Video tutorial: Many analog lenses are still useful in the digital age. In this video, pro photographer Benjamin Jehne explains which models work best and why.



The market for used analog lenses is alive and well, and many optics still change hands regularly online or at real-world swap meets. Among various others, Benjamin Jehne names the Micro Four Thirds-format Olympus PEN and E-mount Sony NEX cameras as particularly suitable for this kind of use.

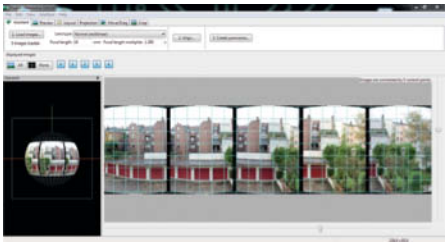
Using a 60-year-old 135mm Pentacon as an example, Jehne explains the pitfalls to watch out for when mounting a legacy lens on a contemporary camera. In this case, he recommends using an APS-C camera body with the 35mm-format lens. This approach utilizes only the center portion of the image circle projected by the lens, thus eliminating lens errors such as unwanted blur at the edges of the frame. Jehne says, "The geometry of legacy lenses isn't as precise as those built using today's technology, but many models nevertheless offer excellent center sharpness, even at wide apertures."

Alongside sheer curiosity, low prices are another good reason to experiment with legacy lenses: a used 50mm Pentacon can often be purchased at eBay for as little as US$40.

To round out his tutorial, Jehne explains how to use an adapter to mount an M42-threaded lens on a Canon DSLR and provides details on what to look out for when choosing an adapter for your own camera (sea)

Creating Panoramas with Hugin

Open source software: With its simple-to-use interface, *Hugin* is the perfect program for creating simple or complex panoramas.



Panoramas are a great way to give large subjects special emphasis and are often used to give landscape and architectural subjects extra punch. In analog times, you had to use costly special-use cameras with a rotating 'swing lens', such as the Hassselblad XPan or the cheaper Horizon 202, to shoot effective panoramas, but digital technology has changed all that.

Today's panoramas are created using a sequence of digital source images that are 'stitched' together using specialized software. Many photographers use the dedicated functionality built into *Photoshop* to create panoramas, but many prefer to use the pro-grade, open source *Hugin* package.

The hardest part of creating panoramas is making sure that perspective in the source images matches, and *Hugin* offers a range of powerful tools that take the guesswork out of the job. You can choose between various panorama formats, such as full spherical (equirectangular and cubic) and 'partial' (cylindrical, arc-formed, rectilinear and partial spherical). Full spherical formats display the entire sphere that surrounds us (360° along the horizon plus 90° up and down), although specialized viewers such as *PTViewer* or *SPi-V* are required to view them. Partial formats don't fill the entire sphere in one or the other direction and can be displayed directly by most common image viewing software if they cover 120 degrees or less along their shorter side.

The most commonly used formats are 'cylindrical' and 'rectilinear', although you can use the software to create partial spherical panoramas too. (sea)

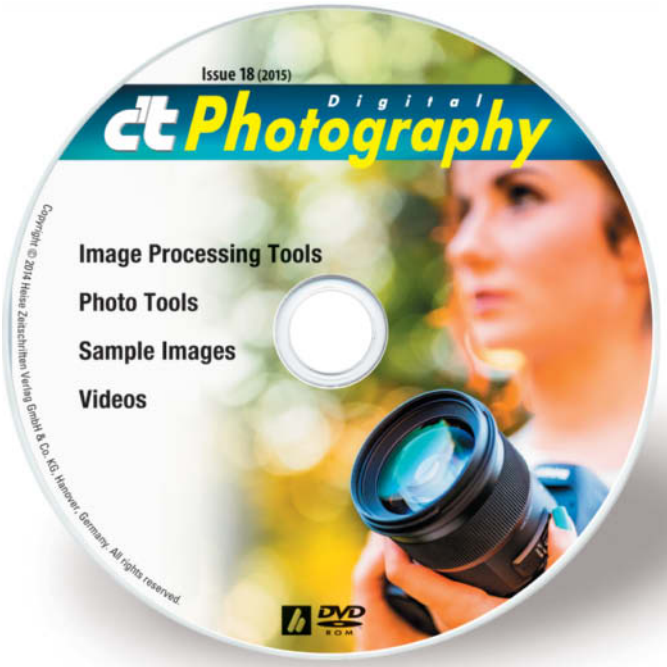


Image Processing Tools

Windows

Artweaver Free 4.5.4
GIMP 2.8.14
GIMP Portable 2.8.14
GREYCs Magic Image Converter (GMIC) 1.6.0.1
HeliosPaint 1.7
Hugin 2013.0.0
Photomizer Retro 2.0.13.308 Vollversion
PSPI 1.0.7
StylePix 1.14.4.2
StylePix Portable 1.14.4.2

Mac OS

GIMP 2.8.14 for Mavericks and Yosemite
GREYCs Magic Image Converter (GMIC) 1.6.0.0
GREYCs Magic Image Converter (GMIC) 1.6.0.1 64-bit
HeliosPaint 1.7
Hugin 2013.0.0

Linux

GREYCs Magic Image Converter (GMIC) 1.6.0.1 32-bit
GREYCs Magic Image Converter (GMIC) 1.6.0.1 64-bit
HeliosPaint 1.7
PSPI 1.0.5 for Ubuntu
PSPI 1.0.7 for SUSE 10

Photo Tools

Windows

AmoK Exif Sorter 2.56
ExifTool 9.74
Gallery 3.0.9
Helicon Photo Safe 4.20
IrfanView 4.38
IrfanView PlugIns 4.38
IrfanView Portable 4.38
PhotoRec 6.14
WordPress 4.0
XAMPP 1.8.3
XAMPP Portable Light 1.8.3
XnView 2.24
XnView Portable 2.24

Mac OS

AmoK Exif Sorter 2.56 32-bit
AmoK Exif Sorter 2.56 64-bit
ExifTool 9.74
Gallery 3.0.9
MacPorts 2.3.2
PhotoRec 6.14
WordPress 4.0
XAMPP 1.8.3

Linux

AmoK Exif Sorter 2.56 32-bit
AmoK Exif Sorter 2.56 64-bit
ExifTool 9.74
Gallery 3.0.9
PhotoRec 6.14 32-bit
PhotoRec 6.14 64-bit
WordPress 4.0
XAMPP 1.8.3 32-bit
XAMPP 1.8.3 64-bit

Videos

Analog Looks in Continuous Light
X-Ray Photography with Nick Veasey
Old Lenses on Modern Cameras, Part 1
Shower Curtain Diffusor – Soft Light on the Cheap

Sample Images

Camera Test Sample Images
Lens Test Sample Images

Get in the Picture

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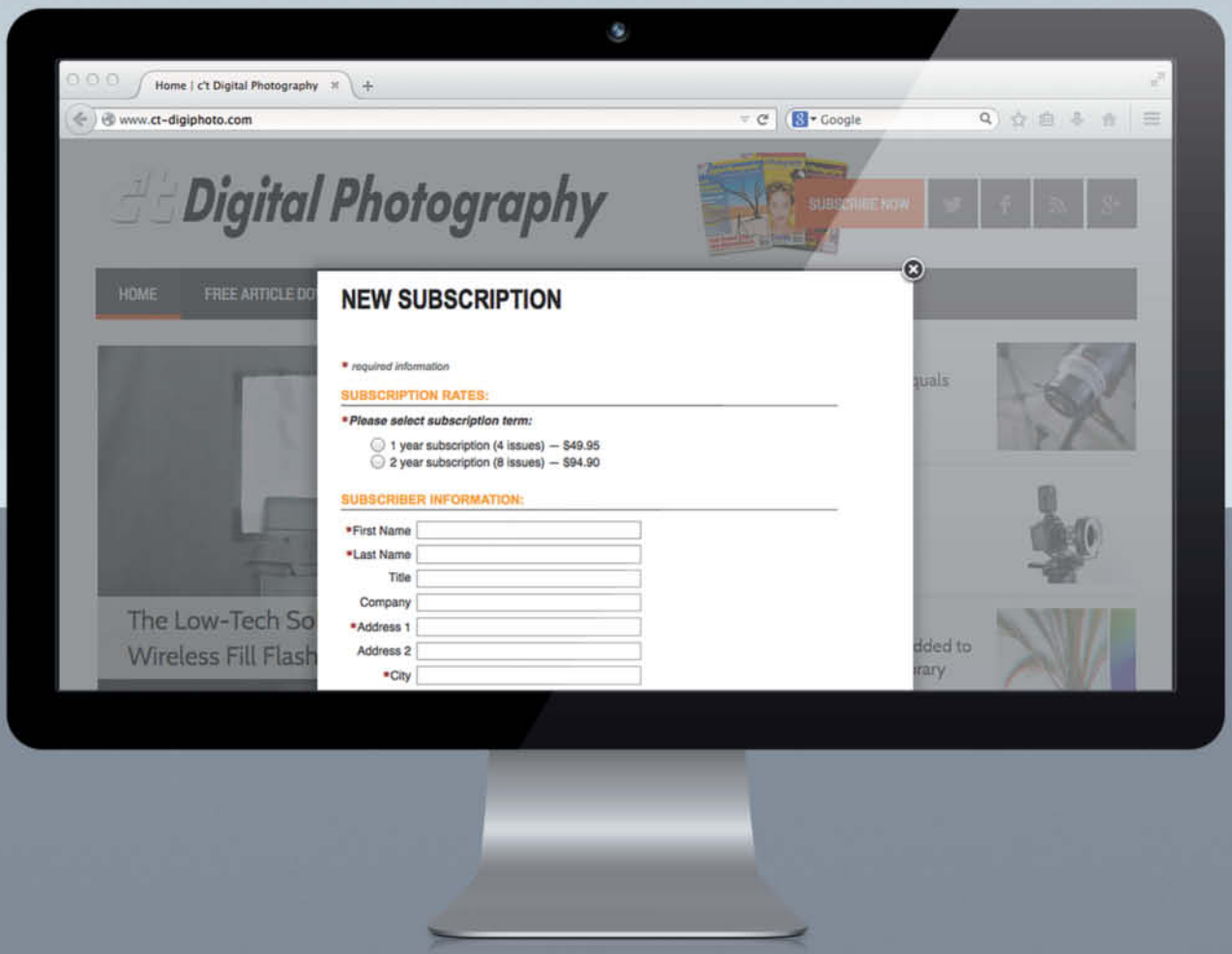

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Portfolio

Insa Cathérine **Hagemann**

What is it like to have a career that has dominated your every waking moment come to an end in mid-life? You stand on the stage for the very last time … the final applause dies away, the curtain falls. What does the future hold? How do you feel?

When French dancer Karine Seneca performed a lead role at the Hannover State Opera for the last time, she was also stepping out into an unknown future. On stage since the age of 17, she performed in Zürich and Boston, as well as with the Deutsche Oper in Düsseldorf and Duisburg. Life was full and busy, and 'afterward' was something she did not waste time speculating about. "I've lived so many different lives, I don't want to start another new life from scratch and have to find new friends again."

Inevitably, she couldn't continue to perform for ever. Twenty years of pressure to remain at the top of her game took their toll; age and arthritis in her feet left her no choice. She had to admit "it was time to say goodbye."

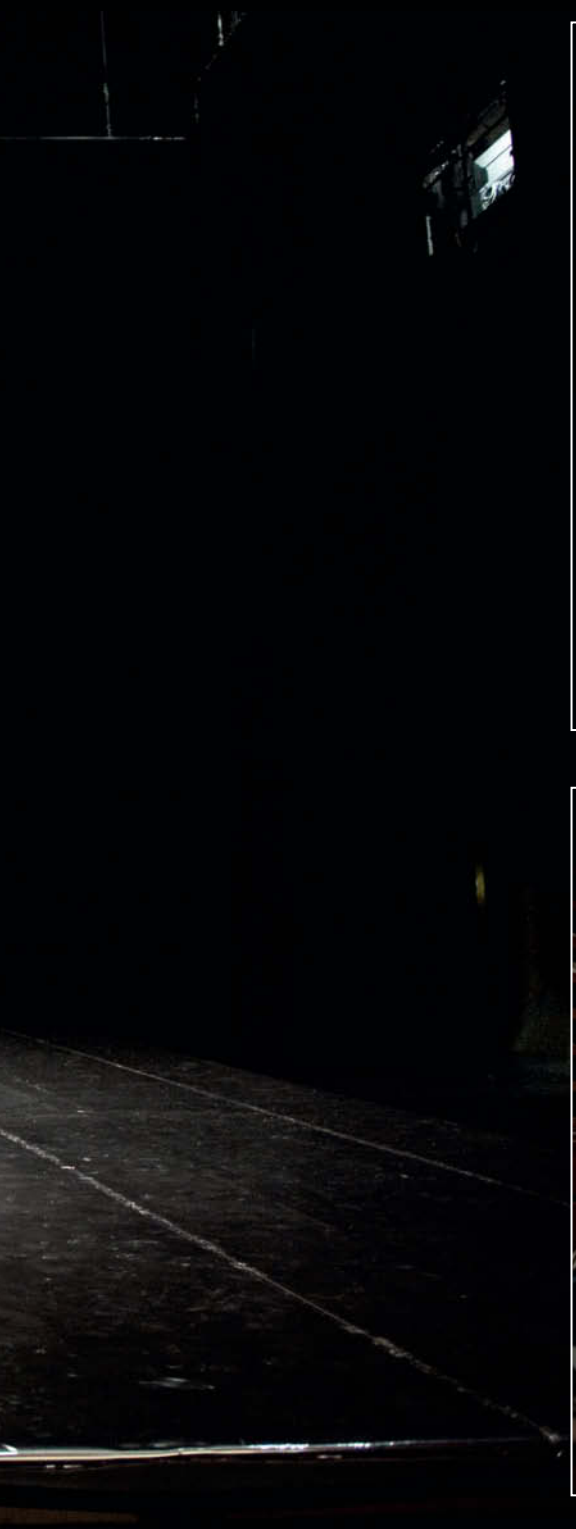
German photographer Insa Cathérine Hagemann picked up the story at that point and accompanied Seneca for several months, documenting not only rehearsals and performances but also the private moments. The resulting sequence beautifully and compassionately portrays Seneca's life immediately prior to the end of her stage career and her preparations for a fresh start in her home city of Cannes, where she intended to find focus and a new direction. "It's the right time – it's time to make a new life," Seneca kept telling herself, still feeling somewhat out of place until she eventually found the way forward in her new role as a ballet teacher.

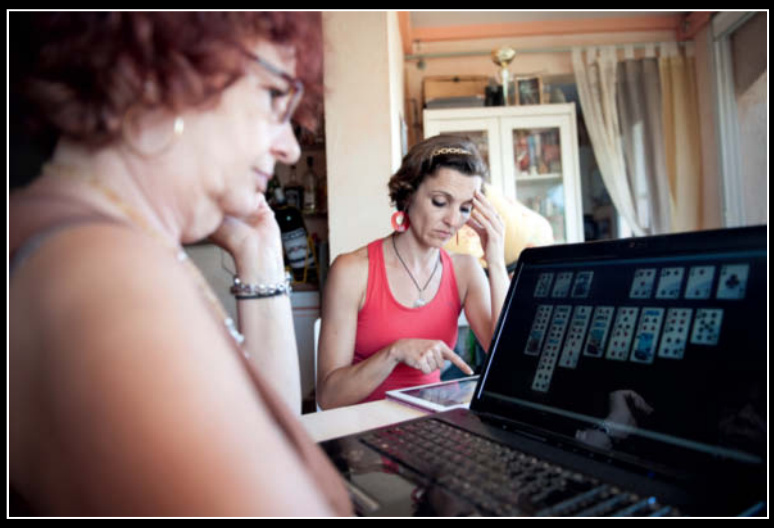
Insa Cathérine Hagemann, 31, studied photography under Professor Rolf Nobel at Hannover University of Applied Sciences and Arts between 2007 and 2013. She has freelanced for the local broadsheet (the 'Hannoversche Allgemeine') since 2011. (keh)

To see more of Insa Cathérine Hagemann's work, visit

www.insahagemann.de

In this issue's portfolio, Insa Cathérine Hagemann's sympathetic portrayal of the final days of a top ballerina's career demonstrates perfectly how to tell a striking story using serene, unruffled images.





Sophia Zimmermann

Super Standards

High-end 50mm Lens Test

50mm standard lenses are among many photographers' favorites. They are versatile and usually offer excellent value for money. Sigma and Zeiss are aiming to change all that with new high-end standard focal length primes. The major camera manufacturers are never far behind and are now introducing their own top-notch standard primes with price tags that match the high image quality they offer. We decided to find out whether these new big-ticket contenders really are that much better than the value competition.


Carl Zeiss
Sonnar FE 1.8/55 ZA
CANON LENS MADE IN JAPAN
CANON LENS EF 50mm 1:1.4

Standard 50mm lenses have a great reputation and, alongside a kit zoom, are often the first lens photographers use. They offer great image quality and plenty of opportunities to hone your shooting skills.

Most standard lenses have a maximum aperture of f1.8 or more, which is much brighter than all but the most expensive zooms and is great for shooting in dim light. Wide apertures are also perfect for experimenting with depth-of-field effects and producing portraits with soft, smooth bokeh. Standard focal lengths are highly versatile and can be used to capture all sorts of subjects, from buildings and interiors to portraits and group shots.

Until recently, one of the strongest arguments in favor of standard primes was the great value for money they offer. The AF-S NIKKOR 50mm f/1.4G currently costs around US$425 and the comparable Canon EF 50mm f/1.4 USM even less. If you are happy to shoot using a slightly darker maximum aperture, you won't have to spend more than about US$120 for a manufacturer's own-brand model, which isn't much for a bright, versatile lens with reliable image quality. What more could you want?

High-end Third-party Standard Primes

Recently, there has been a marked trend toward high-end, high-priced third-party standard lenses, with the race for market dominance being led by Zeiss and Sigma. While Zeiss is known for its high-quality optics, Sigma was hitherto better known for its mid-range mass-market products.

The Zeiss Otus f/1.4 55mm – currently available for Canon and Nikon only – is the most expensive and highly-specified lens we tested. The Nikon version of the manual-focus Otus weighs 970 g (2.13 lb) and, with its overall length of 14.1 cm (5.55″), looks (and feels) more like a medium-format lens than a standard prime. As is to be expected, Zeiss build quality is excellent, and the metal barrel and rubberized focus ring offer perfect control. All this quality commands a high price, and you will have to part with almost US$4,000 if you want to call an Otus your own.

The Sigma 50mm f/1.4 DG HSM Art lens aims to offer similar quality for about a quarter of the price. Although constructed from a synthetic material called TSC (Thermally Stable Composite), the lens has a decidedly high-end feel. Sigma claims that TSC shows less thermal shrinkage and greater elasticity than the conventional polycarbonates used in the manufacture of many lenses. However, it is still a big lens, weighing in at 815 g (1.79 lb) and measuring 99.9 mm (3.93″) in length. Although this makes it smaller than the Zeiss, it is still a giant compared to the f/1.4 Canon.

Objective and Subjective Image Quality

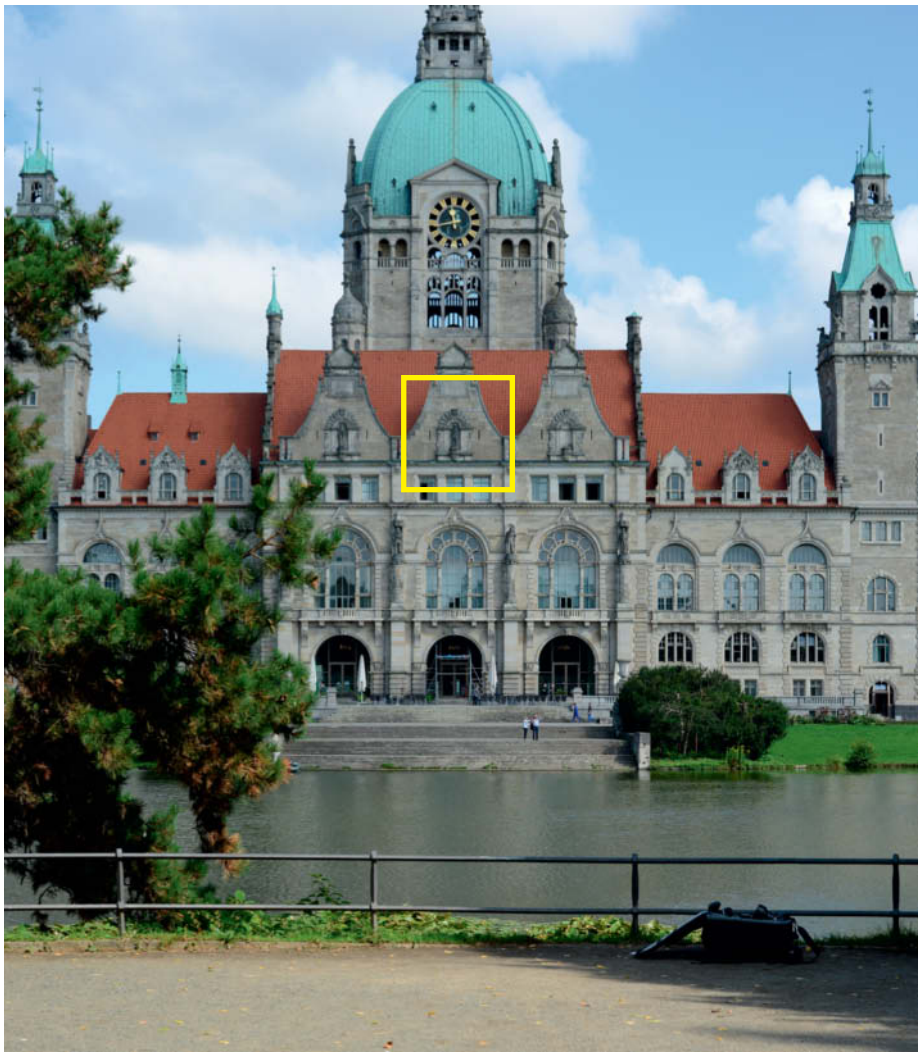
The obvious question is whether these high-end contenders offer image and build quality that matches their premium prices. We decided to put the 55mm Otus and the 50mm Sigma Art model through a thorough ***c't*** test and compared them with the cheaper Canon EF 50mm f/1.4 USM and AF-S NIKKOR 50mm f/1.4G models, as well as the intermediate priced AF-S NIKKOR 58mm f/1.4G, Sony Sonnar T* FE 55mm f/1.8 ZA (E-mount) and Planar T* 50mm f/1.4 ZA (A-mount) models.

We began our test in the lab and captured test shots of a chart made up of 25 Siemens stars with sine wave-shaped brightness gradients to test the resolution of each lens. We then tested for chromatic aberration using a chart made up of a variety of printer's register marks. Where applicable, we also measured AF speed for each camera/lens combo. The Sigma thus ended up with two sets of results – one with the EOS 6D and one mounted on our Sony a7R using a Metabones Mark III Smart Adapter.

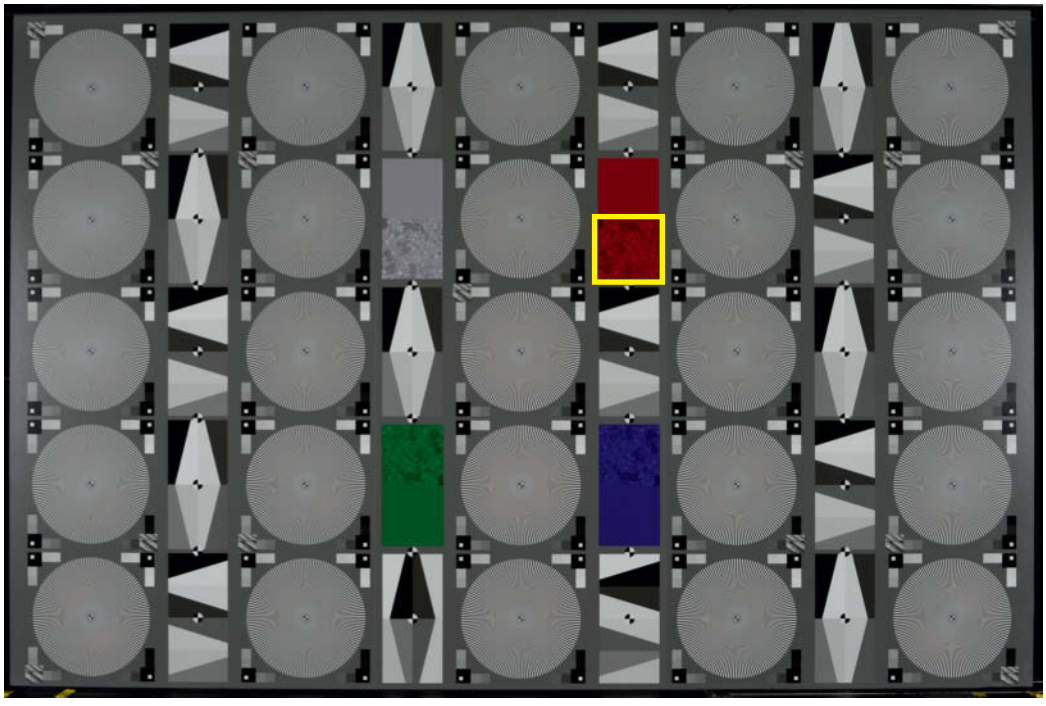
But controlled tests are not the only way to judge image quality, so ***c't*** art director Thomas Saur staged a portrait session to provide a real-world counterpoint to the numbers we produced in the lab. In the course of the session – which also provided us with this issue's cover image – we used aperture bracketing sequences, backlit shots and a range of color compositions to test the limits of all the lenses' performance and reveal the real differences in reproduction quality that the different models provide. Additionally, we captured outdoor test shots at the Town Hall in Hannover – a building that offers a wealth of fine architectural details.

What happened to those compact standard lenses we all know and love? Compared to the Canon EF 50mm f/1.4 USM, the Sigma 50mm f/1.4 DG HSM Art is a real monster that weighs almost three times as much as its compact competitor.

To provide the maximum possible variety of results we performed our tests using a Canon EOS 6D, a Nikon D800E and Sony Alpha a7R and a99 bodies, which offer resolutions between 22 and 36 megapixels. We would of course have loved to shoot using a comparably high-resolution Canon body, but such a beast is not yet available. The sample images on the following pages all show the same image detail – the actual magnifications are listed in the captions.



With its fine textures and complex façade, the Town Hall in Hannover makes a perfect outdoor test scene. The individual lens tests on the following pages show the same image detail (outlined here in yellow) captured using each lens stopped down to f5.6.



The 25 Siemens stars in our lab test scene cover most of the image area and enable us to produce reliable resolution measurements all the way into the corners of the frame. The abstract patterns outlined in the yellow border are great for revealing weaknesses in the reproduction of detail contrast.

Canon EF 50mm f/1.4 USM

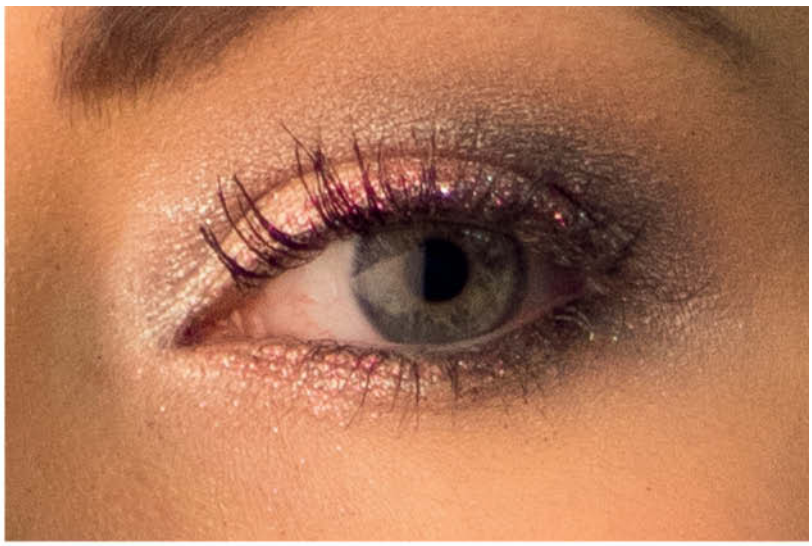
The lens: The EF 50mm is a small, cute blob of plastic that is not very solidly built but is robust enough for the price. The focus ring on our test lens was not particularly grippy and had too much play, so it didn't rotate smoothly. The lens barrel includes a printed distance scale and an auto/manual focus switch. Autofocus is clearly audible in spite of the ultrasonic motor and is not especially fast. We measured an AF shutter lag value of 0.59 s when mounted on the EOS 6D compared with the 0.45 s the 50mm NIKKOR required when used with the D800E.

Test results: The lens performed solidly and produced no surprises. Mounted on the EOS 6D and used wide open, we recorded 1389 line pairs in the center of the frame but only 1067 at the edges. At f4, these values increased to 1602 and 1461 line pairs respectively. At f8, center resolution drops off again slightly while edge resolution catches up and is almost identical. We measured a chromatic aberration value of 0.6 pixels at maximum aperture and our distortion reading of -0.5% is acceptable for this grade of lens.

Image quality: Our outdoor test shots show obvious fringing and vignetting. Center sharpness was good at maximum aperture, although we would liked to have seen a little more detail contrast. Sharpness increases at smaller apertures but doesn't compare with the results produce by our high-end test lenses, although this is not necessarily a disadvantage for portrait shots. The overall sharpness gradient is quite soft at maximum aperture but the resulting bokeh is not especially smooth.

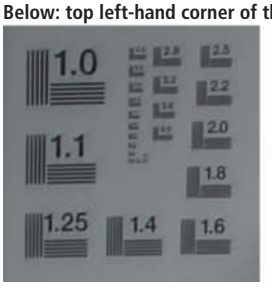
Canon EF 50mm f/1.4 USM	
Focal length	50 mm
Aperture range / No. of blades	f1.4 - f22 / 8
Closest focus	0.45 m (1.5 ft)
Length / Weight	50.5 mm (2") / 290 g (10.23 oz)
Price	US$399
Test Results	
Center resolution [1] (f1.4, f4, f8)	1389, 1602, 1594
Edge resolution [1] (f1.4, f4, f8)	1067, 1461, 1553
Chromatic aberration [2] (f1.4, f8)	0.6 / 0.33
Distortion (f1.4, f8)	-0.6% / -0.5%
[1] Line pairs [2] Pixels	

Canon EOS 6D | 50 mm | ISO 100 | f5.6 | 1/400 s | 200%

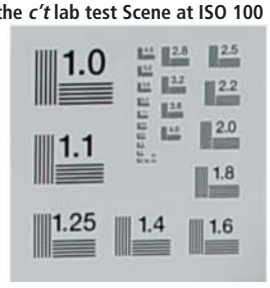


Canon EOS 6D | 50 mm | ISO 250 | f1.4 | 1/320 s

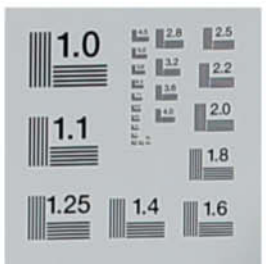
Below: top left-hand corner of the *c't* lab test Scene at ISO 100



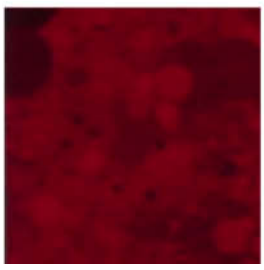
f1.4



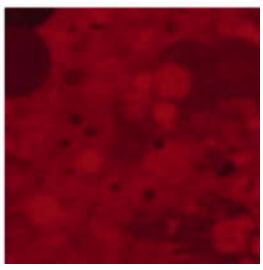
f4



f8



f1.4



f4

AF-S NIKKOR 50mm f/1.4G

The lens: This is a classic standard lens much in the mold of the Canon described on the previous page. It has a similar but slightly more robust build quality and, like the Canon, the similarly-sized NIKKOR includes a distance scale and an auto/manual focus switch.

The 'Silent Wave' motor focuses relatively quietly and more quickly than the Canon's USM system. We recorded AF shutter lag of 0.45 s, making it one of the fastest we tested.

Test results: We decided to push the 'G' to its limits by testing it on the D800E and we were pleasantly surprised by the results. At maximum aperture, we recorded center resolution of 1878 and edge resolution of 1447 line pairs. Center resolution increases to 2265 line pairs at f8 and edge resolution is best at f16, measuring 1901 line pairs. Distortion and chromatic aberration came in at similar levels to those noted for the Canon lens.

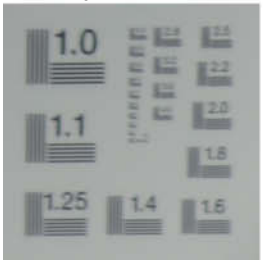
Image quality: Wide open, the NIKKOR has no significant vignetting issues, although there is a little visible shading. There was some visible fringing in the center of the frame but overall, the outdoor shots captured at f1.4 were crisper than those produced by the Canon, due at least partly to the greater resolution of the D800E's sensor. In the studio too, the NIKKOR performed better than the Canon, producing more pleasing overall sharpness and softer, smoother bokeh.

AF-S NIKKOR 50mm f/1.4G	
Focal length	50 mm
Aperture range / No. of blades	f1.4 - f16 / 9
Closest focus	0.45 m (1.5 ft)
Length / Weight	54 mm (2.1") / 280 g (9.9 oz)
Price	US$425
Test Results	
Center resolution [1] (f1.4, f4, f8)	1878, 2124, 2265
Edge resolution [1] (f1.4, f4, f8)	1447, 1710, 1896
Chromatic aberration [2] (f1.4, f8)	0.61 / 0.29
Distortion (f1.4, f8)	- 0.5% / - 0.5%
[1] Line pairs [2] Pixels	

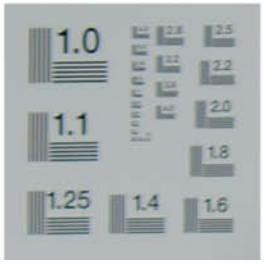
Nikon D800E | 50 mm | ISO 100 | f5.6 | 1/640 s | approx. 150%

Nikon D800E | 50mm | ISO 100 | f1.4 | 1/60 s

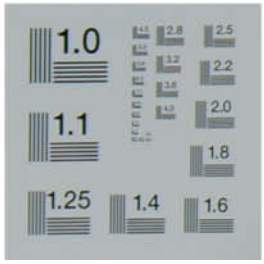
Below: top left-hand corner of the *c't* lab test Scene at ISO 100



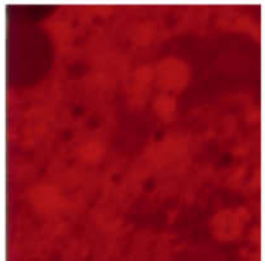
f1.4



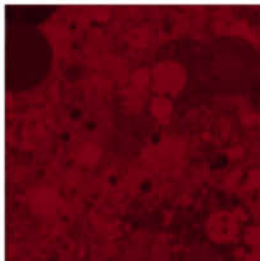
f4



f8



f1.4



f4

AF-S NIKKOR 58mm f/1.4G

The lens: The 58mm NIKKOR's unique status is underscored by its unusual design and deep-set front element that makes it look like a 1970s Noct-NIKKOR. Build quality is much more robust than that of its 50mm cousin but AF shutter lag is slower at 0.52 s. Its external features include the standard distance scale and an auto/manual focus switch.

Test results: Tested with the D800E, the 58mm NIKKOR proves once again that great lab test results don't necessarily equate to perfect visual results. Wide open, the lens recorded 1955 line pairs of center resolution but only 1264 line pairs at the edges. Stopping down didn't improve things very much and, at 1791 line pairs, edge resolution only caught up with center resolution at f16. Chromatic aberration of just 0.44 pixels at maximum aperture is a very good result.

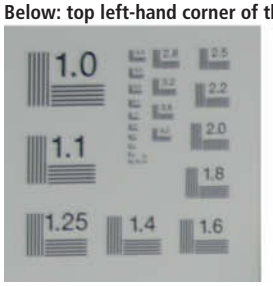
Image quality: At maximum aperture we found very little vignetting and fringing effects, and the images had a very soft, almost analog overall look. We really like this effect, and the soft sharpness gradient and the highly three-dimensional 'glow' were perfect for our portrait session. This is a great lens for portrait and wedding work (see the image opposite).

AF-S NIKKOR 58mm f/1.4G	
Focal length	58 mm
Aperture range / No. of blades	f1.4 - f16 / 9
Closest focus	0.58 m (1.9 ft)
Length / Weight	70 mm (2.76") / 385 g (13.6 oz)
Price	US$1,700
Test Results	
Center resolution [1] (f1.4, f4, f8)	1955, 2190, 2238
Edge resolution [1] (f1.4, f4, f8)	1264, 1296, 1355
Chromatic aberration [2] (f1.4, f8)	0.44 / 0.25
Distortion (f1.4, f8)	- 0.5% / - 0.4%
[1] Line pairs [2] Pixels	

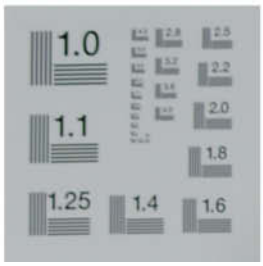
Nikon D800E | 58 mm | ISO 100 | f5.6 | 1/640 s | 150%

Nikon D800E | 58 mm | ISO 100 | f1.4 | 1/40 s

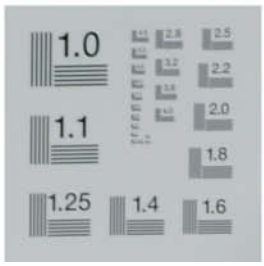
Below: top left-hand corner of the *c't* lab test Scene at ISO 100



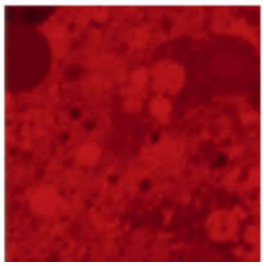
f1.4



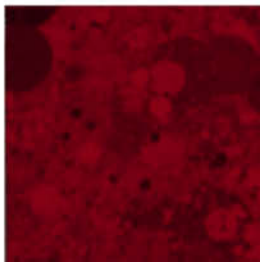
f4



f8



f1.4



f4

c't art director and pro photographer Thomas Saur says, "The NIKKOR produces fantastic portraits but our test lens failed to produce really pin-sharp results. It is a great lens if you want to shoot portraits at maximum aperture without analyzing sharpness too harshly, or if you are prepared to stop down for critical subjects."

NIKKOR 58mm f/1.4G | 58 mm | ISO 640 | f1.4 | 1/250 s

Photo: Thomas Saur

Sony Planar T* 50mm f/1.4 ZA

The lens: The broad metal barrel of the Sony Planar underscores its high-end build quality and, with its ribbed metal focus ring, it is a pleasure to handle, enabling precise focusing. As usual in this type of lens, it has is a distance scale and an auto/manual focus switch. AF is quiet and fast, measuring less than 0.3 s mounted on the Alpha a99.

Test results: The Planar doesn't win any prizes but nevertheless performs solidly, producing well-balanced results. Tested with the Alpha a99 at maximum aperture, we recorded center resolution of 1589 line pairs and relatively high edge resolution of 1369 line pairs. Stopping down brings these values closer together and, in contrast to most of our other test lenses, at f8 there is no longer any discernible difference between center and edge sharpness. The downside of the Sony's performance is its obvious chromatic aberration that measured 0.83 pixels at f1.4.

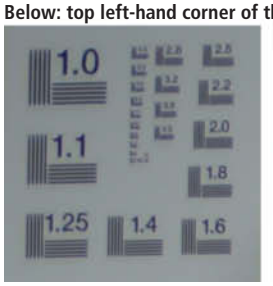
Image quality: Wide open, fringing was detectable at all high-contrast edges in our outdoor test shots, and obvious vignetting played a role too. On the upside, our sample images were really sharp and showed plenty of detail contrast. Our portrait shots also showed great central sharpness at maximum aperture, visible in the well differentiated reproduction of our model's eye makeup. We were disappointed by the weak color reproduction, which is not nearly as good as that of the Zeiss Otus. Sharpness, too, wasn't as good as we had hoped and lagged behind that of the 58mm NIKKOR.

Sony Planar T* 50mm f/1.4 ZA	
Focal length	50 mm
Aperture range / No. of blades	f1.4 - f22 / 9
Closest focus	0.45 m (1.48 ft)
Length / Weight	71.5 mm (2.81") / 518 g (18.27 oz)
Price	US$1,500
Test Results	
Center resolution [1] (f1.4, f4, f8)	1589, 1648, 1625
Edge resolution [1] (f1.4, f4, f8)	1369, 1565, 1591
Chromatic aberration [2] (f1.4, f8)	0.83 / 0.79
Distortion (f1.4, f8)	- 0.6% / - 0.6%
[1] Line pairs [2] Pixels	

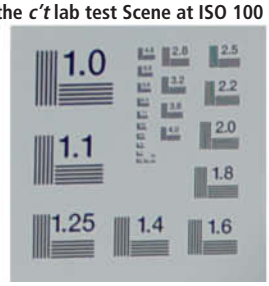
Sony a99 | 50 mm | ISO 00 | f5.6 | 1/400 s | 180%

Sony a99 | 50 mm | ISO 100 | f1.4 | 1/60 s

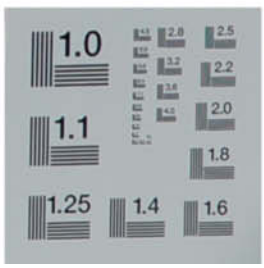
Below: top left-hand corner of the *c't* lab test Scene at ISO 100



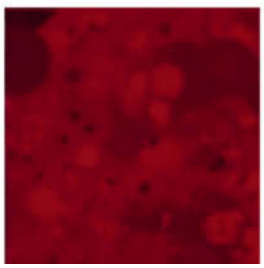
f1.4



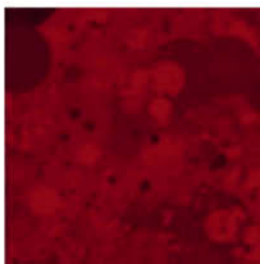
f4



f8



f1.4



f4

Sony Sonnar T* FE 55mm f/1.8 ZA

The lens: This is the standard lens for Sony's a7 range of full-frame mirrorless cameras and is currently the only model that fits the a7 range without the use of an adapter. Like most of Sony's high-end lenses, this model comes with Zeiss branding and a matte black barrel. The lens is relatively small and is well suited to the compact dimensions of the a7 bodies. Unusually for this class of lens, there is no distance scale printed on the barrel and there is no auto/manual focus switch. Autofocus is quiet but quite slow (0.57 s) when used with an a7R.

Test results: The Sonnar produced results on a level with those of the 50mm NIKKOR (see page 25), although it showed better edge resolution at maximum aperture. At f1.8, center and edge resolution came in at 2050 and1725 line pairs respectively, climbing to 2143 and 2049 at f8. Like the other high-end models we tested, the Sonnar showed no discernible distortion or chromatic aberration artifacts.

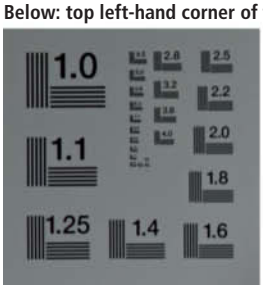
Image quality: Our test shots showed good sharpness across the entire aperture range, although here too, the Otus was sharper. The Sony produced better microcontrast than the 50mm NIKKOR and showed comparatively reliable color reproduction at all times. Its sharpness gradient isn't as smooth as the NIKKOR's and the quality of its bokeh suffers as a result.

Sony Sonnar T* FE 55mm f/1.8 ZA	
Focal length	55 mm
Aperture range / No. of blades	f1.8 - f22 / 9
Closest focus	0.50 m (1.64 ft)
Length / Weight	70.5 mm (2.78") / 281 g (9.9 oz)
Price	US$1,000
Test Results	
Center resolution [1] (f1.4, f4, f8)	2050, 2053, 2143
Edge resolution [1] (f1.4, f4, f8)	1725, 1759, 2049
Chromatic aberration [2] (f1.4, f8)	0.29 / 0.26
Distortion (f1.4, f8)	0% / 0%
[1] Line pairs [2] Pixels	

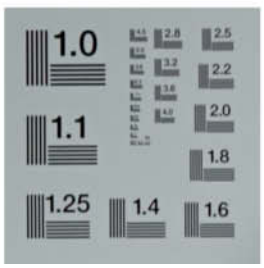
Sony a7R | 55 mm | ISO 100 | f5.6 | 1/640 s | 150%

Sony a7R | 55 mm | ISO 250 | f1.8 | 1/250 s

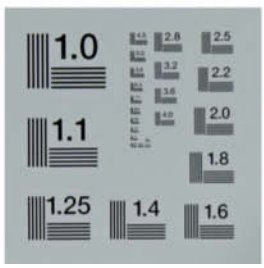
Below: top left-hand corner of the *c't* lab test Scene at ISO 100



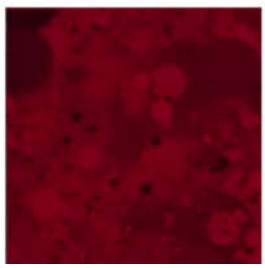
f1.8



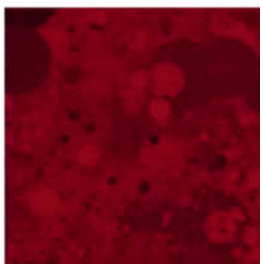
f4



f8



f1.8



f4

Sigma 50mm f/1.4 DG HSM Art

The lens: This is a really big lens. It is twice as long as the standard Canon 50mm and weighs nearly three times as much. Its weight and cool, matte surface give it an extremely high-end feel, and the broad focus ring with its rubberized grip makes precise manual focusing quick and easy. Autofocus is virtually silent but is among the slower models we tested, coming in at 0.53 s coupled with our Canon EOS 6D.

Test results: We tested the Sigma on our Canon EOS 6D and on a Sony a7R using a Metabones adapter. The lens performed extremely well at maximum aperture with both cameras, recording center resolution of 1550 line pairs out of a potential 1824 on the EOS 6D. Used with the a7R, it scored 2121 line pairs, thus beating the 55mm Sony Sonnar – on paper at least. Edge resolution, too, is better than that of the Sony lenses, but the Sigma cannot quite match the Zeiss Otus' center or edge performance. We found no significant distortion or chromatic aberration at maximum aperture and there was no discernible vignetting.

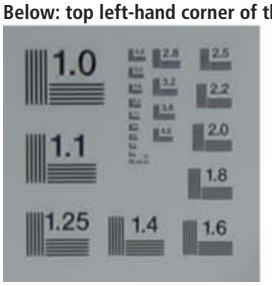
Image quality: Our test shots are clean and crisp, and are easily comparable with those produced using our manufacturer's own-brand test lenses. Images captured at f1.4 and f2 especially have a high-definition look with virtually no detectable artifacts. If soft, wide-aperture portraits are your bag, you will probably have to do some retouching, whereas the Sigma is pretty well perfect for architectural or still life shots. Overall, we very much liked the three-dimensional look of the images the lens produced.

Sigma 50mm f/1.4 DG HSM Art	
Focal length	50 mm
Aperture range / No. of blades	f1.4 - f16/ 9
Closest focus	0.40 m (1.31 ft)
Length / Weight	99.9 mm (3.93") / 815 g (1.79 lb)
Price	US$950
Test Results an Sony a7R	
Center resolution [1] (f1.4, f4, f8)	2121, 2178, 2176
Edge resolution [1] (f1.4, f4, f8)	1748, 1988, 2128
Chromatic aberration [2] (f1.4, f8)	0.37 / 0.26
Distortion (f1.4, f8)	0% / 0%
[1] Line pairs [2] Pixels	

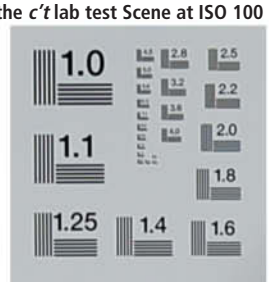
Sony a7R plus adapter | 50 mm | ISO 100 | f5.6 | 1/200 s | 150%

Sony a7R plus adapter | 50 mm | ISO 100 | f1.4 | 1/320 s

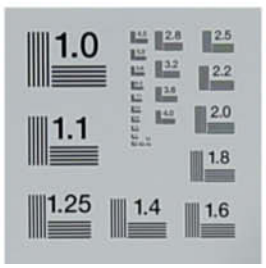
Below: top left-hand corner of the *c't* lab test Scene at ISO 100



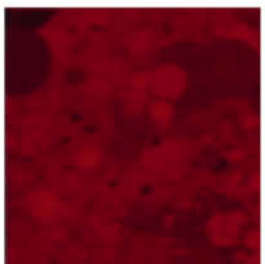
f1.4



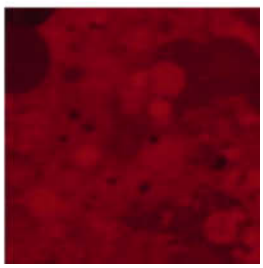
f4



f8



f1.4



f4

Photo: Thomas Saur

Thomas Saur says, "The Sigma is the best all-rounder we tested and represents the best value for money. It is reliable at maximum aperture, producing great overall sharpness and pleasing bokeh. Stopped down, it is hard on the Otus' heels and only lacks the ultra-precise color differentiation of the Zeiss in extreme situations. Overall, the Zeiss produces slightly more three-dimensional-looking results."

Sigma 50mm f/1.4 DG HSM Art (Sony a7R) | 50 mm | ISO 125 | f1.4 | 1/125 s

Zeiss Otus 55mm f/1.4 Distagon T*

The lens: The 55mm Zeiss Otus outstrips all our other test lenses in every respect. It is larger, heavier and much more expensive. A length of 14 cm (5.55") is huge for a standard lens and it takes practice (and muscle power) to keep your camera steady while focusing manually with a lens that weighs more than 2 pounds.

As expected, build quality is faultless. Nothing creaks or wobbles and the precise, gray rubberized focus ring sets off the matte black barrel perfectly. The lens is delivered with a matching metal lens hood with a matt-painted inner surface.

Test results: Our expectations were high and the Otus didn't disappoint. Center resolution of 2175 line pairs at maximum aperture is an excellent result, and 1938 line pairs of edge resolution are unmatched in this test too. Resolution improves all the way up to f8 and only begins to drop off slightly at f11.

A distortion reading of -0.2% is negligible and the 0.36 pixels of distortion we recorded wide open don't make a significant difference to the quality of the images we captured.

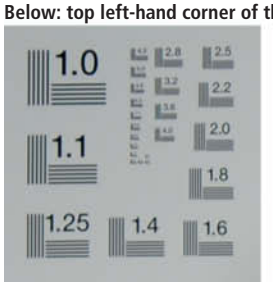
Image quality: Mounted on our Nikon D800E and the Sony a7R, the Otus produced images with an extremely smooth sharpness gradient and beautifully smooth, almost movie-style bokeh. Its almost pedantically sharp reproduction characteristics and perfect microcontrast set it apart from all our other test lenses. Color reproduction is extremely precise, too, and we were unable to find any fringing artifacts, even at maximum aperture.

Zeiss Otus 55mm f/1.4 Distagon T*	
Focal length	55 mm
Aperture range / No. of blades	f1.4 - f16/ 9
Closest focus	0.50 m (19.7")
Length / Weight (Nikon version)	141 mm (5.55") / 970 g (2.13 lb)
Length / Weight (Canon version)	144 mm (5.66") / 1030 g (2.27 lb)
Price	US$3,990
Test Results	
Center resolution [1] (f1.4, f4, f8)	2175, 2355, 2356
Edge resolution [1] (f1.4, f4, f8)	1938, 2043, 2176
Chromatic aberration [2] (f1.4, f8)	0.36 / 0.31
Distortion (f1.4, f8)	- 0.2% / - 0.2%
[1] Line pairs [2] Pixels	

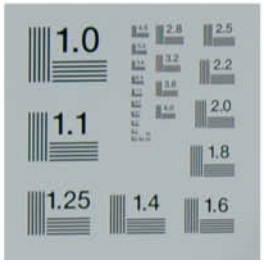
Nikon D800E | 55 mm | ISO 100 | f5.6 | 1/800 s | 150%

Sony a7R plus adapter | 55 mm | ISO 250 | f1.4 | 1/400 s

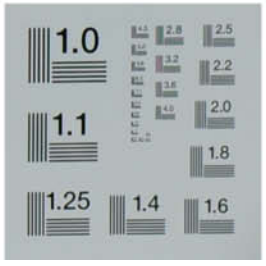
Below: top left-hand corner of the *c't* lab test scene at ISO 100



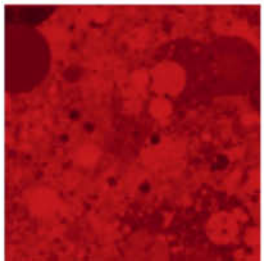
f1.4



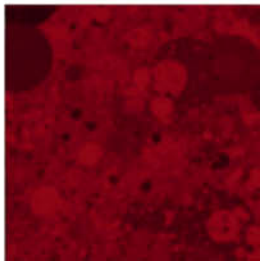
f4



f8



f1.4



f4

Photo: Thomas Saur

Thomas Saur: "The precision offered by the Zeiss Otus is unbeatable and makes it worth every penny. It is also very reliable in extreme lighting and is the most robust of all our test lenses."

Zeiss Otus 55mm (Sony a7R) | 55 mm | ISO 250 | f1.4 | 1/400 s

Conclusions

Although they nominally belong to the same category of lens, our seven test models couldn't be more varied. Alongside the different designs, price is the most obvious variable, with the most expensive of our test optics costing ten times as much as the cheapest. So what makes a Zeiss worth so much more than the competition?

Quality Has Its Price

Build quality is a major factor in determining the price of a lens. The cheaper lenses we tested are made of plastic and feel flimsy and imprecise in comparison to the high-end models with their composite or metal bodies. With a Zeiss or a Sigma, nothing creaks or wobbles and there is no excess play to be found in any of the components. Robustness is key, and the incredibly fine tolerances built into the Zeiss really are beyond compare. The weight of the Zeiss and Sigma models also bears witness to the large amounts of glass contained within them.

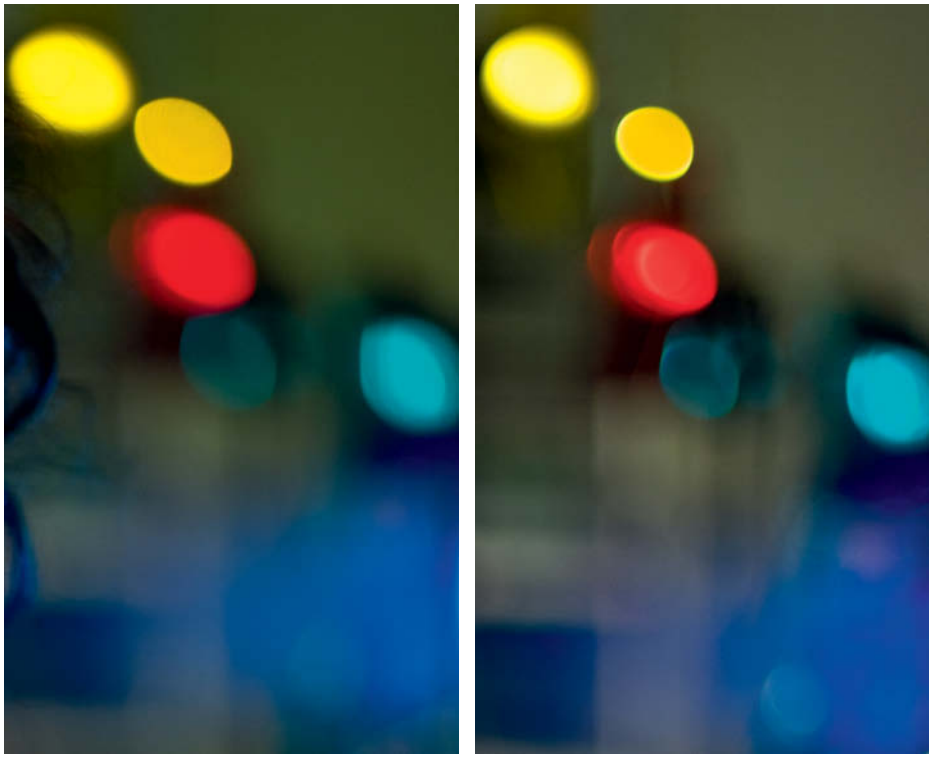
Under controlled lab conditions, the differences in performance were much less significant than in the real world and, on paper, even a US$400 lens produces usable center resolution at maximum aperture and results that are comparable with even the most expensive models when stopped down. The cheapest NIKKOR in particular performed very well, but simultaneously provides clear proof that line pair measurements aren't the only significant metric when it comes to judging absolute lens quality.

Resolution Isn't Everything

The reproduction of color gradients and microcontrast are two respects in which the more expensive lenses show their true qualities. Smooth sharpness gradients and the quality of the bokeh, too, are characteristics that set quality apart from mass-market products. It is impossible to overlook the fact that the cheaper the lens, the less character and verve the resulting images have.

For example, although the 58mm NIKKOR didn't produce the best lab results, the portrait images we captured with it have a wonderfully soft, almost analog look while nevertheless retaining sufficient detail. The Zeiss Otus produces images with a clean, highly three-dimensional and almost cinematic look. The cheaper lenses all produced more obvious vignetting effects and had many more fringing issues than the more expensive competition, especially at wide apertures.

Of course, it is up to you to decide how much a well-built and well-corrected lens is worth to you. Such decisions are never easy and often involve a battle with your conscience, your wallet, and possibly even your partner! (ssi)



Comparing bokeh: wide open, the Zeiss Otus (left) produces much smoother bokeh than the Canon (right)

The Zeiss Otus (left) provides the yardstick for others to match at f5.6. In the resolution stakes, the Sigma (right) is not far behind. c't

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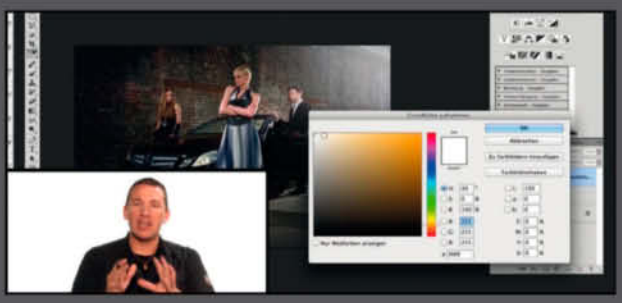

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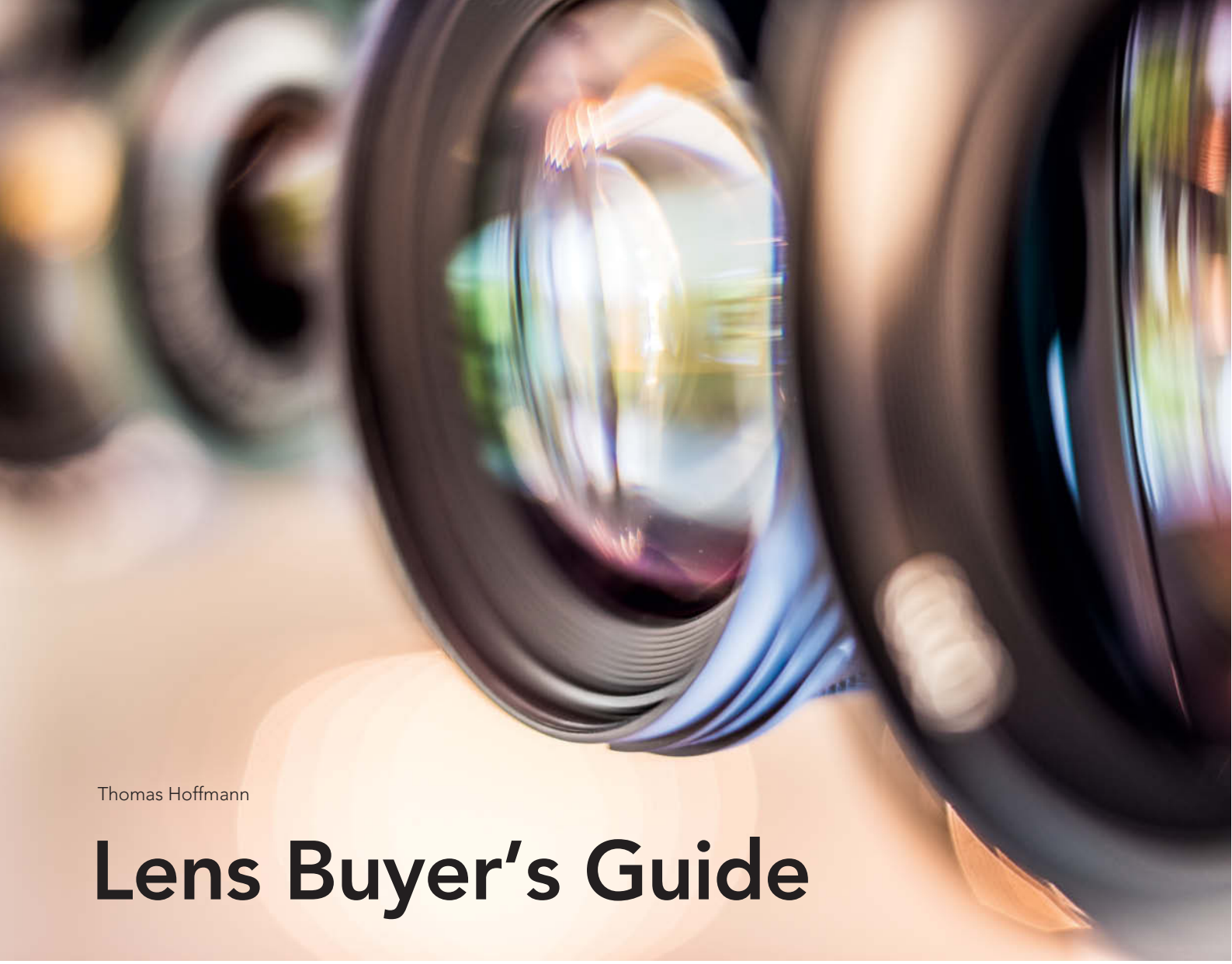


Thomas Hoffmann

Lens Buyer's Guide

Lenses are a critical component in any image capture system and some lenses become lifelong friends. Digital technology may have made analog cameras obsolete, but a good lens remains a good lens, however old it may be. Purchasing a lens therefore requires careful consideration, and this guide will help you to find the right ones for you and your camera.

Which focal length lens do you need? Your choice will depend on the type of images you wish to capture. Shooting in enclosed spaces requires a very different lens from that required for shooting portraits, and when you are on safari or at a public event or a wedding, your requirements will be different again.

When shooting **landscape or architectural** scenes, many photographers use wide-angle lenses with equivalent focal lengths between 16 and 35 mm. These enable you to capture the broad sweep of a range of mountains or a cityscape in a single frame.

In architectural situations, short focal lengths enable you to get close to the subject and keep shooting in narrow streets and enclosed spaces. Wide-angle lenses are often used in the real estate business because the angles of view they provide tend to make rooms look larger and more spacious than they would if captured using a telephoto. However, wide angles of view present unique challenges when it comes to designing the elements that make up the lens. Ideally, a wide-angle lens won't bend straight lines and distort the geometry of the subject.

Wide-angles can also be used to produce unusual portraits of animals and people too.

If you decide not to purchase a wide-angle because you don't see enough opportunities to use it, you can still use a longer lens to capture architectural details or create landscape panoramas made up of multiple source images.

Documentary photographers usually work with standard equivalent focal lengths between 35 and 50 mm. These provide a very similar angle of view and perspective to that perceived by the human eye. The shorter the lens, the more of your surroundings you can capture in a single shot, which gives viewers the feeling that they are directly involved. Longer lenses produce images that concentrate on a single detail and exclude the rest of the action, thus automatically interpreting events before the shutter has even been released.

Bright short or medium telephoto lenses are ideal for **portrait photography**. Equivalent focal lengths from 80 to 100 mm produce a slightly compressed view that draws attention to the subject without distorting the proportions in a face. Using a wide aperture gives you more options as it blurs potentially distracting backgrounds and accentuates the importance of the subject. Wide apertures also make it possible to shoot in low light without flash, thus giving the results a more authentic look.

A powerful telephoto is the lens of choice for capturing photos on **safari**, at **concerts** and at **sports events** because it enables you to fill the frame with even the most distant subject. Because this type of lens is heavy and has an extremely narrow angle of view, you will need either a tripod or a very steady hand if you want to shoot shake-free. The rule of thumb for capturing images without camera shake is to use an exposure time of at least the reciprocal of the focal length you are using. In other words, if you are using a 400mm lens, you will need to use an exposure time no longer than 1/400 s to prevent your results from coming out blurred. Image stabilizers (built into the lens or the camera body) increase the exposure times you can safely shoot handheld. A wide maximum aperture will also help you to shoot accurately when using a telephoto lens, but remember that the brighter the lens, the heavier and more expensive it will be.

If you prefer to capture the beauty of **small subjects**, a macro lens will be more up your street. In macro lenses, the geometry is designed to provide the shortest possible focus distance, enabling you to capture subjects at large magnifications. A reproduction ratio of 1:1 is common in macro lenses, making it possible to fill the entire sensor area with an image of a small subject such as a butterfly.

The greater the focal length of a macro lens, the greater the lens-to-subject distance you can use, thus enabling you to shoot images of timid insects without getting so close that they become agitated and take flight. A cheaper alternative to a dedicated macro lens is to use extension tubes mounted between the camera body and a normal lens. However, although this enables you to focus more closely, it significantly reduces the available depth of focus.

Nikon

The AF-S NIKKOR 85mm f/1.4G with its bright maximum aperture and short telephoto focal length is a typical portrait lens

Remember the Crop Factor

Back in the days of analog photography, nearly all the cameras on the market used the same 36×24 mm film format, so crop factors simply didn't exist. The wide variety of sensor formats now available makes it a lot trickier to choose the right lens. Used with a full-frame camera, 50 mm is the focal length that most closely reproduces the angle of view and perspective of a scene as it is perceived by the human eye. The smaller, widely used APS-C and DX-format (23.7×15.6 mm) sensors increase the effective focal length of a lens, and a 50mm full-frame lens behaves like an 80mm lens when used with a crop-format camera.

Micro Four Thirds (MFT) sensors measure 17.3×13 mm (i.e., half the dimensions of a full-frame sensor) and therefore have a crop factor of 2. Used with an MFT camera, a 50mm full-frame lens behaves like a 100mm telephoto. Correspondingly, if you want to capture a 'normal' perspective using an MFT camera, you will have to use a 25mm lens.

Cameras with even smaller sensors have even larger crop factors. For example, Nikon's '1' range of CX-format cameras have a crop factor of 2.7 and the Pentax Q, with its tiny 1/2.3" sensor, has a crop (or 'focal length extension') factor of 5.5.

Fixed Focal Length or Zoom?

Most photographers prefer to head out prepared for a variety of situations, but using a range of fixed-focal-length lenses makes your photo bag heavier and costs a lot more than using one or two universal zooms that cover all the bases. Beginners often start out using the single 'kit' zoom sold with the camera. However, zoom lenses always involve compromises in image quality and affordable technology is not capable of building a variable-focal-length lens that offers consistently high reproduction quality throughout the zoom range. Cheaper lenses often perform poorly at the long end of the zoom range and at the edges of the frame, where sharpness and contrast take a dive. Additionally, affordable zoom lenses often relatively small maximum apertures, making it imperative to shoot in bright light. So-called 'super zooms' with enormous ranges of focal lengths often produce disappointing results too. The reality of the matter is that lenses designed to fulfill a variety of roles rarely excel in any one of the areas they cover.

If you are prepared to make do with a more modest zoom range, there are a lot of great lenses with bright maximum apertures to choose from. If you choose carefully, you can cover the entire range from wide-angle to long telephoto using just three lenses – for example, a 16-24mm, a 24-70mm and a 70-200mm. Many higher-quality zooms offer a constant maximum aperture throughout the zoom range, although these are usually designed for use with full-frame cameras, which makes them large and expensive.

The major disadvantage of using lenses with fixed focal lengths is that you have to alter your position if you want to reframe a subject. On the upside, fixed-focal-length lenses nearly always provide greater image quality and larger maximum apertures at a similar price point to their zoom counterparts. A 50mm 'standard' lens is a

Sony

Super-telephotos like this Sony 500mm f/4 G SSM can be used to make distant subjects fill the frame

Comparing Sensor Sizes

1/2.3"

Micro Four Thirds

APS-C

Full-frame

Mirrorless system cameras come with a variety of sensor sizes, starting with the tiny 1/2.3" models found in many compact cameras. For enthusiasts, full-frame (36×24 mm) is the largest widely available format. Pro photographers often use cameras with even larger medium-format sensors that measure 48×36 mm or more.

Nikon

The AF-S NIKKOR 24-70mm f/2.8G ED offers a constant maximum aperture and high image quality throughout the focal length range

great choice for beginners, and most camera manufacturers sell perfectly adequate models with a maximum aperture of f1.8 for US$150 or less. Lenses with wider maximum apertures are more expensive, and a true high-end model such as the Canon 50 mm f/1.2L USM costs around US$1,550. Bright telephoto lenses can make a significant dent in your wallet too. A 300mm telephoto with a maximum aperture of f2.8 can cost US$5,000 or more and a 500mm f/4 can easily break the US$10,000 barrier.

What About Kit Lenses?

If you are a beginner purchasing your first camera, it is usually a good idea to purchase the kit lens recommended by the manufacturer. Taking this route ensures that you have a lens that works well with your camera, and purchasing a kit is usually much cheaper than buying a camera and a lens separately. Usually, the more expensive the camera, the more money you save when buying a bundle.

Even cheap kit lenses that sell for US$150 or less represent great value for money. Most APS-C kit lenses have an 18-55mm zoom range coupled with a variable maximum aperture of f/3.5-5.6, and most contemporary camera/lens combos have built-in image stabilization.

Third-party or Manufacturer's Own Brand?

Another way to save money is to purchase a third-party lens instead of one made by the camera manufacturer. Modern third-party lenses are often just as good as manufacturer's own-brand lenses. Quality third-party manufacturers have access to the technology required to match their products to the cameras they are designed for and include all the features of own-brand lenses, such as automatic aperture data transmission, ultrasonic autofocus and built-in image stabilization. Image quality is usually just as good too, and some third-party optics even deliver superior reproduction characteristics. However, quality always has its price, and a high-end lens will have a high-end price ticket regardless of who actually makes it.

On the downside, some cheaper lenses are available only without autofocus and sometimes you will find that there are no software correction profiles available for your particular camera or image editing package. The build quality of cheaper lenses is also inferior.

Specialist Lenses

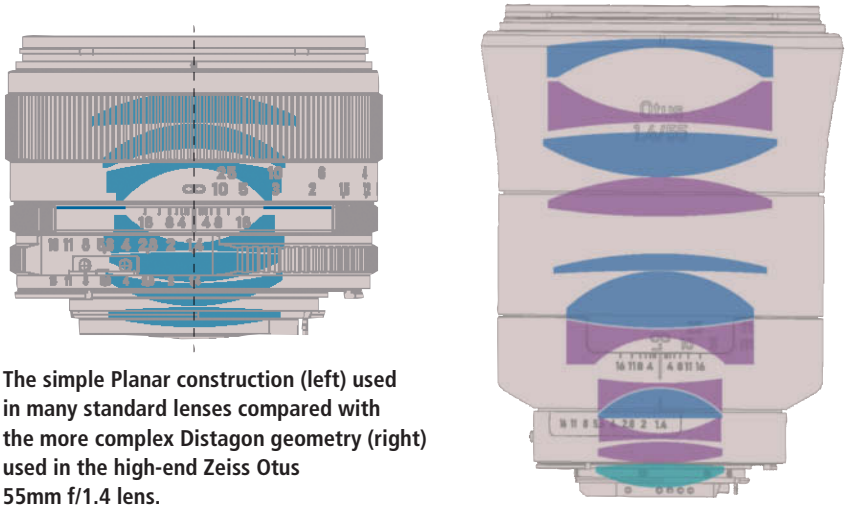
Alongside the multitude of standard, wide-angle, macro and medium-length lenses on offer, there are also a number of specialized models, including fisheye lenses with angles of view of up to 180 degrees and tilt/shift lenses. The latter incorporate special mechanisms that enable you to rotate or shift the lens in relation to the sensor, which is especially useful in an architectural context and makes it possible to correct converging lines and manipulate the plane of focus to capture natural-looking images of large buildings in a single frame. (tho)

Canon

The Canon EF-S 18-55mm f/3.5-5.6 is a typical kit lens that adds about US$100 to the price of the camera body

An Interview with Bertram Hoenlinger (Zeiss)

At Photokina 2014, Zeiss introduced several more new full-frame lenses, including the Otus 85mm f/1.4 Apo Planar T* and a range of Sony E-mount models. We took the opportunity to have a chat with Bertram Hoenlinger from Zeiss about building new lenses and why high-end 50mm optics attract so much interest.



The simple Planar construction (left) used in many standard lenses compared with the more complex Distagon geometry (right) used in the high-end Zeiss Otus 55mm f/1.4 lens.

c't Digital Photography: *This year, you introduced the Loxia and Otus lenses. What are the greatest challenges involved in bringing new high-end products to market?*

Bertram Hoenlinger: The Loxia lenses are very compact because they are designed specifically for use with the Sony a7 cameras. The low throat depth of the E-mount bayonet makes it simpler to design compact geometries but we still cannot 'shrink' our lenses to match the way Sony has reduced the size of its camera bodies. In the end, we decided to compromise on the maximum apertures to keep the lenses small.

In principle, we could simply fit most existing SLR lenses with a new bayonet, but our brief was to create a completely new range of lenses to match the compact size of the Sony cameras. The Loxia range are based on tried and trusted lens geometries that we have optimized to work with the a7cameras. The result is a series that delivers excellent image quality. However, it's not possible to optimize all lenses the same way. The short back focal length of wide-angle lenses makes them particularly difficult to optimize because marginal rays entering the lens hit the sensor's microfilter array at an extremely acute angle. You cannot simply use an existing design for this type of lens if you want to be sure of producing high-quality results, so in some cases we had to start from scratch.

c't: *How long does it take to develop a new lens?*

BH: We spent about three years developing the 55mm F/1.4 Otus. Even though we use simulation software for a lot of our development work, we still have to build prototypes for fine-tuning the design, and that takes another two or three months.

c't: *How closely do you cooperate with camera manufacturers?*

BH: We have very close working relationships with Sony and Fujifilm but working with other manufacturers is trickier. We often use gear purchased on the open market to test our products.

c't: *What do you have to look out for when testing a new lens?*

BH: Canon's EOS DSLRs use a fully automatic aperture control system that isn't designed for use with a lens-based aperture ring, whereas Nikon still uses a mechanical connection to control the aperture via the camera body, which enables us to build a manual aperture ring into F-mount lenses. However, Nikon is moving toward a system that sets the aperture via the camera's control dials, so the latest NIKKOR lenses don't have a dedicated aperture ring. We still include an aperture ring in our lenses to ensure backward compatibility and give our customers the choice of setting the aperture in-camera or via the lens.

c't: *The Loxia and Otus ranges include fixed-focal-length standard lenses. What is it that makes these lenses so fascinating?*

BH: 50mm lenses are extremely versatile and closely match the perspective and angle of view perceived by the human eye. They are often built around the traditional Planar design that has been around since1896. It's a symmetrical design without any specialized elements and represents an unbeatable combination of small size, light weight, wide-aperture performance and an affordable price. The Otus lens represents a completely different approach, with maximum emphasis on performance, so it is a lot heavier and more expensive than more traditional designs. The Otus is based on an apochromatically corrected Distagon design that virtually eliminates color errors. There is no standardized definition of 'APO', so we base our design decisions on Ernst Abbe's 1873 treatise on microscope optics.

c't: *Why are 50mm lenses so bright?*

BH: The relatively low number of elements makes it easier to construct bright 50mm lenses but also means that we cannot correct as many optical errors as we would like.

c't: *The current trend in full-frame cameras is toward ever-greater sensor resolution. Can today's lenses keep up? Are there limits to lens resolution?*

BH: That's a highly theoretical question! There are all sorts of limiting factors that have nothing to do with optics, so the lens itself is not the most critical link in the chain. Even a simple lens design can deliver extremely high resolution if it is constructed precisely enough. The quality of a lens is really determined by the contrast it delivers at wide apertures rather than by its absolute resolution.

(Sophia Zimmermann)

Sophia Zimmermann

Canon G1 X Mark II, Nikon 1 V3 and Sony RX100 III compared

Digital compacts have been almost completely usurped by smartphone cameras, and camera manufacturers have responded by producing increasingly powerful fixed-lens and interchangeable-lens pocket cameras to buoy up the market – in our eyes a very good thing.

This issue's test candidates are real heavyweights in their respective camera and sensors segments. They easily stand comparison with many mid-range DSLRs specifications and performance-wise, and might just help to save the reputation of smaller cameras in general. They are all proof of a trend away from bargain snapshot devices and toward high image quality captured using a camera with compact dimensions.

These cameras often cost just as much as a DSLR. The Canon G1 X Mark II and Sony RX100 III cost around US$800, while the Nikon 1 V3 comes in at around US$1,200 in a kit with a 10-30mm lens and an electronic viewfinder. For the price, you get a high-spec feature set and some useful custom features too.

Small cameras with large sensors are becoming increasingly popular. They make a usable alternative to a bulky DSLR in many situations and perfect second cameras for capturing high-quality spontaneous snapshots if you don't want to do without your main camera. We tested the high-end Canon G1 X Mark II and Sony RX100 III models and compared them with Nikon's remarkable 1 V3 system camera.

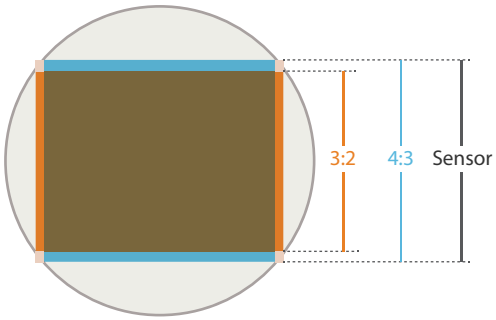
Canon G1 X Mark II: Multiple Aspect Ratios

The Canon G1 X Mark II is a chunky-looking camera and has the largest sensor of those we tested. At 18.7×14 mm, the sensor is larger than the Micro Four Thirds sensors (17.31×12.98 mm) that were often built into mid-range DSLRs and are today mostly used in mirrorless system cameras. Canon's APS-C sensors measure 22.2×14.8 mm.

The sensor in the G1X Mark II is a multi-aspect model that can capture 3:2 and 4:3 images without cropping. In other words, it works at maximum yield in both formats. The camera's firmware uses the complete width of the sensor to capture 3:2 and its full height to capture 4:3 images. All images are captured using a fixed 5× zoom lens with an equivalent range of 24-120 mm and maximum apertures of f2.0 at the wide-angle end of the scale and f3.9 at the telephoto end.

The camera also includes a number of features that are probably more at home in a smartphone, including Wi-Fi, NFC and touch screen functionality. The monitor can be tilted 180 degrees upward and 45 degrees downward.

Image: Canon



The G1 X Mark II can capture multiple aspect ratios without cropping. The sensor itself measures 18.7×14 mm, of which the entire width is used for 3:2 and the entire height for 4:3 images.

Nikon 1 V3: System Camera that Sets Speed Records

The Nikon 1 V3 is a high-end but compact system camera which, unlike our other two test candidates, has interchangeable lens functionality. Nikon currently offers thirteen 1-series lenses that range from wide-angle prime to compact telephoto zoom.

The Nikon has the same 13.2×8.8mm sensor size as the Sony RX100 III, and offers 18 megapixels of resolution at a crop factor of 2.7. This equates to a much higher pixel density than the Canon G1X with its crop factor of 1.9 and relatively moderate 13-megapixel resolution.

Speed is a major selling point for the 1 V3. While this issue's other test cameras reach a peak burst shooting rate of less than 10 fps (frames per second), the Nikon's electronic shutter enables it to shoot at up to 60 fps and at up to 20 fps with continuous autofocus, thanks to its hybrid AF system that combines contrast and phase detection technology.

Image: Nikon

The Nikon 1 V3 is a mirrorless system camera with interchangeable lenses. Its sensor measures 13.2×8.8 mm and there are currently 13 lenses available for the proprietary '1' system bayonet.

Sony RX100 III: Pop-up Viewfinder and a Bright Built-in Zoom

The RX100 III is the smallest and lightest of our test models and feels most like a compact to hold. The 20-megapixel sensor measures 13.2×8.8 mm and therefore has even greater pixel density than the Nikon.

The camera has a built-in 2.9× zoom that covers the popular equivalent focal length range of 24-70 mm. Compared to other cameras in its class, the Sony's Zeiss lens has unusually bright maximum apertures that range from f1.8 at the wide end to f2.8 at 70 mm.

This camera's most unusual feature is its 1.44 million-dot built-in pop-up OLED viewfinder that you can simply stow away in the camera's body when you don't need it. The 3-inch LCD monitor can be tilted a full 180 degrees upward, thus making selfies a snap.

Extra features include built-in Wi-Fi and NFC functionality, and Sony's own online PlayMemories Store offers additional free and paid apps for download.

Image: Sony

The Sony RX100 III has a sensor the same size as the Nikon's but uses a built-in zoom lens with a maximum wide-angle aperture of f1.8

Look and Feel, Handling

Canon G1 X Mark II: Control Rings Around the Lens Take Getting Used To

The design of the G1 X Mark II is quite plain. It neither follows the current retro-look trend nor does it look like the compact cameras of yore. The grip and the large lens give it a professional look, and it could easily be mistaken for an interchangeable-lens system camera. The aluminum body is pleasant and easy to hold and has a high-quality feel. A usefully placed rubber thumb grip at the rear complements the body design.

The camera's handling has not been thought out as well as its design, however. It lacks the control dials that we would expect to find in a camera of this caliber and instead has a step ring and a continuous ring built around the lens. These serve primarily as focus and zoom controls but can be set to perform other tasks. The zoom ring can, for example, be used to set the aperture in aperture-priority exposure mode.

If the camera isn't switched to manual focus mode, the focus ring, too, can be assigned an additional function, such as exposure compensation. There is an additional control ring around the four-way button on the back of the camera that can also be assigned various functions, such as adjusting ISO sensitivity. The 'S' (Shortcut) button can be assigned any one of a number of important functions. All in all, the control and menu system is not very intuitive and you will have to consult the manual if you want to use the camera's complex feature set to the full.

The G1X Mark II has no viewfinder, but an add-on one is available separately, which is a surprise in a camera in this price segment. If you don't want to pay around US$250 extra, you will have to make do with the built-in touch screen monitor, which is tiltable and has a fairly wide angle of view but is very difficult to see in bright sunlight.

If you do opt to purchase the viewfinder, you will find it bright and flexible and its tilt function is a big plus, especially in macro situations. On the downside, color rendition is rather pale and the image tends to judder during fast pans.

Body

The Canon's body is solidly built and well balanced, and looks a lot like a mirrorless system camera

Lens Controls

The zoom and focus rings can also be used to set aperture and exposure time – a setup that takes some getting used to

Viewfinder

There is an optional electronic viewfinder available

Nikon 1 V3: Great Handling, Especially with the Optional Grip

Nikon has managed to give this camera a full set of control dials for adjusting major functions, despite the fact that its tiny body offers less surface area than the Canon. Nevertheless, Nikon's proprietary system does have some drawbacks.

Once you have selected a shooting mode, the 'F' (Feature) button takes on a central role in camera operation. Pressing it displays all of the major settings and the multi selector gives you direct access to each.

If that was as far as it went, everything would be simple, but Nikon has managed to build in a couple of 'hurdles' to keep you concentrating. For example, when shooting in creative mode, you can use the 'F' button to switch between the HDR, toy camera and miniature effect options but all other functions are grayed out. This seems to us like a serious oversight, as manual adjustments are particularly important when you are working creatively. In other automatic and semi-automatic modes, shooting parameters can be adjusted via the 'OK' button in the center of the multi selector. Our test camera included the optional GR-N1010 grip and DF-N1000 electronic viewfinder. The grip doesn't make the camera much larger, but does make it a lot easier to hold, which is a boon when using larger lenses. It also has an additional control dial and an extra customizable function button, giving you more manual control options.

If you prefer, you can adjust most of the camera's settings via the touch screen vari-angle monitor. Active parameters are displayed on the screen and tapping them calls up a slider for making adjustments. Focus and the shutter release can also be controlled via the touch screen and you can scroll through or zoom into and crop your photos in playback mode using typical finger-tip gestures. The monitor reacts quickly and reliably to all types of input.

Grip

The optional grip makes the camera easier to use and includes an extra control dial and an additonal customizable function button

Body

Without its grip and viewfinder, the 1 V3 is highly compact but nevertheless offers a comprehensive set of controls

Control Dials

The Nikon has a practical set of traditional control dials that cover all major functions

Viewfinder

Nikon's optional viewfinder isn't as flexible as the Canon offering

Sony RX100 III: Pocket-sized with a Built-in Viewfinder

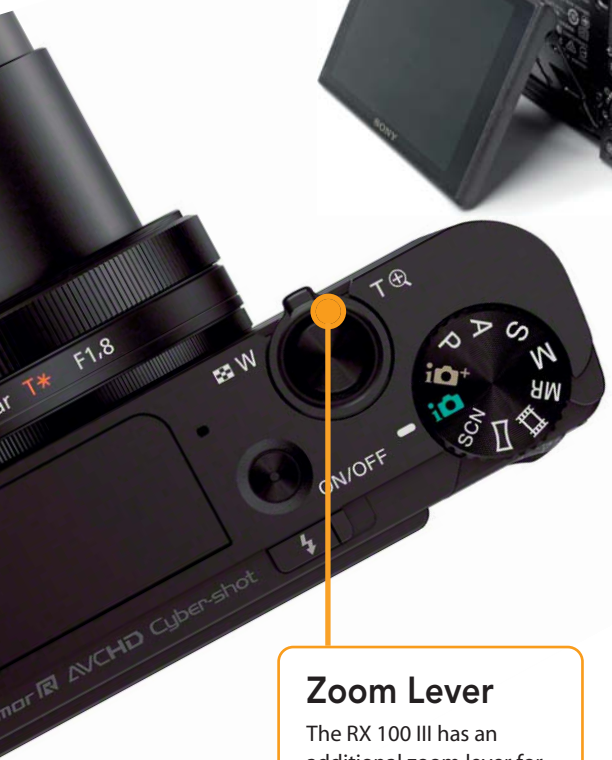
Even though it has a built-in retractable viewfinder, the RX100 III is the smallest camera we tested and is truly pocket sized. The viewfinder is located where the built-in flash used to be in the previous version of the RX100. The tiny screen measures just 1 cm diagonally but still manages to squeeze in1.44 million dots of resolution. It produces a bright image with plenty of contrast and enables you to compose images carefully in bright conditions that make using the monitor impossible.

The RX100 III is heavier than it looks, but the rubberized thumb grip on the back makes it relatively easy to hold securely.

There are not many buttons and dials in evidence: apart from the control wheel, there are just five other buttons offering access to video mode, image playback, the camera's menu system and various other functions. The 'Fn' button can be used to control virtually all major shooting parameters and it is up to you to decide which functions you assign to it. This approach saves a lot of unnecessary scrolling through menus and lets you make manual adjustments quickly when necessary. In P mode, the control ring around the lens adjusts the focal length and takes over a variety of other functions (aperture, exposure time, exposure shift etc.) in other shooting modes. The control wheel, too, offers fast access to a variety of shooting parameters.

Body

The RX100 III's aluminum body is heavier than it looks and may be too small for people with large hands



Zoom Lever

The RX 100 III has an additional zoom lever for times when you are using the lens ring to set the aperture or exposure time

Viewfinder

The Sony's clever pop-up solution is the only built-in viewfinder in this test. Sony has sacrificed the accessory shoe to make space for this innovative feature.

Test Results and Image Quality

To keep the playing field as even as possible, we tested the Nikon using a zoom with a similar range to the other cameras' built-in lenses. We are certain that the 1 V3 would leave the other two cameras standing in the detail resolution stakes if tested with a bright prime lens. However, we weren't happy with the performance of the 10-30mm kit lens provided with our test camera, so we performed our tests again using the 1 NIKKOR 11-27.5mm f/3.5-5.6.

This lens has an equivalent zoom range of 30-74 mm, compared with the RX100 II's 24-70 mm and the Canon's slightly more capable 24-120 mm. We took all our test measurements stopped down to f5.6.

Noise and Dynamic Range

In theory, the Canon's large sensor and moderate pixel density should put it at the very top of heap, but this proved to be only partially the case. At its lowest sensitivity setting, the G1 X recorded a signal-to-noise value of 56 and a visual noise reading of 1.2, which is perfectly respectable for this size of sensor. At ISO 100, the Nikon 1 V3 recorded the same signal-to-noise value but a lower visual noise value of 1.1. The Sony brought up the rear with a signal-to-noise value of 45 and visual noise that came in at 1.3.

At higher ISO levels, the Canon and the Nikon behave like most cameras do, showing more noise at higher sensitivities, whereas the Sony's results actually improve at ISO 400 and it produces better-quality results than the competition all the way up to its highest ISO setting.

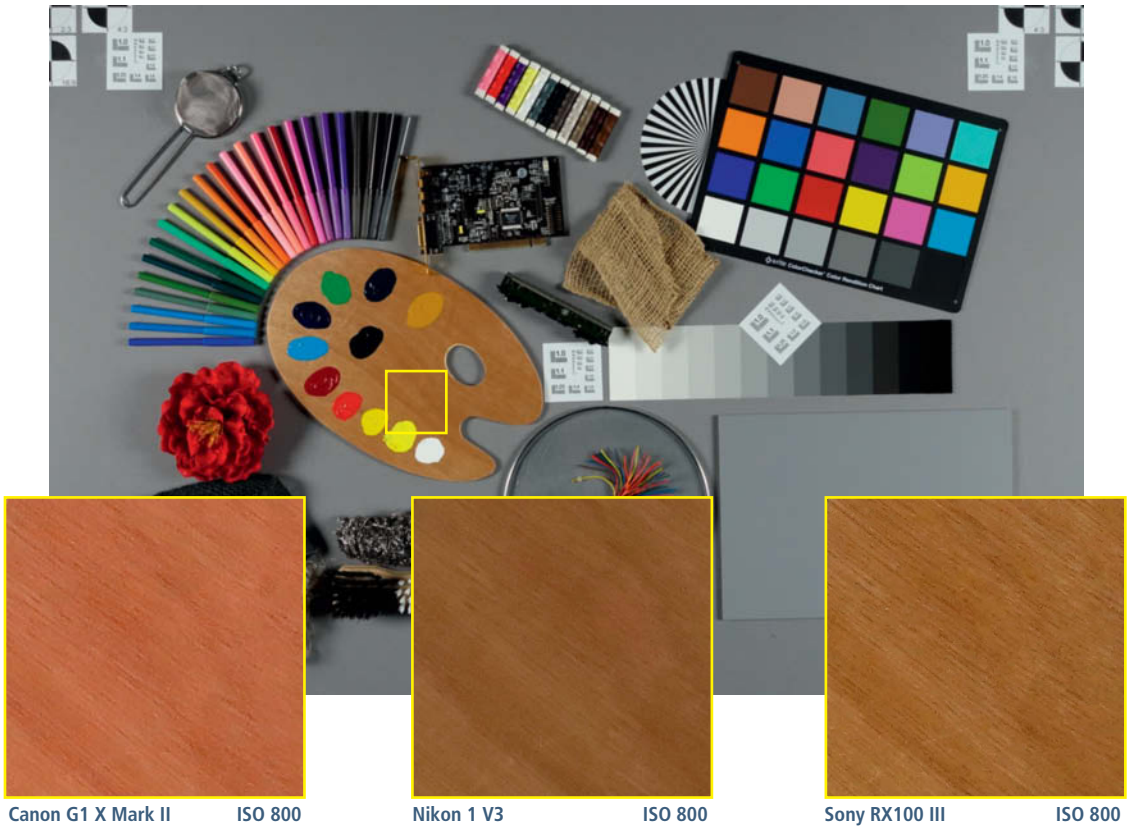
These values are mirrored in our test images. The Sony uses a selective noise reduction algorithm that 'flattens' detail in some places and sharpens it in others. This approach benefits fine textures and details, which remain sharp and three-dimensional, even at high ISO settings. Our ISO 800 comparison (see below) shows clearly how the Sony retains the detail in the woodgrain pattern of the artist's palette in our test scene, while the Nikon's noise reduction algorithm produces obvious detail softness.

Overall, the Nikon's color rendition is neutral and almost too subtle for our taste, while the Canon takes a different route, producing bright, almost garish JPG colors, especially reds. The Sony's colors lie between these two extremes.

Resolution

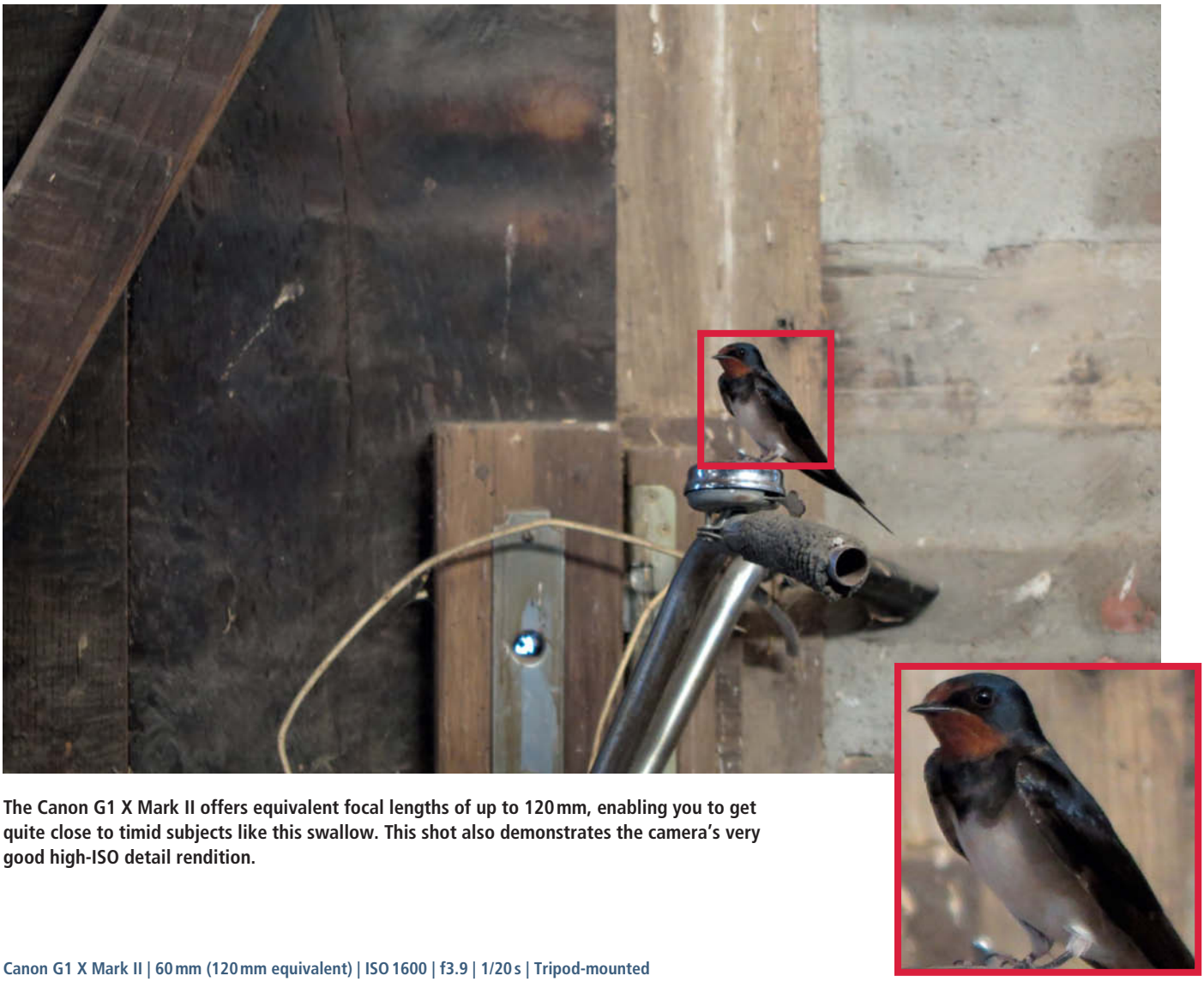
According to the numbers alone, the Sony wins the resolution race too, producing balanced results throughout the zoom range. The edges and center of the frame show very good rendition at telephoto and standard focal lengths, although quality drops off at the edges at the wide-angle end. From the theoretically possible 1824 line pairs that the sensor can resolve, at ISO 100, 24 mm and f5.6 the RX100 III recorded a central value of 1672 and 1380 at the edges.

The G1 X Mark II performed similarly. From the relatively low theoretical maximum of 1452 line pairs, it recorded1420 in the center of the frame and 1102 at the edges, also when shooting at ISO 100, 24 mm and f5.6. In spite of its relatively long lens, the Canon produces great resolution, even at the telephoto end. At 120 mm, ISO 100 and f5.6, we recorded center resolution of 1316 and edge resolution of 1237 line pairs.



Canon G1 X Mark II ISO 800 | Nikon 1 V3 ISO 800 | Sony RX100 III ISO 800

The crops show each camera's ISO 800 performance, recorded using our standardized lab test scene. The Sony photo shows the most detail, followed by the Canon and then the Nikon.
Our original test images are included on this issue's free DVD.



The Canon G1 X Mark II offers equivalent focal lengths of up to 120 mm, enabling you to get quite close to timid subjects like this swallow. This shot also demonstrates the camera's very good high-ISO detail rendition.

Canon G1 X Mark II | 60 mm (120 mm equivalent) | ISO 1600 | f3.9 | 1/20 s | Tripod-mounted

The Nikon zoom lens is a worthy competitor to the high-end glass built into our other two test cameras and produced well balanced results. Of the theoretically available 1744 line pairs, it resolved 1485 in the center and 1352 at the edges of a wide-angle test shot.

Shooting Outdoors

The differences we noted in the lab were virtually undetectable during our outdoor test shoot at the Hannover Adventure Zoo and Berggarten botanical garden, although the images produced by each camera do have their own distinctive look.

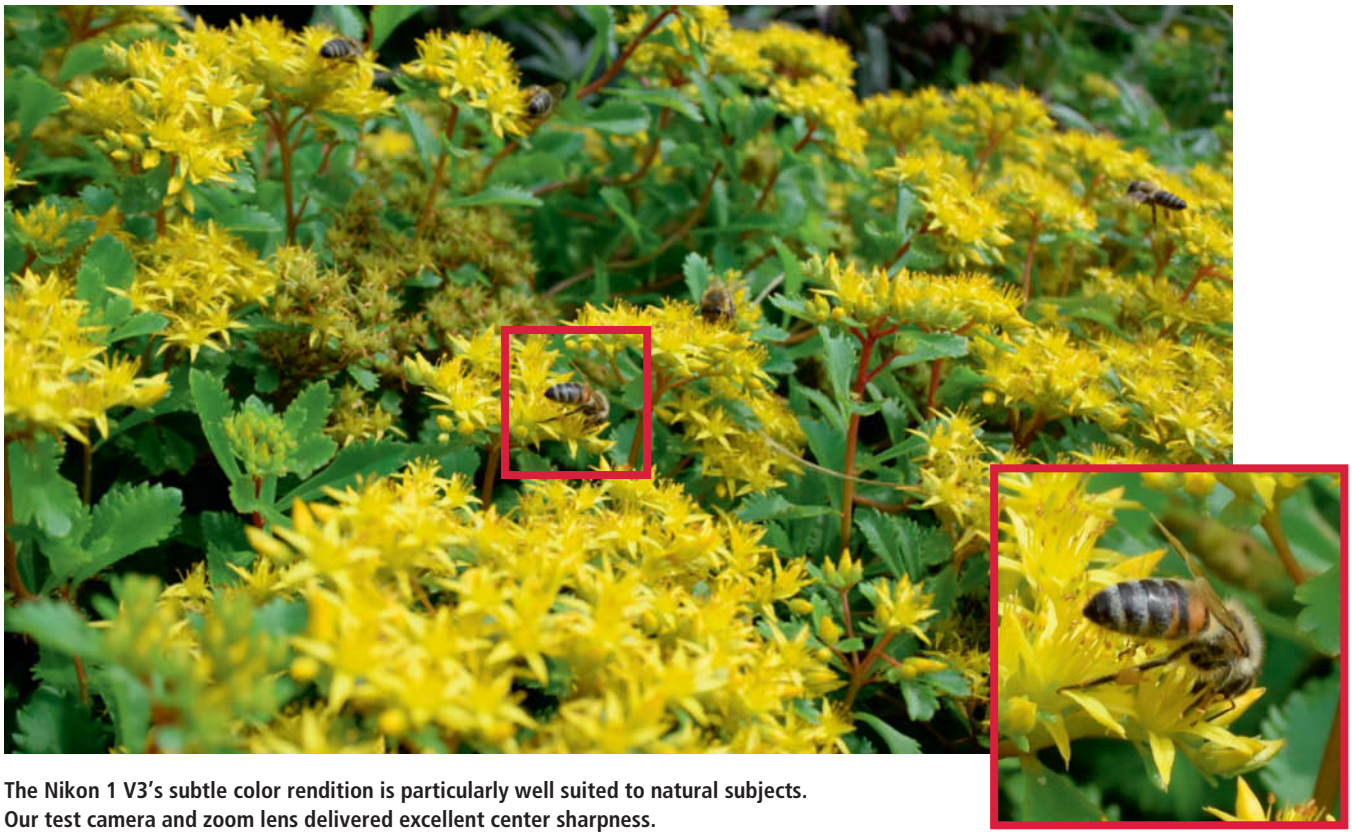
The Sony's unusually wide maximum apertures produce wonderfully smooth bokeh, even at short focal lengths, and its cool color rendition helps to produce fresh-looking images. Our only real complaint is that images shot at maximum aperture are lacking in detail contrast.

The Nikon's kit lens, with its maximum wide-angle aperture of f3.5 doesn't suffer from a lack of sharpness but doesn't overdo things either, producing satisfying images that are particularly well suited to natural subjects.

The Canon's relatively long telephoto lens helped us get closer to timid subjects and delivered much better performance than other compact cameras do at this kind of focal length. Center sharpness is fine throughout the range and detail remains good, even at higher ISO settings (see the photo above for an example).

Speed

The Nikon's autofocus system is by far the fastest of the three. In daylight, we measured AF shutter lag of 0.26 s at a wide-angle setting and 0.27 s at the telephoto end. Even the D7100 DSLR can't beat these results. The Sony RX100 III recorded a respectable 0.3 s (wide-angle) and 0.35 s (telephoto), while the Canon came in last with 0.42/0.49 s. The Sony and the Canon simply cannot compete when the Nikon rattles off 40 full-resolution (non-RAW) shots at a burst rate of 60 fps. Although we were initially reluctant to believe it, this feature is real and works as promised. The camera even manages 20 fps using continuous focus tracking, making it virtually impossible to miss the critical moment.



The Nikon 1 V3's subtle color rendition is particularly well suited to natural subjects. Our test camera and zoom lens delivered excellent center sharpness.

Nikon 1 V3 with the 1 NIKKOR VR 10-30mm zoom | 10 mm (27 mm equivalent) | ISO7160 | f3.5 | 1/640 s | Tripod-mounted

The Sony produces wonderful bokeh, even at wide-angle settings, but center detail definition is rather soft at maximum aperture

Sony RX100 III | 9 m (24 mm equivalent) | ISO 125 | f1.8 | 1/400 s | Tripod-mounted

Conclusions

Our tests made it quite clear that these three cameras are worthy competitors, although they are obviously designed for very different types of photographers. Whichever you choose, you will need a healthy bank balance!

If you are on the lookout for a good compromise between compactness and performance – perhaps because you already own a DSLR or simply because you prefer a lighter camera, then you should take a closer look at the Sony RX100 III. This is the only really pocket-sized camera in this test but it still delivers image quality that is worthy of much larger sensors. The wide maximum aperture enables you to use shallow depth of field as a compositional tool and the built-in viewfinder makes framing your subject easy in bright sunlight. The downside of all this quality is, of course, the price, which is currently in the region of US$800.

The biggest issue the G1 X Mark II has is that it tries to be too many things to too many people. While not particularly compact, it still doesn't offer enough functionality or a set of controls that allow it to be taken seriously as a professional photographic tool. The lack of a built-in viewfinder and the high price of the optional EVF-DC1 make it just as expensive to purchase as a mid-range DSLR with a kit lens. On the plus side, the wide zoom range covers a multitude of situations and might just make a name for itself with fans of fixed-lens cameras with large large hands, or simply those who are looking for high image quality without having to make too many manual adjustments.

The Nikon 1 V3's trump card is its autofocus and shooting speed. Its high burst shooting rates and minimal shutter lag are not far short of a miracle. The system supporting the camera makes it a flexible device and, used with the 'pancake' standard lens, it will fit into some shoulder bags, even if it is still too large for most pockets. Purchased with the 10-30mm zoom lens, an electronic viewfinder and the optional grip, the V3 is well set up for pro-level use but costs around US$1,200.

TEST CAMERA COMPARISON

Technical Data	Canon G1 X Mark II	Nikon 1 V3	Sony RX100 III
Sensor, effective megapixels	CMOS, 12.8 (3:2), 13.1 (4:3)	CMOS, 18.4	CMOS, 20.1
Sensor size	1.5", 18.7 × 14 mm	Nikon CX, 13.2 × 8.8 mm	1", 13.2 × 8.8 mm
Image resolution	4352 × 2904 (3:2); 4160 × 3120 (4:3); 4352 × 2248 (16:9); 3120 × 3120 (1:1); 2496 × 3120 (4:5)	5232 × 3488 (3:2); (4800 × 920 (120:23); 1536 × 4800 (8:25); 9600 × 920 (240:23); 1536 × 9600 (4:25)	5472 × 3648 (3:2); 4864 × 3648 (4:3); 5472 × 3080 (16:9); 3648 × 3648 (1:1); 12416 × 1856 (panorama)
Crop factor/ Bayonet	1.9/ –	2.7/ Nikon 1	2.7/ –
Image formats	JPEG, RAW	JPEG, RAW	JPEG, RAW
Video: max. resolution, fps	MPEG-4 AVC/ H.264, 1080p, 30 fps	MPEG-4 AVC/ H.264, 1080p, 60 fps (720p at 120 fps)	XAVCS/ AVCHD, 1080p, 50 fps
Autofocus type	contrast detection	hybrid phase and contrast detection	contrast detection
AF areas	31, with touch control	171 (105 phase detection)	25
Shortest / longest exposure time	1/4000 s / 60 s	1/4000 s (mechanical), 1/16 000 s (electronic) / 30 s	1/2000 s / 30 s
Burst shooting	5.2 fps (until card full), 3 fps with AF	60 fps (40 at at a time); 20 fps with AF	10 fps (12 at a time)
Sensitivity	ISO 100-12 800	ISO 160-12 800	ISO 125-25 600
Lens type	5× zoom	Kit standard zoom 1 NIKKOR VR 10-30 mm	2.9× zoom
Equivalent focal lengths	24-120 mm	27-80 mm	24-70 mm
Aperture range	f/2.0-f/3.9	f/3.5-f/5.6	f/1.8-f/2.8
Vewfinder	optional (elektronic EVF-DC1)	optional (elektronic DF-N1000)	built-in electronic pop-up OLED
Viewfinder resolution	2.36 million dots	2.36 million dots	1.4 million dots
Monitor type / size	LCD / 3" (7.5 cm)	LCD / 3" (7.5 cm)	LCD / 3" (7.5 cm)
Monitor resolution	1.04 million dots (3:2)	1.04 million dots	1.28 million dots (4:3)
Monitor articulation	45 degrees down, 180 degrees up	87 degrees down, 90+ degrees up	180 degrees up
Dimensions (W × H × D)/ Body material	116.3 × 74 × 66.2 mm / aluminum	110.9 × 65 × 33.2 mm / magnesium alloy	101.6 × 58.1 × 41 mm / aluminum
Weight (incl. battery and mem. card)	558 g (19.7 oz)	324 g (11.4 oz)	280 g (9.9 oz)
Memory card tapes	SD, SDHC, SDXC	microSD, microSDHC, microSDXC	SD, SDHC, SDXC, Memory Stick (PRO-HG) Duo
Connectors	USB 2.0, Micro HDMI, PictBridge	USB 2.0, Micro HDMI, PictBridge	USB 2.0, Micro HDMI
WiFi / NFC / GPS	yes / yes / via smartphone	yes / no /optional (GP-N100)	yes / yes / via smartphone
Current price	US$800	US$1,200 (with 10-30mm zoom and EVF)	US$800
Test Results			
	better ▶	better ▶	better ▶
Sensor resolution (line pairs)	1452	1744	1824
Wide-angle resolution, center/edge (ISO low)	1417/1102	1485/1352	1672/1384
Telephoto resolution center/edge (ISO low)	1316/1237	1355/1182	1518/1476
Wide-angle resolution, center/edge (ISO 400)	1413/1096	1396/1284	1665/1377
Telephoto resolution center/edge (ISO 400)	1320/1240	1264/1070	1515/1476
Wide-angle resolution, center/edge (ISO 1600)	1276/1004	1161/1044	1619/1279
Telephoto resolution center/edge (ISO 1600)	1212/1138	1087/916	1434/1338
Wide-angle resolution, center/edge (ISO 3200)	1203/946	990/908	1477/1175
Telephoto resolution center/edge (ISO 3200)	1140/1059	900/790	1289/1226
Dynamic range[1] (ISO low)	10.19	9.93	9.97
	◀ better	◀ better	◀ better
Visual noise (ISO low)	1.2	1.1	1.3
Visual noise (ISO 400)	1.3	1.3	1.3
Visual noise (ISO 1600)	1.7	1.7	1.4
Visual noise (ISO 3200)	1.9	1.9	1.4
AF shutter lag at 1000 lux (wide-angle/telephoto)	0.42/0.49	0.26/0.27	0.3/0.34

[1] in f-stops

Thomas Hoffmann

Nikon D810

The New Version of Nikon's High-Resolution Baby

The D810 is Nikon's follow-up to the ground-breaking D800 and D800E full-frame models. As with the D800E, the new camera has no low pass filter but provides a raft of updated details that aren't very different from the previous version and which make using the new camera an even greater pleasure. We detail the changes and put the camera through its paces in the *c't* lab to check whether image quality has improved too.

Nikon's D8XX-series cameras still represent the highest resolution 35mm full-frame cameras available on today's market and only Sony's a7R offers direct competition in the 36-megapixel segment. The improved sensor built into the D810 has the same 7360×4912 resolution as its predecessor, while other features, including the autofocus module and the image processor, are borrowed directly from the pro-grade D4S. Other features, such as the split screen zoom display, improved video recording and an additional metering mode all contribute to the new camera's expanded feature set. The menu now includes a total of 65 custom functions.

Handling

In spite of slight changes to the shape of the grip and the layout of the buttons and controls, the D810 is just as easy to use as the D800. All major functions are accessible via their own buttons and you can assign custom functions to many of the buttons according to your needs.

The dust and moisture-proof body is made of magnesium alloy. The camera's weight underscores its professional aspirations and, unlike previous models in the D8XX series, the various connectors are located behind three separate covers instead of just one.

Features

The most important changes in the new model are its sensor and shutter units. The improved CMOS sensor has a standard ISO range of 64-12 800 and an extended range of 32-51 200. The D810 has no low pass filter (in other words, there is no 'E' version) and the sensor has new, improved microlenses. To capture the improved detail rendition made possible by these improvements, the shutter and mirror damping mechanisms have been revised too. As a result, the shutter is a lot quieter than the previous version (see *Reducing Shutter Noise* in Issue 17 for more details) and the mirror should, theoretically, produce less minor camera shake. If you want to eliminate camera shake altogether, you can use the new electronic first shutter curtain, which ensures that the shutter only produces physical movements when it closes at the end of an exposure.

The D810's Advanced Multi-CAM 3500FX autofocus unit is borrowed from the D4S and is more accurate than its predecessor, and its 51 focus points can be grouped to reduce the likelihood of focusing errors. The EXPEED 4 image processor comes from the D4S too, enabling full-resolution burst shooting at up to 5 fps (frames per second). Used with eight fresh Alkaline batteries in the MB-D12 battery pack (which costs US$400 extra), the camera can capture up to seven DX-format frames per second.

Concert and event photographers are sure to like the new highlight-weighted metering mode, which ensures that detail is retained in highlight areas such as those often caused by theater spotlights. This mode often produces exposures that are slightly shorter than usual, but any unwanted shadows can be easily corrected at the post-processing stage.

The split screen zoom function is a boon to landscape and architectural photographers, and enables you to view two separate details of the frame simultaneously while composing an image. Among other applications, this feature can be used to precisely align the horizon in tripod-mounted shots.

The 1,229 k-dot, 3.2-inch monitor now has additional white pixels that make it brighter and easier to read in bright light than the one built into the D800(E).

Video-wise, the D810 doesn't offer 4K capture but does include improved 60p Full HD (1920×1080) variable-aperture capture. If you switch on the Auto ISO feature, the camera automatically keeps the exposure level constant in varying lighting conditions. The uncompressed HDMI output stream will please professional film-makers, while compressed footage for low-resultion usage can be saved directly to the camera's memory

Body

The magnesium alloy body is dust and moisture-proof

Camera Back

A wide range of buttons and controls make using the D810 simple and relatively intuitive. Once you have got used to the layout, it is easy to adjust the settings with the camera held up to your eye.

Control Panel

The illuminated control panel displays all major settings and functions at a glance. The camera has no other illuminated controls.

Viewfinder

An OLED display shows exposure and camera settings in the viewfinder. The built-in eyepiece shutter prevents stray light from entering the camera during long exposures.

Image: Thomas Hoffmann, Hannover Adventure Zoo

Even at its highest regular setting of ISO 12 800, the D810 produces highly usable results. Noise artifacts and loss of detail are only apparent in the 100% view.

Nikon D810 with the 85mm f/1.4G lens | ISO 12 800 | f8 | 1/25 s | Tripod-mounted

card. The camera can display burned-out highlights using 'zebra' stripes on the monitor, and the 'Flat' Picture Control setting preserves detail over a wider tonal range, making subsequent color grading simpler.

Read on to find out how these enhancements affect our lab test results.

Test Results

We tested the D810 using the AF-S NIKKOR 85mm f/1.4G lens and overall, we recorded results that were in line with our high expectations.

The camera produced its greatest signal-to-noise ratio of 53 at it lowest native ISO setting of 64, while subjective visual noise came in at a thoroughly acceptable level of 1.1. This is way below critical levels, which begin at a value of 2.0.

The sensor's extremely high pixel density makes great demands on the lens, and only the very highest-quality glass is capable of making the most of the available resolution. The 85mm portrait lens we used provided solid performance and enabled us to closely observe the changes in image quality that increasing ISO values produced.

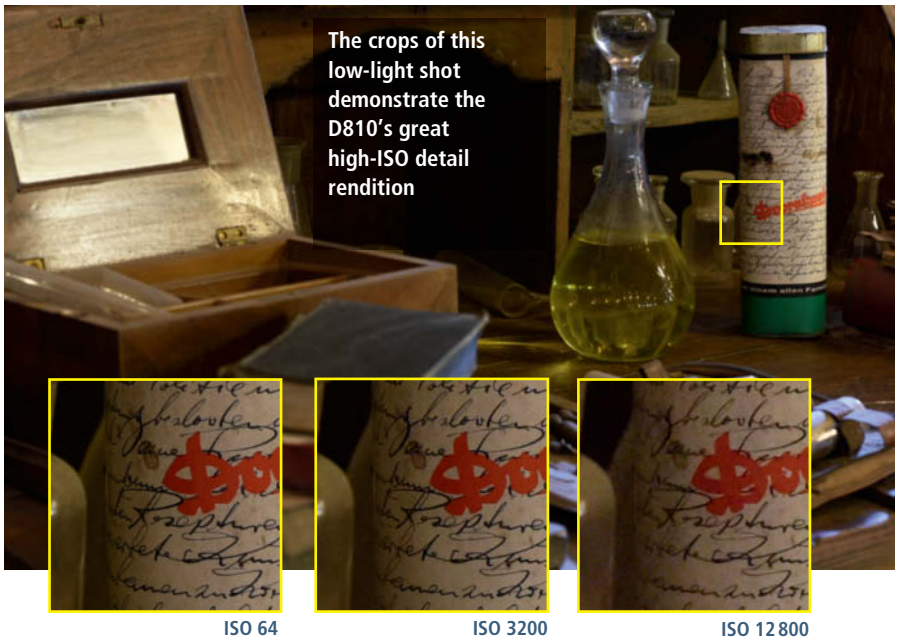
In the center of the frame at ISO 64, we recorded resolution of 88 per cent of the potential maximum of 2,456 line pairs. This value rose to 92 per cent at ISO 100, where the signal-to-noise value of 52 and a visual noise reading of 1.2 were well in line with our expectations. All kinds of artifacts are a non-issue all the way up to ISO 3200, where the visual noise value remains virtually unchanged at 1.3. The major difference at this level is center resolution, which drops by up to a quarter, recording just 1,834 line pairs.

Visual noise increases rapidly at ISO 6400, measuring 1.9, while the signal-to-noise ratio remains relatively low at 42 – the same value as the one we measured at ISO 800.

At maximum sensitivity (ISO 12 800), detail resolution drops off significantly. This observation is mirrored by a signal-to-noise value of 28, although the visual noise value at this level is still less than our critical threshold value of 2 and resolution still measures a usable 70 per cent. A full screen view shows no really obtrusive artifacts, and disruptive noise and loss of detail only became apparent once we zoomed in to 100%.

The D810 delivers dynamic range of 10.1-10.6 stops throughout the ISO range.

Our test images (also available on this issue's free DVD) underscore our lab test results, providing usable results at 100% magnification all the way up to ISO 3200. There is some loss of detail from ISO 6400 upward, but this is only really an issue at high magnifications. Smaller prints are fine throughout the ISO range.



Conclusions

With the D810, Nikon has introduced a useful addition to its range of high-resolution, pro-grade full-frame DSLRs. This model definitely represents evolution rather than revolution, with sensible additions to the existing feature set, a new state-of-the-art sensor and proven pro-grade autofocus and image processing units.

If you already own a D800 or a D800E, there is no real reason to upgrade, but if you are considering switching from a camera with a smaller sensor or an older full-frame model, the D810 is a sophisticated and powerful option.

Nikon has announced that the new camera will only be available via authorized Nikon dealers, so the online price wars that usually follow the introduction of a new high-quality camera won't be influencing any purchase decisions for the D810. The street price is currently still on a level with Nikon's SRP of US$3,300. (tho) c't

NIKON D810 AT A GLANCE

Technical Data	
Sensor resolution	7360 × 4912
Number of megapixels	36.3
Sensor size	full-frame (35.9 × 24 mm)
Crop factor	1
RAW capture	yes
Autofocus	phase and contrast detection (mode-dependent)
Number of AF areas	51
Shortest/longest exposure time	1/8000 s / 30 s
Sensitivity range	ISO 32 - 51200
Viewfinder type	pentaprism
Monitor type / size	LCD, 3.2 " (8 cm)
Monitor resolution	VGA: 640 × RGBW × 480 (= 1,228,800 dots)
Monitor articulated	no
Dimensions (W/H/D)	146 × 123 × 82 mm
Weight	980 g (w/battery and mem. card)
Memory card types	SD, SDHC, SDXC, CF
Connectors	USB 3.0, HDMI, microphone, headphones, other accessories
Body price (RSP / street)	US$3,300 / US$3,300

Test Results	
	better ▶
Sensor rsolution (line pairs)	2456
Center resolution (ISO 64)	2162
Center resolution (ISO 100)	2252
Center resolution (ISO 1600)	1975
Center resolution (ISO 6400)	1871
Center resolution (ISO 12 800)	1679
Dynamic range (ISO 64)	10.2
Dynamic range (ISO 100)	10.4
Dynamic range (ISO 1600)	10.5
Dynamic range (ISO 6400)	10.3
Dynamic range (ISO 12800)	10.4
	◀ better
Visual noise (ISO 64)	1.1
Visual noise (ISO 100)	1.2
Visual noise (ISO 1600)	1.4
Visual noise (ISO 6400)	1.9
Visual noise (ISO 12800)	1.8
Shutter lag at 1000 lux	0.34

Sophia Zimmermann

Sony a7S

12-Megapixel Low-light Miracle

There's no need to be afraid of the dark! The Sony a7S has cat-like capabilities in low light situations and keeps going long after the competition has given up. Its 12-megapixel, full-frame sensor can shoot at extended sensitivities of up to ISO 409 600.

With the a7S, Sony has extended its mirrorless lineup to include a highly specialized system camera, with low-light capabilities designed to complement the ultra-high-resolution a7R and entry-level a7 models. The new camera's sensor measures 35.6×23.8 mm, packing a mere 12 megapixels of resolution but with sensitivity settings that range from ISO 50 to an unparalleled 409 600 in extended mode.

The camera competes directly with Nikon's D4s in the ISO sensitivity stakes. Nikon's top-of-the-range model has the same maximum ISO range of 50-409 600 and a higher-resolution, 16-megapixel sensor that

of course means that it has greater pixel density too.

Features

Like its sister models, the a7S is equipped with a vast range of features. The body is made of magnesium alloy and its buttons, dials and monitor are all dust and moisture-resistant. The body is slightly heavier than the other two a7 models, weighing in at 490 g (17.3 oz) with the battery and a memory card inserted. However, it is still a lightweight contender compared with the 1350 g (3 lb) Nikon D4s. You won't need to visit the gym before you head out on a shoot with the Sony!

Unlike the Nikon competition, the Sony's 921,600-dot monitor is tiltable. Overall resolution for the widescreen monitor is slightly lower than it would be if Sony had opted for a 4:3 model. The OLED viewfinder is more highly specified than the monitor, with a total of 2,359,296 dots.

The a7S has the same 25-point contrast detection autofocus system as the high-resolution a7R, while the entry-level a7 model uses a hybrid contrast/phase detection system. Image processing is handled by the same BIONZ-X engine that is found in the other two models – a processor that is said to be particularly good at selective noise suppression and is know for its faithful detail rendition.

Body

Visually, the a7S is extremely similar to its sister models, and only the subtle blue 'S' on the front of the body reveals its true high-sensitivity identity

Tiltable Monitor

An unusual feature for a camera with pro-grade aspirations, the monitor can be tilted 90 degrees upward and 45 degrees down

Handling

The built-in rubberized grip makes the a7S easy to hold, even though the camera is heavier than it looks. Handling doesn't feel too complex, in spite of the multitude of buttons and dials that Sony has managed to squeeze into the diminutive body. In fact, the controls help to underscore the camera's pro-grade aspirations.

The top plate houses the main mode dial, a dedicated exposure compensation dial and the C1 custom function button. The additional (front and rear) dials are used to adjust aperture, exposure time and other shooting parameters, depending on how the camera is set up.

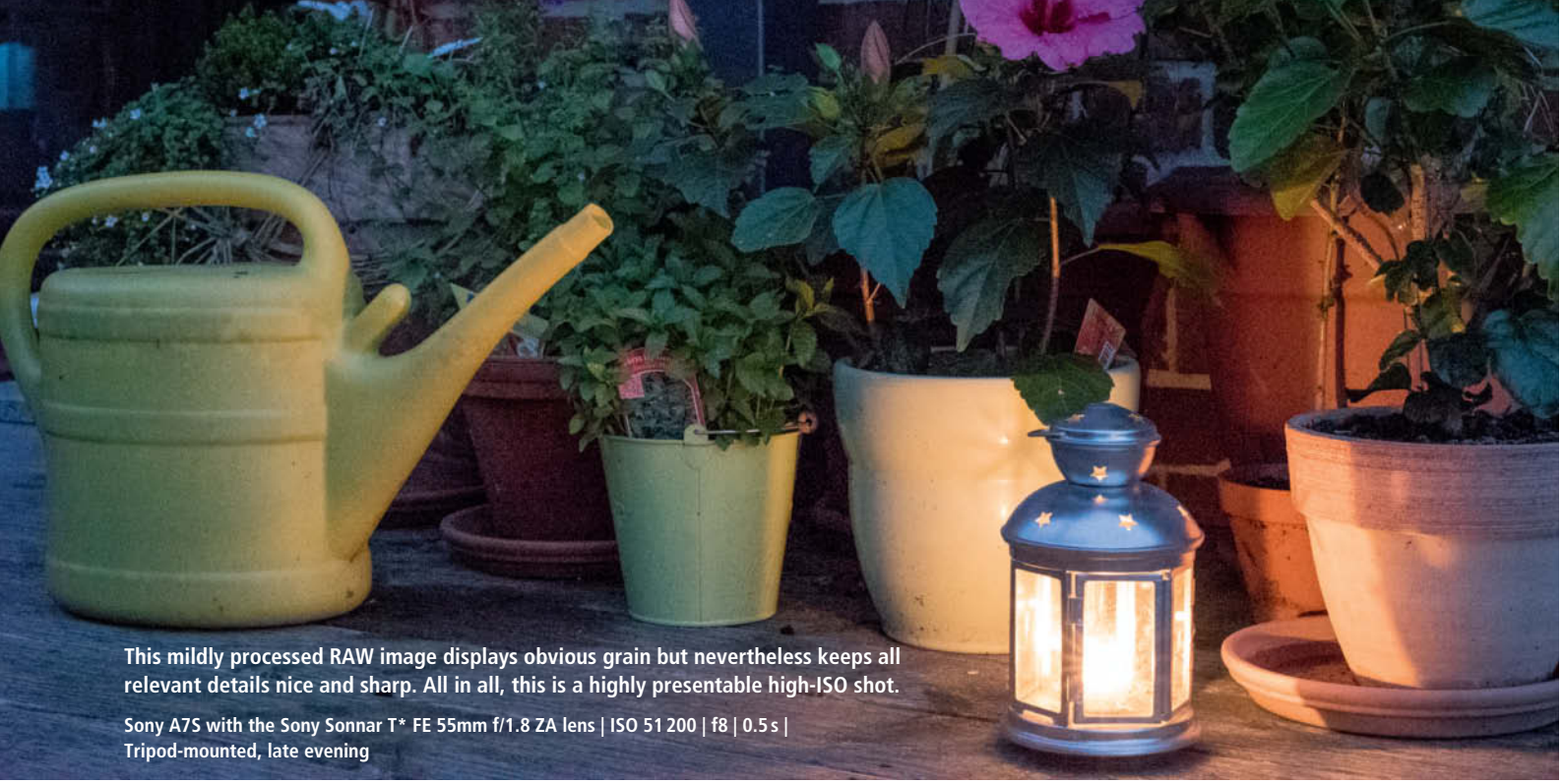
The camera back is well filled too, with the Fn button taking on a central role. This can be used to call up a summary of all the major settings and allows you to select and adjust them using the control wheel. You can select which parameters the button covers using a typical Sony tabbed menu system. There are numerous custom function buttons and other ways to customize the interface, enabling you to turn the a7S into a highly individualized tool.

Command Dials

The Sony's huge range of dials and user-assignable buttons make it simple to set the camera up to suit your own personal shooting style

Viewfinder

The OLED viewfinder is a lot more detailed than the camera's monitor and the large, bright display is great for manual focusing if used with the Focus Magnifier feature



This mildly processed RAW image displays obvious grain but nevertheless keeps all relevant details nice and sharp. All in all, this is a highly presentable high-ISO shot.

Sony A7S with the Sony Sonnar T* FE 55mm f/1.8 ZA lens | ISO 51 200 | f8 | 0.5 s | Tripod-mounted, late evening

Sony a7S at a Glance

Technical Data	
Sensor resolution	4240 × 2832
Number of megapixels	12.2
Sensor size	full-frame (35.6 × 23.8 mm)
Crop factor	1
RAW capture	yes
Autofocus	Contrast detection
Number of AF points	25
Shortest/longest exposure time	1/8000 s / 30 s
Sensitivity range	ISO 50 - 409 600
Viewfinder type	electronic OELD
Viewfinder resolution	2.36m dots(1024 × 768)
Monitor type / size	wide screen LCD, 3" (7.5 cm)
Monitor resolution	921,600 dots
Monitor tiltable	yes
Dimensions (W/H/D)	127 × 94 × 48 mm
Weight	489 g (w/battery and mem. card)
Memory card types	SDHC, SDXC, Memory Stick Pro Duo
Connectors	USB 2.0, HDMI, Bravia Sync, microphone, headphones, Wi-Fi, NFC, PC, other accessories
Body price (RSP / street)	US$2,500 / US$2,500

Test Results	better ▶
Sensor rsolution (line pairs)	1416
Center resolution (ISO 100)	1211
Center resolution (ISO 1600)	1211
Center resolution (ISO 6400)	1185
Center resolution (ISO 12 800)	1155
Dynamic range (ISO 100)	9.9
Dynamic range (ISO 1600)	9.9
Dynamic range (ISO 6400)	9.8
Dynamic range (ISO 12800)	9.7
	◀ better
Visual noise (ISO 100)	1
Visual noise (ISO 1600)	1.1
Visual noise (ISO 6400)	1.3
Visual noise (ISO 12800)	1.9
Shutter lag at 1000 lux	0.43

As is to be expected, the new camera includes Wi-Fi functionality for sharing and downloading to and from a smartphone, tablet or the Sony PlayMemories Camera Apps website. The site hosts free and paid apps that cover a wide range of photographic applications, including ones for capturing star trails and shooting professional-looking portraits. The Smart Remote Control app even enables you to turn your mobile device into a remote control for your camera. Its simple interface gives you access to exposure adjustments and the shutter release, and you can make other adjustments using the camera controls even if it is in remote mode.

Test Results and Image Quality

Previous tests have shown that the more professional the camera, the more consistent our test results turn out, and this trend continues with the a7S. We recorded a signal-to-noise ratio of 56 at ISO 100, while subjectively perceptible visual noise recorded a value of 1. In earlier tests,we recorded a signal-to-noise value of 100 and visual noise value of 0.7 for the other a7 models, but this difference disappeared at higher ISO levels.

At ISO 1600, the a7S recorded a visual noise value of 1.1, increasing only slightly to 1.3 at ISO 6400 and 1.9 at ISO 12 800. As a comparison, 0.8 represents noise-free images, while all values of less than 2 are virtually negligible. Values above 2 and below 3 represent obvious noise and values above 3 represent significant, disruptive artifacts.

Our test images (included on this issue's free DVD) mirror the excellent lab test results. Our 100% monitor view revealed negligible loss of detail and texture all the way up to ISO 3200. Higher ISO values produce some grain effects, but we were still able to make out the woodgrain pattern in the artist's palette in our lab test scene at ISO 25 600. Our nighttime outdoor shots show great detail too, even at extremely high ISO settings, although color rendition falls off quite significantly under these conditions. Used with the Sony Sonnar T* FE 55mm f/1.8 ZA lens, the a7S produced extremely good detail and highly three-dimensional images at lower ISO sensitivities (see the red flower in the image opposite and on DVD for an example).

The Sony's dynamic range of almost 10 full f-stops puts it on a level with the Nikon D4s and the Canon EOS 5D Mark III. In fact, the a7S is only beaten by the a7R which, in the lab, recorded a dynamic range of 12 stops at its lowest sensitivity setting.

The a7S is not the fastest camera out there, and its contrast detection AF system recorded a relatively long focus lag of 0.4 seconds when tested with the 55mm Sony T* lens. The a7 entry-level model's hybrid AF system was significantly faster at 0.28 seconds. In this respect, the more obviously pro-grade Nikon D4s is still in a league of its own.

Conclusions

This latest camera in the a7 range is a useful addition, filling the gap between the simplicity of the basic a7 and the ultra-high resolution a7R with its own special low-light capabilities. This understated camera is the perfect choice for shooting in unpredictable conditions that demand high sensitivity in preference to perfect exposure. The results we produced using the a7S show plenty of detail and remain sufficiently natural-looking, even

at extremely high ISO settings. This capability gives you a great deal of freedom and, coupled with the camera's complex but intuitive interface, makes the a7S a highly customizable, pro-grade workhorse.

Such high-end capabilities don't come cheap, and the list price of US$2,500 for the body only make the 'S' the most expensive a7 so far. The a7 can be purchased for around US$2,000 with a 28-70mm kit zoom, so you will have to shoot a lot of highly prized night shots to make up the difference. (ssi) dt

Like all cameras we test, the a7S had to show its mettle based on images of our standardized lab test scene

ISO 100 ISO 1600 ISO 6400

Torsten Andreas Hoffmann

A Fresh Take On Travel Photography

The challenge of portraying a foreign country authentically is almost irresistible, because it gives photographers the opportunity to get off the beaten path, leave the tourists behind and discover the country for themselves. We will take India as an example of how important it is to look beyond stereotypical issues like the oppression of women by men, the caste system, poverty, corruption and traditions that should have been left behind long ago.

Reality is far more nuanced than that and our mission as photographers is to look deeper. It can be a fantastic adventure that helps people get past their prejudices and begin to think outside the box.

The most important thing is to travel on your own, not with a group, and to be on the road for as long as you possibly can. I also recommend not having a fixed itinerary but staying as flexible as possible about choosing your locations and destinations. If you try to see and photograph 'everything', you are doomed to disappointment; in a huge country like India, less is definitely more. Of course you have to prepare by informing yourself about the cultures and customs of a country but, once you are there, it is even more important to talk to as many people as you can and find out how they experience life. It's all about discerning and understanding their world view. This is quite possible in India, as English is widely used, together with Hindi, 15 other main languages and more than 300 indigenous languages. Once you get talking to people, you will realize how a country that is still affected by extreme poverty has the potential to spiritually enrich those of us from over-privileged countries – all you have to do is travel with an open-minded attitude and refrain from making hasty judgments.

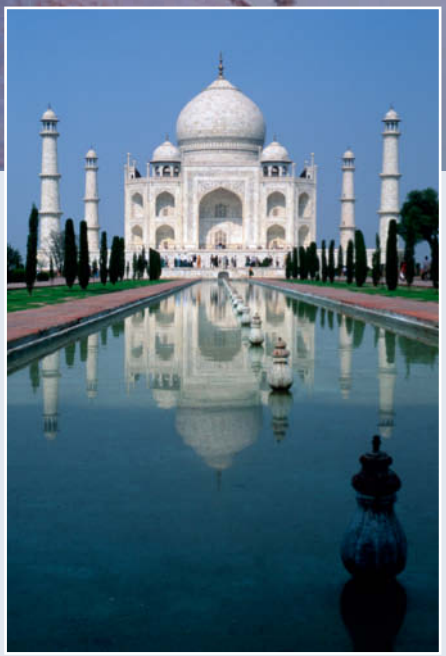
Travel guidebooks rarely recommend anything more than museums, historic places and palaces, none of which have much to do with the realities of daily life for most people in a developing country. Torsten Andreas Hoffmann's photos show how to create an authentic, imaginative portrait of a country in a way that is neither trite nor stale.

Presenting the Sights

Mass tourism often devalues the very places and sights it promotes, and makes it impossible for normal life to exist in those places. This does not mean you have to avoid world-famous locations like the Taj Mahal altogether, but it is extremely difficult to be creative when you are surrounded by endless busloads of tourists, and you'll probably end up with a standard snap much like the ones taken by millions of other visitors.

It pays to put some distance between yourself and a well-known monument to enable you to see it from a new point of view. In the case of the Taj Mahal, this is not particularly difficult, as the famous tomb is right next to a river and there are almost no tourists on the opposite bank. Look carefully and you will find similar opportunities near other famous places, where you are more likely to be able to compose a really good photo in relative peace and quiet than if you have to share your spot with a crowd.

Captured from behind the Taj Mahal where not many tourists go, this perspective is less familiar than the usual front-on view (below left). It was taken at dusk using a 28mm wide-angle lens, with the building shrouded in a haunting blue-violet haze.



It is difficult to take a bad photo of the Taj Mahal, but the best that can be said about most is that they are predictable. This image shows the view we see in most travel brochures. Beautiful indeed, but so familiar that we are tired of it.

Motion Blur as a Compositional Tool

The great masses of people in megacities like Mumbai and Delhi can make the urban environment feel overwhelming. The everyday chaos makes it difficult to create good compositions, so it is better to incorporate it in your photographs by immersing people and vehicles in motion blur. You'll need a tripod and – in daylight at least – a neutral density filter to reduce the amount of light entering the lens so that you can use long exposure times. In bright daylight, I recommend using a 6 or 10-stop ND filter. Use the lowest ISO setting your camera provides and switch off image stabilization so that it won't create unwanted vibrations during the exposure.

In these two images of Varanasi (left) and Mumbai (right), the blur of humanity takes on a watercolor-style look

If people are moving through your field of view, an exposure time of 0.5 s like the one used for the image at top left should be sufficient. If the people within the frame are moving toward you (top right) or away from you (main image), an exposure of 3-6 s is more appropriate.

Composing with Color

People who don't really understand photography are easily deceived into thinking that a successful photo provides a precise rendition of reality with accurate colors. However, this mindset is equivalent to saying that all that is required for a good concert is instruments that are in tune. The whole is more than the sum of the parts, and what really makes a concert experience memorable is the composition – in other words, the way each individual sound relates to all the others. It is the same with a photo: the individual elements and colors in an image have to harmonize in a way that makes the result an interesting whole. In India, already such a colorful place, the colors have to support the overall effect of each image. Whether the subject comes across powerfully or not depends on the photographer's compositional skill.

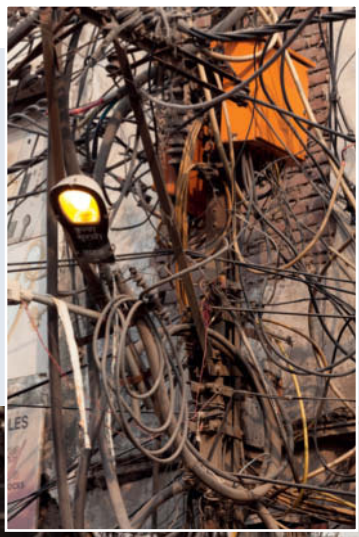
The vibrancy of this photograph of the old inner city of Varanasi comes from the contrast between the complementary colors blue and orange. The color of the fabric the woman is wearing matches the pedestal of the small temple and the tone-on-tone composition makes for a highly harmonious feel. An exposure time of 1.3 seconds provided the right compromise between motion blur and allowing us to see the outline of the woman as she moves through the scene.

Glowing colors are everywhere in India, including in its art world. Well-thought-out color photographs can deliberately use a limited range of tones to bring an image to life, as in this orange/red shot captured in an art gallery in Mumbai.

This image has a painterly quality, and the women in the foreground doing their laundry look like spots of color scattered across a canvas. The cyan, magenta, yellow and black colors dominate the color scheme, while the other colors blend in harmoniously. A graduated filter was used to even out the difference in brightness between the top and bottom halves of the image and make it more atmospheric.

Creation from Chaos

For people used to an orderly European or North American urban landscape, much of India seems chaotic – although this impression surely has a lot to do with differences in world views. Most Indians are devout Hindus and believe in reincarnation, so they do not care about living conditions in the here and now as much as Westerners do. In any case, most Indians are a lot more easygoing than Westerners and have a greater tolerance of circumstances that seem impossible to us – the ubiquitous, sometimes extreme, poverty, for example. The capacity of the entire culture to suffer is therefore an order of magnitude greater than in the West. To incorporate chaos in photographic images, you have to master the art of bringing order to visual disorder. However extreme the visual chaos, it is important to find a clear language of form and identify the rhythm created by the individual elements in a scene.



Westerners find the network of electric cables in Old Delhi hair-raising even without an electric shock.
In the image on the left, the viewer's eye is led through the chaos in the form of a triangle: we focus first on the lamp, then on the ocher-colored junction box in the top right-hand corner and finally the larger of the two snake-like cables.

Looking down a street in Old Delhi. Photographed using a 200mm lens, this image is almost symmetrical, with the rows of houses and the jumble of cables more or less the same on each side. This composition creates a sense of balance despite the apparent chaos.

The only way to capture the density of the crowd surrounding a suburban train arriving in Mumbai is from above. If your camera does not have an articulated monitor, simply use a wide-angle lens (in this case, a 17mm), hold the camera up as high as you can and simply guess the shooting angle.

Once out of the railway station, you will find the streets and sidewalks just as crowded and busy and subject to a constant game of survival of the fittest. The raised highway sweeping overhead is a key element in this composition, and its blackness appears to 'push' down from above into the mêlée.

Using motion blur is a great way to capture the whirl and swirl of the crowd at Victoria Station in Mumbai. An exposure time of 3.2 s effectively conveys the flowing movement without rendering the people invisible. This is another highly symmetrical composition.

Interpreting Religion and Rituals

India is famous for its many festivals and religious rituals, although these are not easy to photograph. Even using a telephoto lens, a photographer sticks out like a sore thumb at this kind of event.

India has long been a popular destination for those who have not found the spiritual satisfaction they were looking for in Western churches, although your first taste of India will probably make you wonder how this can be, since you will encounter so much that is hostile or damaging to humanity at every turn.

On the other hand, the age-old wisdom contained in literature like the Vedas and the Upanishads still provides a spiritual foundation for most of the people living there. Even if things look dire to an uninitiated visitor, many more people than in the West are in touch with worldly knowledge and a philosophy that provide spiritual sustenance during the grind of daily life. In India, a man can only become a guru (i.e., a spiritual teacher) if he practices what he teaches, and these teachings are often based on leading a simple life.

The image reproduced here was captured at the spiritual stronghold of Varanasi, where dozens of Hindu ceremonies take place in the evenings on the banks of the Ganges. Taking photos here is not a problem, as many Indians are there doing the very same thing.

Shooting RAW with a high-end camera makes it possible to achieve excellent image quality, even at ISO 3200 and using a 100mm lens in the semi-darkness.

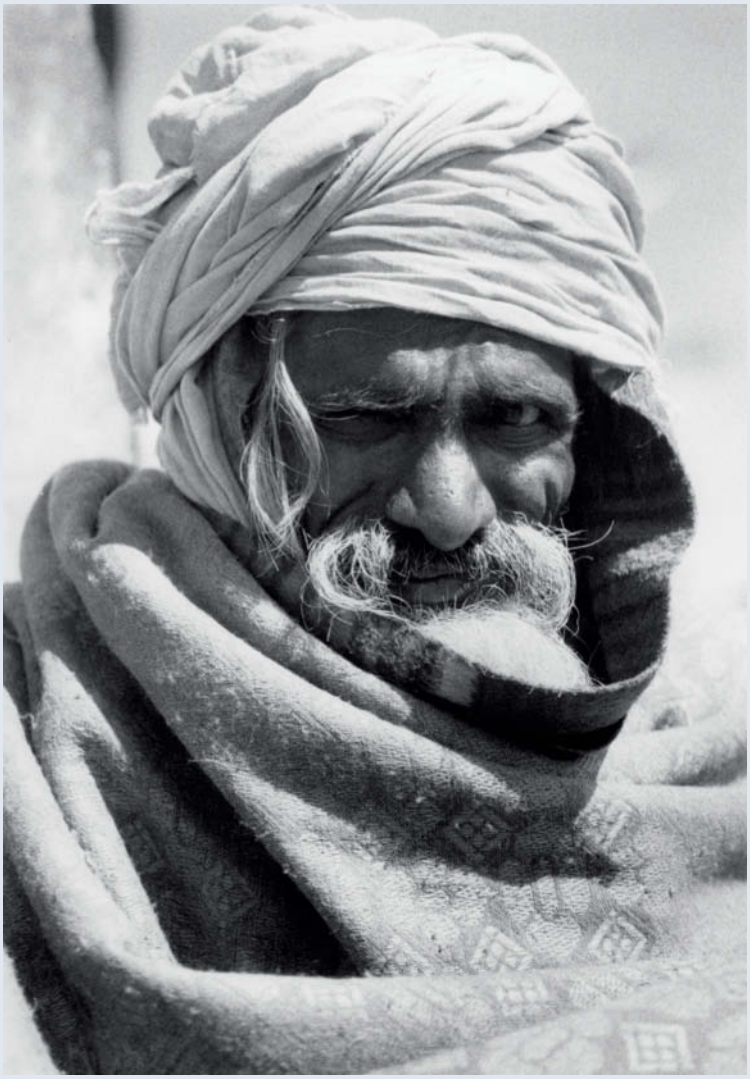
Portraying People

Most people consider a good portrait to be a well-lit representation of a smiling, young, dynamic face. However, this type of portrayal is often superficial, and representing a person artistically requires much more than just good lighting.

Each of us has a unique character, an inner self and a world view, and we all relate directly to our immediate environment. In an exotic country like India, people's faces are particularly expressive and therefore highly individual and distinct. To work in a meaningful way, a photographer has to be able to capture a person's unique characteristics and features and the way they have been shaped by their surroundings and way of life, emphasizing what makes them special.

Approaching someone you don't know and engaging them in conversation can often pave the way to being given permission to take photographs. If you ask unusual and personal questions, you can begin to understand life from a subject's point of view, although this is of course easier if you have an interpreter with you. Only take out your camera once you have spoken to your potential subject. Most Indians, particularly if they are Hindus, like having their photo taken and always appreciate it if you show them the result on the camera monitor.

I photographed this striking girl in a suburb of Mumbai near 'Bollywood'. Although she was only 14, her penetrating gaze seemed more like that of a grown woman, yet her arms and the plastic duck she is holding create a childlike, almost despondent impression.



This man, from the Toda tribe in southern India, lives near the city of Ooty. Photographed with a 100mm lens, this image shows how deeply he is rooted in a world that is profoundly different from ours.

Searching for Introspective Scenes

India is a truly multi-faceted country. While a tiny minority of extremely rich people living in huge cities enjoy the benefits of late-stage capitalism, most of India's billion or so citizens live in what appears to outsiders as alarming poverty. However, because we experience it in natural surroundings that are visually more appealing, poverty in rural areas appears different from poverty in the big cities. Nevertheless, the drift to the cities continues as millions of people leave their rural homes in the hope of making some money. Parents still sell their children into slavery in the cities.

A majority of India's population lives rurally and makes a living from agriculture. The amount of rice the country produces exceeds domestic demand, and India now exports rice all over the world. However, virtual slavery still exists in rural areas, as a handful of rich landowners exploit countless workers under inhumane conditions. Unionism is virtually unheard of, and the fatalistic Hindu world view and belief in reincarnation mean that most of the people being exploited have no concept of what it may mean to make an effort to alter their destiny.

Travelling as a photographer is difficult in rural areas and what little accommodation exists is extremely basic. One option is to hire a vehicle (car, motorcycle or bicycle) in a city and make short trips to your chosen locations. Whatever approach you take, your kit should include a robust photo backpack.

The early morning mist gives the sun's rays a magical look. Anthills are a common sight in rural areas and are seen as a symbol of the Hindu deity Shiva.

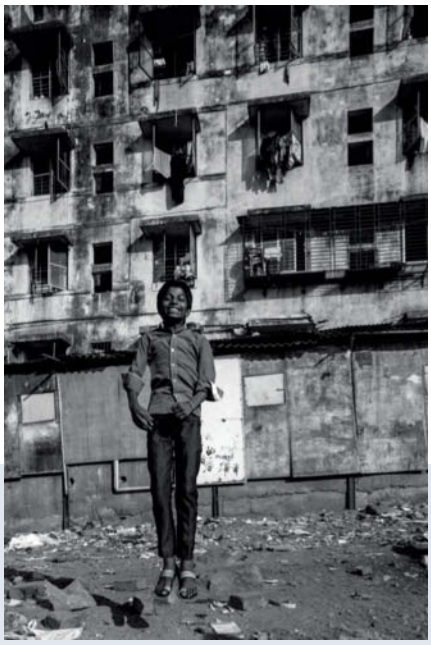
Captured using a 105mm lens on Ilford Delta 100.

As a Westerner taking photographs in India, you can expect a constant flow of people wanting to talk to you. This can actually be quite annoying and just such an interruption almost made me miss this shot of a sail being hoisted. Sometimes you simply have to concentrate on your work, even at the risk of being rude.

Taking Photographs in Slums

No accurate and authentic portrayal of India can exclude the slums in the major cities. It is estimated that exorbitant rents have forced more than 6 million people into the slums in Mumbai alone.

Don't venture into a slum without a local at your side; it's the only way to communicate with the residents and get to know them. Try to leave your preconceptions behind too. In tourist areas, you will often be targeted by beggars and probably also get ripped off by retailers, but this very rarely happens in the slums. On the other hand, you will instantly be surrounded by hordes of children all wanting to touch your tripod, your camera and especially your lens. It is difficult to stop them doing so, even with an interpreter on hand. However, most adult slum-dwellers are friendly and more than willing to talk about their life, and they are usually quite happy to have their photo taken.



This image was captured using a 28mm shift lens and an exposure time of 1/320 s. I converted it to black and white using Lightroom. Children in socially stressed areas have an irrepressible vitality; this boy was so delighted to have his photo taken that he jumped up in the air again and again.

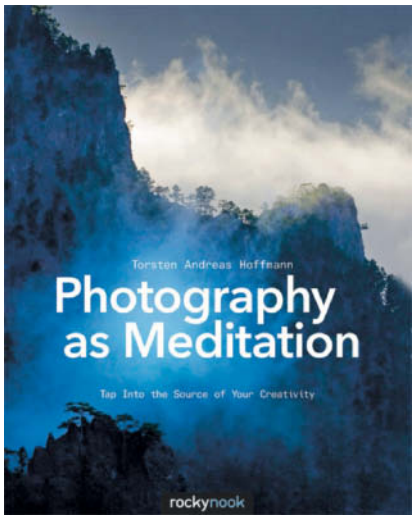
The lack of toilet facilities is a major problem in the slums of Mumbai. Residents relieve themselves in the open air or use one of a small number of public toilets, which are anything but hygienic. Nevertheless every household, however humble, has a television.

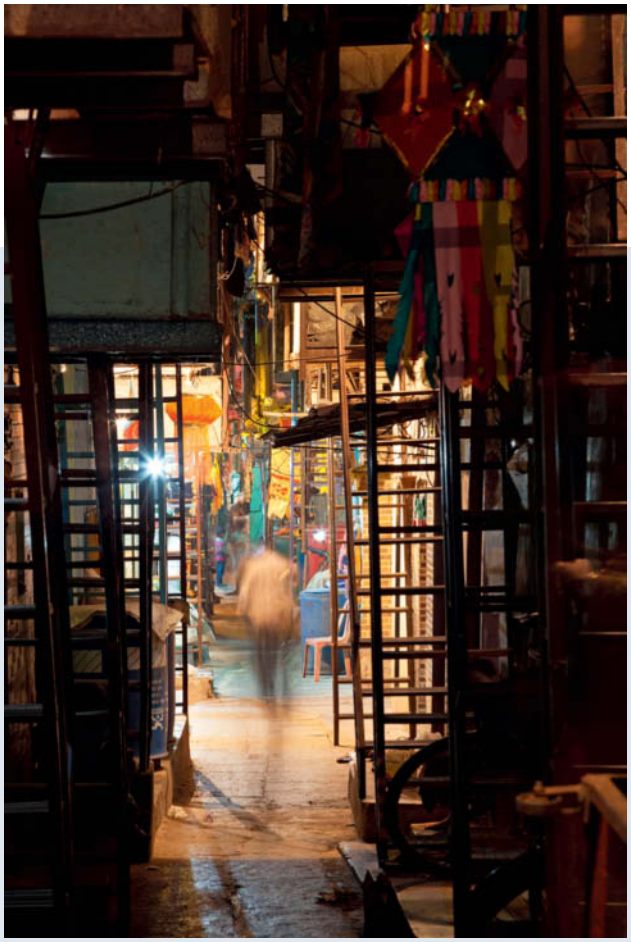
About the Author

Torsten Andreas Hoffmann was born in Düsseldorf, Germany in 1956 and studied art education, majoring in photography, at the Braunschweig University of Art. He has travelled as a photographer in India, Indonesia, Mexico, Nepal, Turkey, the USA, the Sahara and the United Arab Emirates. In 2013/14 he returned to India 20 years after his first visit.

His book *The Art of Black and White Photography* is now available in six languages and his latest book, *Photography as Meditation* is published by Rocky Nook, Los Angeles.

Hoffmann runs workshops and provides individualized coaching to help photographers develop their own style.





Dharavi in Mumbai is one of the largest slums in Asia. Tucked away in its labyrinth of tiny lanes, entire families live in a single room, often without windows. The ladders are for accessing the upper floors.

Thomas Hoffmann, Peter Nonhoff-Arps, Sophia Zimmermann

Trick Tripods

Although most photographers choose a conventional model for their main tripod, standard camera supports aren't always equal to the challenges presented by unusual shooting conditions. This is where specialized tripods and supports come in – we checked out some of the more unusual devices on offer and put them through their paces.

A conventional tripod is the right choice of camera support in hundreds of situations. However, there are almost as many shots for which you might wish you had something slightly different in your bag. For example, on a long hike in the mountains, a walking stick with a tripod thread built into its head will usually suffice, whereas on safari in an all-terrain vehicle, you will probably only have space for a window mount, although you are sure to need one that can support long lenses too. For bird's-eye view shots, you need either a ladder or some kind of extendable support that allows you to trigger the shutter remotely via Wi-Fi or using an infrared release. Conversely, macro shots are often captured close to the ground, where a conventional tripod is usually too bulky or not flexible enough. The following pages introduce some useful alternative camera supports and explain when and how to use them.

Manfrotto Pocket: A Constant Companion

Even compact tripods take up a fair amount of space in your photo bag, but the Manfrotto Pocket series aims to change all that. These tiny tripods fold up so small that you can leave them attached to your camera at all times, even when they are not in use. The smaller MP1 is designed for use with compact cameras, while the larger MP3 can be used with system cameras and even small DSLRs.

The all-metal Pocket models fit directly to the tripod thread on the base of your camera, and both models have slits that enable you to shift the center point if your camera's tripod thread is not located directly beneath the lens. The MP3's basic design is triangular, so you can shift your camera sideways or back and forth as necessary.

To set the tripods up, simply fold out the legs. The built-in spring mechanism ensures that they remain stable in any position, so you can iron out any unevenness in a surface using different positions for each leg.

Of course, the very short legs make these tripods suitable only for tabletop or wall-top use – perhaps for selfies or nighttime long exposures.

They are not particularly cheap, but offer a stable solution for a variety of situations and benefit from their extremely compact size.

Folded down, the Manfrotto Pocket tripods are small enough to leave attached to your camera. The MP3 is shown supporting the camera, and the smaller MP1 is shown in front.

MANFROTTO POCKET

Model	MP1	MP3
Manufacturer	Manfrotto	
Suitable for	Compacts	Lighter system cameras
Max. load	1.3 lb (0.6 kg)	3.3 lb (1.5 kg)
Max. height	0.8" (2.1 cm)	1.6" (4 cm)
Weight	1 oz (0.03 kg)	2.5 oz (0.07 kg)
Price	US$20	US$30

Beanbags Fit any Camera and Work on any Surface

The tried and trusted beanbag solution has a lot of competition these days in the form of compact and universal tripods. Nevertheless, this simple idea still has many devotees, especially among nature photographers, who appreciate its low stance and flexibility. Nowadays, instead of rice or beans, beanbags are usually filled with plastic beads contained in a separate plastic lining.

If you are heading off on vacation, you can save baggage weight by emptying your beanbag(s) and taking a variety of resealable plastic bag liners with you that you can then fill with cheap beans or rice from a local supermarket when you arrive.

Beanbags are perfect for supporting all sizes of cameras and lenses on tree branches, railings or perched on the top edge of an open car window. Omnipod beanbags are available in a variety of sizes and colors.

Beanbags are a widely-used alternative travel tripod and can be used on any type of surface

OMNIPOD BEANBAG

Model	Camo-Pro7
Manufacturer	Omnipod
Anwendung	DSLR, long lenses
Packmaß	11 × 7 × 2.5 inches
Weight	3.5 lb (1.6 kg), ships filled
Price	US$35

The Novoflex Survival Kit: Compact and Versatile

The term 'survival kit' is usually associated with natural disasters or other undesirable events. The Novoflex Survival Kit, however is a really useful tool for use in a wide variety of situations.

The kit comes in a bag that is about the size of half a letter-size sheet of paper and includes a stable mini ball-head tripod, an extension rod, a suction cup, a ground spike, a plastic clamp and a Uniklem42 clamp.

The robust components enable you to affix a compact or small system camera to just about any kind of surface, although you are sure to find that some are more useful than others in the course of your daily photo workflow.

The street price of around US$165 is quite expensive, but the individual components are well-made and should stand up to many years of use.

The Novoflex Survival Kit is a potpourri of useful accessories for stabilizing your camera on a variety of surfaces

NOVOFLEX SURVIVAL KIT

Novoflex Survival Kit	
Manufacturer	Novoflex
Suitable for	Compacts, system cameras
Weight	1.3 lb (600 g)
Price	US$165

Berlebach Mini Tripod: Perfect for Macro Shots

The Berlebach brand is widely known for its beautiful ash-wood tripods. The German manufacturer has been making these unmistakable devices for more than a hundred years, although the mini model shown here has only been available for a little over a year. This particular model is designed specifically with macro applications in mind.

Its variable-length legs can be spread via five click stops and raised to 100 degrees (i.e., above horizontal). This makes the mini a highly flexible tool for use close to the ground. The built-in leveling ball makes an additional ball head unnecessary in most situations.

This is an extremely attractive and stable unit and is worth every penny.

The Berlebach Mini is a useful tool for shooting close to the ground, with legs that can be spread and raised more than 90 degrees

BERLEBACH MINI

Model	Mini with Leveling Ball
Manufacturer	Berlebach
Suitable for	Macro photography
Size folded	11.4″ (29 cm)
Height	4.0-15.7″ (10-40 cm)
Weight	2 lb (900 g)
Max. load	17.6 lb (8 kg)
Price	US$293

Feisol Bicycle Mount: Ideal for Action Fans

The Feisol BM-254 bicycle mount fits to handlebars with a diameter of up to 1″ (25.4 mm) and supports all types of cameras, including even heavy DSLRs. The larger B-318 model fits tubes of up to 1.25″ (31.8 mm) diameter. The supports are made of machined aluminum and both models include a set of Allen keys and 1/4″ and 3/8″ tripod adapters.

Compact cameras with a depth of up to 2.4″ (6 cm) can be attached directly to the BM-254, but all other cameras require the use of an additional tripod head. We tested the CB-40D ball head, which appeared to be just as solid and well made as the BM-254 baseplate.

Note that this device has no damping mechanism whatsoever, so any bumps and shocks that occur during a ride are transmitted more or less directly to the camera. This might not be an ideal application for your cherished high-end DSLR!

The Feisol bicycle mount is perfect for capturing photos and videos of your two-wheeled adventures

Berlebach Car Window Mounts: No More Camera Shake on Safari

These Berlebach mounts are specially designed for use with open car windows and are available in two sizes. The smaller model offers a base plate that measures 3.15×3.94″ (8×10 cm), while the larger one measures 5.9×11″ (15×28 cm). The large one has two holes for the fixing screw, which you can also use to attach a ball head or other standard-threaded accessory. The base plate itself can be tilted from -10 to +90 degrees.

When using the large model, you can produce a stable base simply by resting your camera on the base plate without actually affixing it.

The car window mounts from Berlebach are a great aid to capturing shake-free wildlife images when you are on safari

The surfaces of the wooden clamp are rubberized to prevent damage to the car window. Take care if your vehicle has curved windows, as tightening the clamp could break them.

GorillaPod: Ultimate Flexibility

Each of a GorillaPod's legs consist of 10 separate ball joints that can be swiveled and bent in any direction and hold their position once they have been moved into place. Each joint and the foot of each leg is rubberized to prevent slippage and to protect the surface of whatever you are wrapping your GorillaPod around. We found that the system is stable enough to firmly support compact and system cameras weighing up to 2.2 lb (1 kg). Larger GorillaPod models are available that support up to 11 lb (5 kg).

You can attach your camera to the built-in ball head using an adapter plate, and a built-in level helps to keep your subject properly aligned. Good ideas always have their imitators, and there are similar tripods available more cheaply from other manufacturers. If you do opt for one of these, make sure that the legs really do stay put in tricky conditions the way the original Joby design does.

The Joby Gorillapod can be attached to trees, fences, rocks, lampposts and just about anything else you can find, transforming the entire world into a camera support

FEISOL BM-254/CB-40D

Model	BM-254 and CB-40D
Manufacturer	Feisol
Suitable for	all cameras
Max. load	17.6 lb (8 kg)
Max. height	3.1″ (8 cm)
Weight	12 oz (340 g)
Price	US$39 (US$169 with CB-40D)

BERLEBACH CAR WINDOW MOUNT

Model	small	large
Manufacturer	Berlebach	
Suitable for	all cameras	all cameras
Max. load	22 lb (10 kg)	22 lb (10 kg)
Max. height	3.1″ (8 cm)	3.1″ (8 cm)
Weight	0.93 lb (419 g)	2 lb (920 g)
Price	US$86	US$120

JOBY GORILLAPOD HYBRID

Joby GorillaPod Hybrid	
Manufacturer	Joby
Suitable for	Compacts and system cameras
Max. load	up to 2.2 lb (1 kg)
Max. extension	10.2″ (26 cm)
Weight	6.4 oz (181 g)
Price	US$27

Novoflex Patron: Emergency Support and Umbrella in One

This clever device looks like a conventional umbrella but, on closer inspection, has a tripod thread and a telescopic extension mechanism hidden under a cap on its handle. There are various ways to use the Patron. Folded down with the umbrella in its case, it can be used as a conventional monopod with a maximum height of 45" and stability that is suitable for use with compact cameras. If you want to use it as a "selfie stick", you need to attach an additional ball head (Novoflex models start at around US$40). There is also a set of custom 80×80 cm reflector foils available that you can attach to the umbrella to create sunlight, silver, gold, white and black reflector and light shaping effects.

The most unusual application for the Patron is as an emergency camera support. This requires turning the umbrella itself inside out, which is actually quite hard work! The result is a usable but not particularly stable support that might just help you out if all other options fail. Check out the manufacturer's video at http://www.youtube.com/watch?feature=player_embedded&v=U-uKHYn2CrE for an impressive demonstration of its accessories and other capabilities.

NOVOFLEX PATRON

Novoflex Patron Umbrella	
Manufacturer	Novoflex
Suitable for	Compacts, light system cameras
Max. load	no data available
Max. extension	30-45.7" (78-116 cm)
Weight	19 oz (535 g) with case
Price	US$170 (basic umbrella kit only)

The Novoflex Patron protects you from sun and rain, acts as a mobile changing room, reflector or blind and, last but not least, as a camera support. This is the Swiss Army knife of the photo accessory world.

LEKI Photosystem: Combined Hiking Stick and Monopod

At a first glance, this LEKI hiking stick doesn't appear to have any photographic functionality. Our test model was painted in a racy combination of black, red and white and had an ergonomically formed grip that made it a pleasure to hold. The stick can be extended up to 59" using the two built-in "SpeedLocks" that replace the more conventional twist locks found in most hiking sticks. Folded down, the LEKI is just 27" inches long and is easy to carry attached to a backpack.

The built-in tripod thread is located beneath the knob at the top of the 'Aergon' grip, which you have to remove to gain access to it. Although the screw mechanism in our test model was of poor quality and jammed easily, the plastic Aergon Photo Adapter (available separately), seems quite robust.

The manufacturer doesn't provide any data regarding the stick's maximum load, so you will simply have to see what works if you decide to go ahead and purchase one. We tested it with a fairly heavy mid-range DSLR and felt that the device was just about up to the job, although it wasn't, of course, as stable as a multi-leg support. The LEKI is, however, great for use with all types of compact and small system cameras, with which you can safely shoot at long exposure times without risking camera shake. Overall, this is a useful extra support but is not suitable for regular photographic use.

The LEKI Photosystem is a robust hiking stick and a useful monopod in one. With a maximum length of 59", it can be used to capture overhead shots too.

LEKI PHOTOSYSTEM ALU

LEKI Photosystem Alu	
Manufacturer	LEKI
Suitable for	Compacts, lighter system cameras
Max. load	no data available
Max. extension	27-59" (70-150 cm)
Weight	11.4 oz (323 g)
Price	US$130

Berlebach Camouflage Tripod

Wildlife photographers often spend hours, or even days, waiting for the right moment to release the shutter and capture a long-awaited shot – perhaps of a young fox leaving its den for the first time or eagle chicks hatching.

Such conditions often require the use of extremely long lenses with focal lengths of 500 mm or more and, together with a pro-grade camera, can weigh several kilos. Long lenses also require a stable and vibration-free support if the results are to turn out sharp, and this is where the Berlebach camouflage tripod comes into play.

This model has the usual solid wooden legs and metal locks that we have come to expect from Berlebach, and weighs 11 lb. The legs have four click stops and allow the unit to be lowered to a minimum of 9" for ground-level work. The manufacturer quotes a 110lb (50kg) maximum load, while maximum height is limited to 40" to make working in a sitting position easier. The custom leveling unit (required) allows you to attach your favorite head.

BERLEBACH CAMOUFLAGE

Model	Camouflage Tripod
Manufacturer	Berlebach
Suitable for	wildlife photography
Size folded	29" (73 cm)
Height	9-40" (22-101 cm)
Weight	11 lb (5 kg)
Max. load	110 lb (50 kg)
Price	US$690 + US$170 (leveling unit)

The Berlebach camouflage tripod is designed for wildlife photographers who spend a lot of time shooting from blinds. Used with a suitably robust head such as the Novoflex CB5 shown here, it supports even the heaviest cameras and lenses.

Gitzo Mountaineer Set: High-end Lightweight

The Gitzo Mountaineer GK1542-80QD is a high-end universal tripod/ball-head set with a wide range of useful features. The three-piece legs and center column are made of carbon fiber, so the tripod alone weighs just 2.8 lb and the head an additional 1.1 lb. In spite of its light weight, the Mountaineer is extremely stable. The Magnesium-alloy head is also light but extremely robust. With the center column lowered, the 57" (145cm) tripod can support up to 22 lb shake-free.

The center column can be reversed and the head can be attached directly to the leg assembly (without the column) for ground-level shooting if necessary.

The textured surfaces make it easy to grip and great to look at and the only real drawback is the price. However you look at it, US$1,000 is a lot of money and makes this fantastic tool one for the pros or extremely keen amateurs.

GITZO MOUNTAINEER SET

Model	GK1542-80QD
Manufacturer	Gitzo
Suitable for	universal use
Size folded	25.6" (65 cm)
Max. extension	67" (170 cm)
Weight	4 lb (1.8 kg)
Max. load	22 lb (10 kg)
Price	US$1,000

The Gitzo Mountaineer is a luxury universal tripod with a comprehensive feature set and a price to match

Novoflex Quadropod: Four Legs for Increased Stability

It is said that a table with three legs never wobbles, and the same can be said of most tripods. Nevertheless, in the name of increased stability, Novoflex has developed the Quadropod support system. The main advantage of an extra leg is that it can carry more weight, and the Quadropod can support up to 88 lb (40 kg) of gear. Anyone who has ever been camping knows how tricky it can be to get a four-legged table properly level, and the Quadropod requires the same "first three legs and then the fourth" approach to get it set up. There is a video of how to do this available at http://www.youtube.com/watch?feature=player_embedded&v=QkvK5IlBRpI if you need help.

The Quadropod itself consists of just the basic support to which you can attach various lengths and weights of legs and a variety of heads. The legs can be angled steplessly and can be used in any combination of lengths (two long and two short, for example), making this a truly flexible system. Other accessories enable you to convert the base unit into a car-window or suction-cup support and you can use the leg threads to attach other accessories, such as a gooseneck flash support or the Patron multi-purpose umbrella described on page 76.

NOVOFLEX QUADROPOD	
Model	**Quadropod QP B/A2840 legs**
Manufacturer	Novoflex
Suitable for	heavy gear
Max. load	88 lb (40 kg)
Max. extension	61" (155 cm)
Weight	6.6 lb (2.99 kg)
Price	US$570 (base unit)+US$276 (four-section aluminum legs)

The four-legged Quadropod looks unusual but, when coupled with a robust head, offers an extremely flexible heavy-duty photographic support system

Manfrotto 190: Acrobatic Center Column

The unique feature of the Manfrotto MT190XPRO3 is its center column, which can be rotated and locked in a 90-degree horizontal position using an easy-to-use built-in mechanism that enables you to reposition the column without having to remove it first. The only drawback is that if you accidentally rotate the column while repositioning it, it can take a moment to find the correct position when it comes to returning it to its original vertical position. In spite of its flaws, the system is solidly built and makes the 190 a useful universal and macro photography tool.

The 190 series is available in a number of different configurations, with three- or four-section legs made of aluminum or carbon fiber, and in sets with various tilt/swivel or ball heads.

MANFROTTO 190	
Model	**MT190XPRO3**
Manufacturer	Manfrotto
Suitable for	universal use
Size folded	23.2" (59 cm)
Max. extension	63" (160 cm)
Weight	4.4 lb (2 kg)
Max. load	15.4 lb (7 kg)
Price	US$220 (with 3-section legs)

The 90-degree tiltable center column makes the MT190XPRO3 ideal for universal and macro photographers

UNI-LOC Major: Low-level Outdoor Specialist

UNI-LOC tripods are hand made in Bovingdon in southern England. They are quite bulky (the MASYS1220 model we tested weighs 8.4 lb and measures 29 inches folded down), so they are not particularly well suited to use on long trekking tours.

However, they have a number of unique features. The most obvious of these is the large metal lever located on the side of the base unit which enables you to release the central lock and position the legs and center column however you like. The system takes a little getting used to but once you have learned how it behaves, it is quick and simple to set up.

The legs in our test model extend to a maximum of 58 inches and other models are available with a maximum extension of up to 98 inches (2.5 m).

Used with an additional macro rail and a ball head, these tripods are perfect for low-level macro use. The end of the center column can be hinged up to 180 degrees for added flexibility and the column itself can be tilted independently of the central leg lock, enabling you to fine-tune the position of your camera once you have found a stable position for the legs.

The downside of all this flexibility is that the head of the center column can actually end up protruding beyond the solid base formed by the legs, thus causing unwanted vibrations due to the camera's mirror movements or if you knock the assembly accidentally. (pen)

UNI-LOC MAJOR SYSTEM

Model	MASYS1220
Manufacturer	Envoy UNI-LOC
URL	www.uniloctripod.com
Suitable for	DSLR and macro use
Size folded	29" (73 cm)
Max. extension	58" (147 cm)
Weight	8.4 lb (3.8 kg)
Price	US$389

The Uni-Loc Major System is designed specifically for low-level shooting under tricky conditions. The downside of this extremely flexible system is its weight.

Michael Jordan

Handheld Light Meters

Better than in-camera metering?

Every digital camera has a sophisticated built-in light meter. In spite of this, manufacturers such as Gossen and Sekonic still make dedicated light meters for situations in which a manual approach offers distinct advantages over camera-based metering. This article tells you all about when and how to use a dedicated meter and details the features built into 12 current models.

Technological progress has given rise to all sorts of all-in-one devices, including fax/scanner/photocopier/printers and portable telephone/gaming/multimedia/photo computers (i.e., smartphones). Cameras with built-in light meters, too, represent a combination of devices that started life as separate, dedicated machines. Multifunction devices save space and money and are often easier to use than multiple dedicated devices, which is why they have found their way into so many aspects of our lives. Nevertheless, handheld light meters are still being manufactured and find use in a wide range of situations. This article investigates whether this is due simply to nostalgia on the part of users or whether there are still conclusive arguments for using a separate light meter.

For a long time, using a dedicated light meter was the only way to be sure of capturing correctly exposed photos, and built-in light meters only began to appear in SLR cameras in the late 1960s. Professional large-format cameras still rely on separate light meters. Because the analog photo capture process offers no easy way to judge results immediately after shooting, light meters offer a reliable way to assess and set up exposures. In analog photography, Polaroid cameras and backs were the only way to produce real-time test photos but, as well as being expensive to use, these were not available for all types and brands of camera. As a result, dedicated light meters were long the most professional way to meter photographic exposures.

Through-the-lens Metering

The invention of built-in light meters made it possible to meter an exposure through the camera's lens. This system not only accurately assesses the amount of light reflected or produced by the subject, it also compensates automatically for any loss of light caused by imperfections in the camera's optics or the use of accessories such as filters or macro bellows that alter the effectiveness of the transmission of photons along the light path.

Most built-in light meters are so sophisticated that they cover virtually all the

A typical metering settings menu – in this case, the one from the Canon EOS 70D

For subjects with patchy distribution of brightness – in this case, with more dark than light tones – spot metering delivers the best results and also prevents overexposure and burned-out highlights.

All photos captured at ISO 100 and f1.8 using a Canon EOS 5D MK III with an EF 85mm f/1.8 USM lens. The handheld light meter calculated a brighter exposure with an exposure time of 1/1600 s.

bases in most people's everyday photo workflow and obviate the need for a dedicated light meter. Nevertheless, many photographers still prefer to use a handheld meter. Are there technical reasons for using supposedly 'old' technology, or do photographers simply prefer to trust the techniques they know?

Because it is impossible to tell how the photographer metered a subject by looking at an image, we decided to check the differences between built-in and handheld light meters for ourselves.

Camera Metering Modes

Most DSLRs offer a range of metering modes, all of which meter directly using through-the-lens (TTL) technology. This approach automatically compensates for the use of filters, close-up bellows and other accessories that alter the amount of light entering the lens.

Metering options vary from manufacturer to manufacturer and model to model, but the most commonly found methods are 'matrix', 'evaluative', 'center-weighted', 'spot' and 'partial'. The main differences between these methods is the size of the portion of the frame they meter and, if the method in use meters multiple areas, the weighting of these in relation to one another.

Evaluative metering assesses the light reaching the entire frame and calculates an appropriately averaged exposure value. This method usually produces perfectly good results for subjects that show a balanced distribution of brightness.

Center-weighted metering is similar to matrix metering (see the next page) but assumes that the most important element of the composition is to be found in the center of the frame and weights the averaged exposure value accordingly. This was the metering method most widely used by analog photographers in the 1980s and 1990s, and cameras at the time used algorithms that apportioned between 60 and 80 per cent of the metered exposure value to the center of the frame. This method is most useful when the subject is obviously central and contrasts distinctly with its surroundings.

If you don't want to meter for the entire frame, you can use either **selective** or **spot metering**. Selective metering covers an area of about 6 per cent in the center of the frame and simply ignores the details contained in the rest of the image area. Spot metering assesses an even smaller area that covers about 1.5 per cent of the frame. These two methods are most useful in situations in which

Using through-the-lens (TTL) metering to measure reflected light, our frame-filling test shot of a light-colored object turned out too dark (above left), while the darker object ended up too bright (above right). Metering the incident light produced more realistic-looking results (below left and right). The difference between the metered value of f22.6 and our setting of f22 compensated nicely for the loss of light produced by the long subject-to-focal-plane distance demanded by our close-up.

These images were captured at ISO 100 and f22 using a Canon EOS 5D MK III with an EF 85mm f/1.8 USM lens and 36, 20 and 12mm extension tubes

the subject is relatively small in relation to the image area and displays strong contrast with its surroundings.

You can, of course, use selective and spot metering for any subject, but the smaller the portion of the frame you meter, the greater the risk that the metered area lies outside the subject area and that the resulting exposure value will be inappropriate for the situation at hand. Some cameras allow you to couple spot metering with the active AF area, which makes metering correctly much simpler for non-central subjects.

The most sophisticated method offered by most DSLRs is **matrix metering**, which combines metering results from multiple areas within the frame to produce an optimized overall exposure value. Camera manufacturers are reluctant to explain how their metering algorithms work, although some claim that this method evaluates exposure values for thousands of known subjects, enabling the camera to 'recognize' the subject and select appropriate settings. Matrix metering is usually highly reliable and is the default method used by many cameras' automatic and 'creative' exposure modes.

Reflected or Incident Light?

To meter an exposure, you can measure either the light reflected by the subject or the incident light reaching it. Reflected light can be metered using all the methods described above. If you use your camera's built-in meter to measure the light reflected first by a light-colored object and then by a darker object (see the example at the foot of the previous page) while keeping the lighting the same, you will produce different results for each subject. The camera will calculate a brighter exposure for the darker subject and a darker one for the lighter subject, resulting in two images that both display mid-range tonal values.

To measure the incident light, a light meter has to be positioned close to the subject and pointed toward the light source. It makes no difference to the meter whether the subject itself is dark or light and it will produce only a single meter reading, regardless of the distribution of tonal values in the subject.

The results of incident and reflected light metering for a subject with evenly distributed tonal values will be similar. A balanced distribution of tonal values produces an average value that is equivalent to medium gray. This does not, however mean that the tonal values themselves have to be evenly distributed throughout the frame – an image that contains a few extremely bright spots but many slightly darker areas will produce the same average tonal value as an evenly lit image.

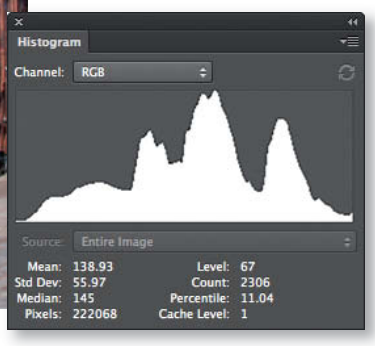
The Photoshop Filter > Blur > Average command is a great tool for training your perception of average tonal values. Selecting this command averages the individual channels in the image. If you then desaturate an averaged image using the Image > Adjustments > Hue/Saturation tool, the result will show the average grayscale value contained in it.

Most handheld light meters have an angle of view of 20-30 degrees. Some are also supplied with adapters that enable you to narrow the angle to between 7.5 and 15 degrees when you are metering reflected light. These adapters usually have a built-in viewfinder to enable you to meter for a specific detail in your subject.

Mean values
R: 129
G: 134
B: 153

Average:
RGB: 139

As a comparison:
RGB 128 (medium gray)



The tonal values are distributed fairly evenly in this image, and the average RGB value is a medium blue tone. It is even easier to evaluate the distribution of brightness in an image if you desaturate it or convert it to grayscale values.

If this angle of view still isn't narrow enough for your purposes, you need to use a handheld spot meter with a built-in viewfinder and an angle of view of one degree or less. Unlike a camera, in which the angle of view of the built-in spot meter changes when you swap lenses, the angle of view of a handheld spot meter remains constant.

To use a handheld spot meter, all you have to do is hold it up to your eye and aim the viewfinder at the detail you wish to meter for. The view is similar to the one through a camera viewfinder, with the addition of a marking that indicates the one-degree sector that is being metered. The meter's viewfinder usually also contains a readout that indicates the appropriate exposure values for your subject. Advanced black-and-white photographers often use handheld spot meters to expose their images in accordance with the well-known zone system of tonal distribution.

The spot meters built into most full-frame DSLRs cover about 1.5 per cent of the 24×36mm frame, although the angle of view varies according to the type of lens you are using. For example, when used with a 200mm lens with an angle of view of 10 degrees, the built-in spot meter covers the same area as a handheld spot meter, while longer lenses cover smaller and therefore more precisely definable areas. The converse is also true, and the camera's spot meter will cover an angle of view of about four degrees when used with a standard 50mm lens, 7.4 degrees with a 24mm lens and 10.4 degrees with a 14mm wide-angle.

The Advantages of a Handheld Meter

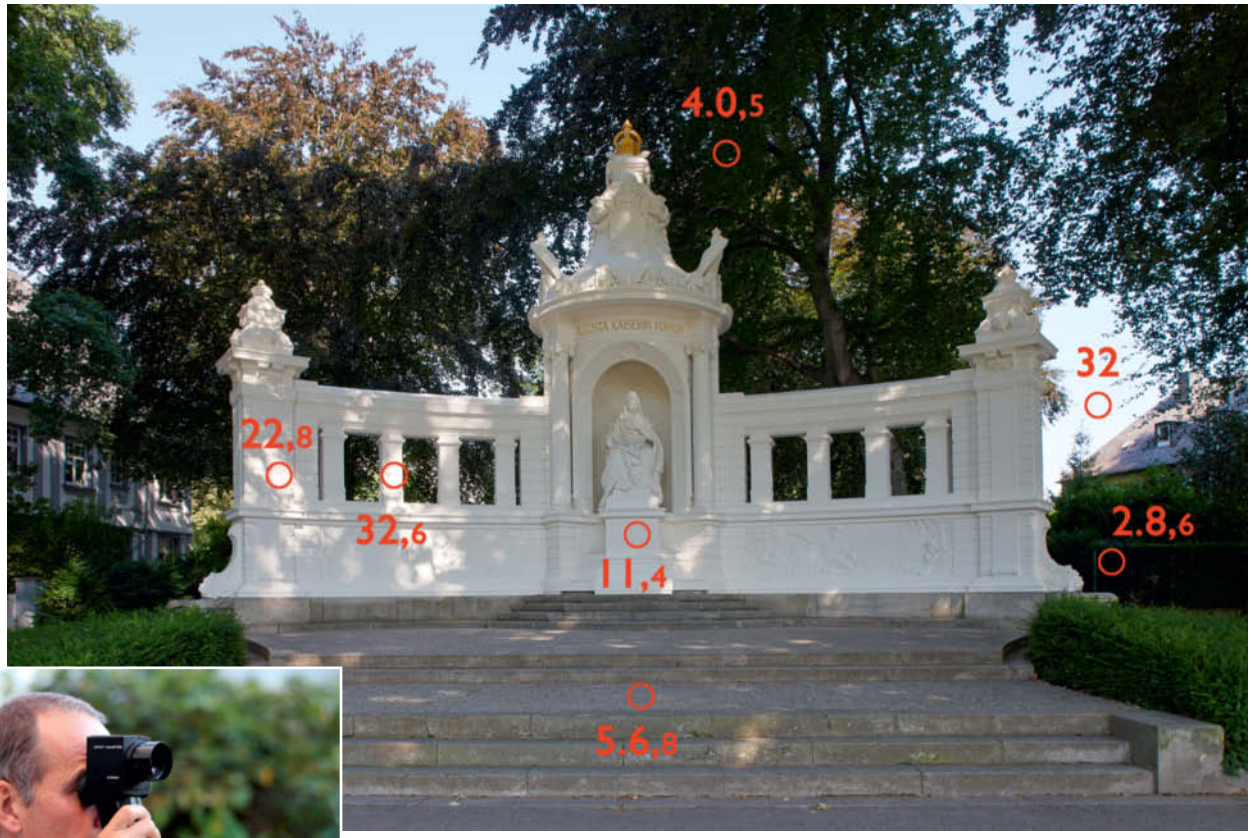
While built-in exposure meters are designed to measure continuous light sources, dedicated meters are often also capable of metering short-duration flash light. Some can even meter both.

A separate handheld flash exposure meter is an indispensable investment for any serious studio photographer, saving the time and effort involved in making multiple test shots for each setup. In studio situations, the meter is used to measure the overall light levels and the light produced by the individual flash units, thus enabling the photographer to balance all the light sources involved.

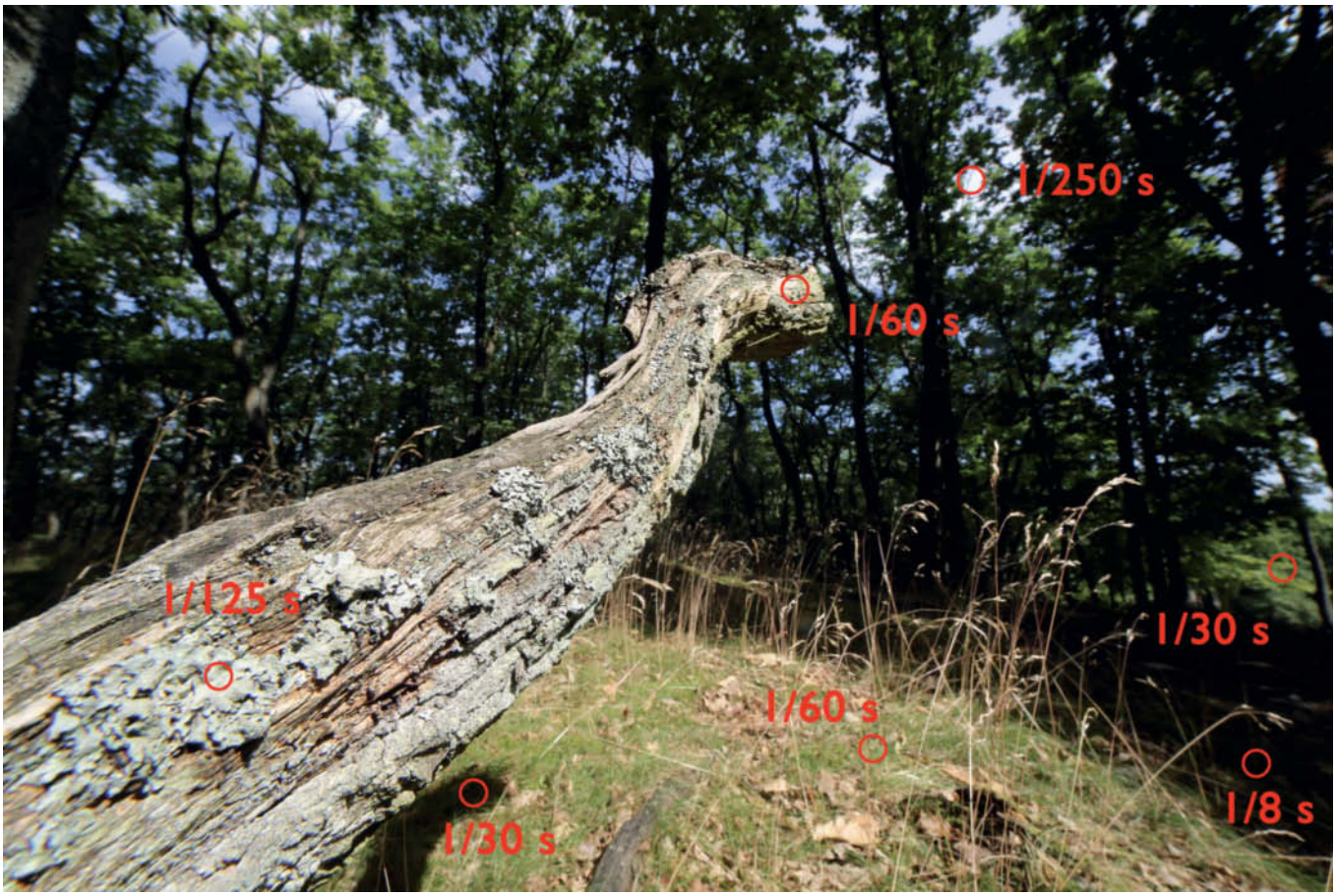
A powerful handheld exposure meter is essential if you want to use light sources with differing maximum output to evenly light a large surface or an entire room.

Flash exposure meters are usually attached to flash units using a dedicated cable, and a test flash is triggered by pressing a button on the meter itself. This is the preferred method for smaller setups in which the subject is positioned no more than two or three meters away from the flash or if you are working on your own.

You can also meter flash 'wirelessly' by triggering the flash manually once your flash meter is in place, which is a more practical approach if you are working with an assistant or over longer flash-to-subject distances.



A handheld spot meter can be used to precisely determine the distribution of tonal values within a subject. The Gossen Spot-Master shown here (now superseded by the Mavo-Spot model) is often used to meter exposure for traditional black-and-white photography according to the tenets of the zone system. The illustration shows the spot meter readings for various zones in the subject.



This scene has a wide range of light and dark areas and we used a Minolta light meter to assess the exposure times necessary for each. The values we measured vary from 1/250 s for the brightest to 1/8 s for the darkest part of the frame.

A handheld light meter enables you to set up a shot without having to make multiple test shots, thus saving a lot of time and effort

Light meters display exposure time, aperture and ISO setting data. Practically speaking, it is usually simplest to set a fixed ISO value before metering and to use your meter to calculate appropriate combinations of exposure times and apertures. Most light meters also allow you to select a specific exposure time or aperture in advance and, once you have taken a reading, you can shift your original value if necessary. If you do adjust your value, the other value indicated by the meter will be adjusted automatically to suit.

If you are metering flash, the exposure time should be preset to match your camera's flash sync speed. If you are shooting landscapes using a tripod, it makes more sense to preset the aperture, as depth of field is the more important exposure parameter in such situations.

If you are using a filter, you can also program an appropriate correction factor into your meter. As previously mentioned, the TTL light meters built into most cameras compensate automatically when you use filters and other accessories.

Market Overview

Light meters are available with a range of functions at various price points. The current market leaders for pro and semi-pro devices are Gossen, Sekonic and Kenko. Following Sony's takeover of Konica/Minolta in 2008, Kenko has continued to manufacture Minolta light meters under its own brand. A cheap alternative to all these dedicated devices is a light meter app that transforms your smartphone into a reflected light meter (see the box on the next page).

Gossen currently offers a range of six different models, starting with the value Digisix 2, designed to meter continuous light sources at a price of about US$160. The top-of-the-range Starlite 2 costs around US$700 and offers a greater metering range as well as continuous light, spot and flash metering functionality. The mid-range

HANDHELD LIGHT METER OVERVIEW

Model	Digisix 2	Digiflash 2	Sixtomat F2	Digipro F2	DIGISKY	Starlite 2	Auto Digi Meter KFM-1100	Flash Meter KFM-2200	L-208	L-308S	L-478DR Litemaster Pro	L-758 DigitalMaster
												
Manufacturer	Gossen	Gossen	Gossen	Gossen	Gossen	Gossen	Kenko	Kenko	Sekonic	Sekonic	Sekonic	Sekonic
Incident metering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reflective metering	✓	✓	✓	✓	✓	✓	✓ (without diffuser)	✓ (Spot metering)	✓	✓	✓	✓
Angle of view	25°	25°	25°	25°	20°	1°, 5°		1,4°	33°	40°		1°
Range in continuous light	1/2000 s to 4 min	1/2000 s to 4 min	1/8000 s to 60 min	1/8000 s to 60 min	1/8000 s to 60 min	1/8000 s to 60 min	1/8000 s to 30 min	1/16 000 s to 30 min	1/8000 s to 30 min	1/8000 s to 1 min	1/8000 s to 30 min	1/8000 s to 30 min
Range at ISO 100	EV 0 to +18	EV 0 to +18	EV -2.5 to +18	EV -2.5 to +18	EV -2.5 to +18	EV -2.0 to +18	EV -2.0 to +19.9	EV -2.0 to +19.9	EV +3 to +17	EV 0 to +19.9	EV -2.0 to +22.9	EV -2.0 to +22.9
Flash metering	–	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	✓
Sync speed	not applicable	1-1/500 s	1-1/1000 s	1-1/1000 s	1-1/1000 s	1-1/1000 s	1-1/1000 s	30 min to 1/1000 s	not applicable	1-1/500 s	1/80 s, 1/90 s, 1/100 s, 1/200 s, 1/400 s	1/80 s, 1/90 s, 1/100 s, 1/200 s, 1/400 s
Street Price	US$160	US$200	US$250	US$300	US$470	US$720	US$330	US$700	US$125	US$230	US$400	US$640

Smartphone Light Meters

For smartphone owners, dedicated light meter apps make a cheap alternative to purchasing a separate handheld light meter. There is a range of apps available for Android and iOS at prices from free to just a couple of dollars. This is a great way to add functionality to a device that you probably carry with you all the time anyway. Be sure to compare the results produced by a new app with those from your camera's built-in light meter or a separate handheld device before you rely on it in critical situations. This way, you can factor in any deviations from the start. If you have an iPhone, we recommend you try the Luxi – an incident light meter adapter that (at the time of writing) costs a Kickstarter pledge of US$22 for the iPhone 5 version or US$19 for the iPhone 4/4S and comes with a free dedicated app.

Thanks to its built-in calibration function, the Luxi app can be used with third-party diffuser adapters too. The range and precision of all smartphone light meter apps cannot compete with those of dedicated devices, but they are still a great way to learn how to use a handheld light meter.

LIGHT METERING APPS

For Android

					
Name	beeCam Light Meter	Light Meter Free	Light Meter Pro	Light Meter Tools	Tiny Light Meter
Price	free	free	free	US$1.99	free
Details	Meters ISO, exposure time, aperture, EV and lux values	Traditional-looking interface, readings in lux (the SI unit of illuminance)	Sophisticated LED-style interface	Comprehensive exposure and spot meter functionality plus depth-of-field calculator	Simple but effective
Online ratings	Many, many good or very good ratings	Lots of satisfied users	Loads of ratings, most either very good or very poor	Many good or very good ratings	Users mostly satisfed. App now free but wihtout support.

For iOS

					
Name	Light Meter free	Light Meter Pro	iColorZoner	Photometer	Pocket Light Meter
Price	free	US$0.99	US$1.99	US$0.99	free
Details	Very neat interface	Clear, intuitive interface	Includes spot metering functionality	Great-looking app, looks a lot like the old Gossen Profisix	Available in multiple languages
Online ratings	Very few ratings for the current version	Very few ratings for the current version	Ratings extremely varied	Many good ratings, especially concerning the app's precision	Many very good ratings

DIGISKY model has a built-in wireless flash release capability and offers metering in four separate groups. It also has a USB connector for software updates and battery charging. Price and functionality-wise, the Digiflash 2, Sixtomat F2, and Digipro F2 models from Gossen are positioned between the Digisix 2 and the DIGISKY.

Sekonic offers a similar range of meters. Its entry-level L-208 continuous light model costs about US$125, while the more expensive models offer greater ranges of sensitivity and flash exposure metering. The L-758DR DigitalMaster (US$635) is a combined incident/reflected light and flash meter.

Even if it appears expensive at a first glance, the price of a quality light meter represents an investment that will last a lifetime.

Unlike the single measurements that a camera's built-in light meter can make, many handheld light meters can also make and save multiple readings from different viewpoints, which can then be averaged out to provide ideal expsoure parameters. This functionality can also be used to measure the brightest and darkest parts of a subject and thus determine its overall contrast. In the studio, you can also use multiple readings to determine the 'contrast' between multiple light sources of differing strength. Meters that are capable of measuring flash and continuous light can be used to meter and compare mixed light sources, making it much simpler to select the appropriate settings than it would be if you had to make test shots for each different setup.

Conclusions

The 'smart' exposure metering technology built into most modern digital cameras leaves little to be desired in the course of most everyday photographic situations. However, there are still a number of situations in which a handheld light meter offers more flexibility and custom options, especially when it comes to shooting in a studio environment.

Using a dedicated light meter requires practice but it is an indispensable tool if you are using studio flash or mixed light sources. A light meter is also great for repro work or for situations in which you need to evenly light large surfaces or spaces. A separate light meter is also the tool of choice when it comes to metering subjects with extreme ranges of contrast or in extreme lighting.

If you are looking for an accessory meter to use with an old analog camera, one of the smartphone apps listed here will probably be perfectly adequate for the job. (pen) c't

Andreas Kesberger

The History of Digital Photography

Photography celebrated its official 175th birthday in 2014, but an exhibition in Mannheim, Germany displayed a photo said to be 188 years old. 2014 also saw the legendary Leica camera celebrating its 100th birthday using photos taken 101 years earlier in 1913. Photo historians may not be particularly strong in the arithmetic department, but one thing is certain – digital photogaphy would not exist if it hadn't been for its analog ancestor, so we are simply joining the celebrations by saying 'Happy Birthday Digital Imaging, whenever you were born!'

Althoug photography has enjoyed rapid development that is unparalleled in modern history, it has always had a struggle to justify itself alongside other media. Painters were always assumed to be somehow 'better' artists, and the only way to help photography up onto a similar pedestal was to aim high and include big names like Aristotle in the documentation of its history – due largely to the legend of his thoughts on how light cast the pattern of leaves onto the ground. Aristotle was surely not the only person who had such thoughts, but he was probably the first to write them down.

It is probably safe to assume that historians of digital photography are more relaxed about their job, although a little name dropping doesn't do any harm here either. The binary system of counting, without which computers and therefore pixels would not exist, was discovered by no lesser person than Gottfried Wilhelm von Leibniz, the great German mathematician. With a little imagination, we could also attribute the invention of the inkjet printer to Rayleigh and Kelvin – two of the 19th century's most renowned scientists who experimented with ways to use dots of ink on paper to represent telegraphic transmissions.

Image: Kesberger

The powerful impact of photography is apparent in this sculpture in Berlin, erected a mere 10 years after the death of Daguerre and immortalizing him alongside Johann Wolfgang von Goethe, Germany's most famous author, poet and polymath

The Digital Century

Although the first truly digital camera was not invented until 1975, the roots of some of the technology involved go much farther back. For instance, the optical and mechanical principles on which analog cameras are based were developed by several people simultaneously, even though it was French PR genius Daguerre who managed to declare the invention of photography his own at a government-backed mega-event on August 19, 1839.

The French government kick-started the first major open source project in the history of imaging by presenting the invention as a free gift from France to the world. Today's marketing strategists could certainly learn a thing or two from such a coup – and the rumor pages that scour the net for the latest camera news are simply the modern-day equivalent of 'Renaissance Man' Alexander von Humboldt's letters to the press that announced the trailblazing invention months before it actually appeared. Other inventors, from Bayard and Fox Talbot to long-forgotten names such as Read and Florence, all just picked up on a trend that was developing in full public view. The basic principle of the camera was already available in the form of

"It needs more work!"
The world's first digital camera – and yes, it really did record images on an audio cassette. This photo shows its inventor, Kodak engineer Steve Sasson, with his 1975 prototype.

Image: Photoindustrie-Verband e.V.

the camera obscura, which painters used as a drawing aid, and people had known since the 18th century that silver halides were light sensitive. All that was missing was an effective fixative. Sir John Frederick Herschel gave Fox Talbot and Daguerre the idea of using sodium thiosulfate, and modern photography was born.

As with so many scientific discoveries, it simply took a fresh view of the available material to produce the moment of revelation. Herschel had founded the *Analytic Society of Cambridge* with his fellow universtiy students George Peacock and Charles Babbage, and it was Babbage who went on to invent the first world's first mechanical counting machine, for which Ada Lovelace wrote the very first program in 1843. If electronics had already existed, Herschel might just have invented digital photography instead of just the Cyanotype.

The First Digital Camera

A number of analog events prepared the ground for the birth of digital photography. Just like the children of today's few remaining analog photographers, Edwin Land's daughter asked him in 1940 why it wasn't possible to see the images captured by a camera immediately. Land's answer was to invent the Polaroid camera, which set the scene for the broad acceptance of instant images, even if they were not of such high quality as their conventionally developed counterparts. However, it was quite some time before the quality of instant images surpassed that of their analog predecessors.

The firstly truly digital camera was built by Steve Sasson and Jim Schueckler at Kodak in 1975 and captured images on an audio cassette – a slow method that produced poor-quality results. Kodak, whose business at

Image: Kesberger

Edwin Land's invention of the Polaroid instant camera probably did more to make digital photography acceptable than he imagined. With the advent of the Polaroid 'instant' idea, image quality was traded off for speed in the image capture process.

Image: Alcatel Lucent USA Inc.

Moving digital pictures actually existed before digital stills. This photo, captured in 1974, shows Willard Boyle (left) and George E. Smith with a camera based on the CCD that they invented in 1969.

the time was selling analog film, probably saw this as a bonus, although it everntually became one of the few companies that actively brought about its own demise. The 'red+2×green+blue' Bayer Pattern microfilter array still used in most of today's digital cameras was invented in the same year by Bryce E. Bayer and enabled the grayscale image data captured by the sensor to be interpolated and transformed into color data. The only other type of array used in modern digital cameras is the Foveon type favored by Sigma and, briefly, Polaroid, which uses a pattern that more closely resembles the arrangement of chemical layers in color film than the Bayer model.

The world's first digital camera weighed 3.6 kg (8 lbs) and took 23 minutes to record a 100×100-pixel image. The Kodak employee who posed for the first digital photo ever wasn't very impressed: "It needs work" was her parting shot as she left the session. The original image file no longer exists, and the longevity of digital images has been an issue ever since.

As in Daguerre's day, the technology was already available, simply waiting to be put to appropriate use. Five years previously, while searching for ways to build electronic memory, Willard Boyle and George E. Smith had already invented a basic CCD sensor – work that was honored decades later with the 2009 Nobel Prize for physics. The first CCDs could only display a live image and, just like in the early years of analog photography, what was lacking was a way to preserve images.

The audio cassette memory medium needed work too, and more efficient memory technology was essential if the available image capture technology was to be of any real use. Popular analog photography developed in a similar way, and Oskar Barnack had already completed the basic Leica design in 1914. In 1925, Ernst Leitz showed commercial foresight and courage by coupling Barnack's design with the 24×36mm movie film format and high-resolution lenses that enabled photographers to make enlargements instead of contact prints of their negatives. Until then, 9×12 and 13×18cm plate glass negatives were the industry standard. If you want to know what photographers back then thought of the new, smaller format, all you have to do is search through a few online photo forums for discussions on the relative merits of full-frame vs. Micro Four Thirds or APS-C sensors. Now, as then, the world is full of skeptics, enthusiasts and those who are out to convert everybody else.

The first single-lens reflex (SLR) cameras appeared in the 1930s, but Oskar Barnack's heirs continued to improve on his original design, adding a bayonet for interchangeable lenses and a rangefinder focusing system to the first M-series Leica in 1954. This proven technology is so good that it is still used in today's M-series digital cameras. The Japanese optical industry started a massive push and by the 1970s, SLR technology had become de rigeur. This was the state of affairs when the world's first digital image was recorded on an audio cassette in a Kodak lab. The final analog development that ensured the rise of the digital camera was autofocus. There is no point in being able to capture images instantly if you have to fumble around with focus settings before you release the shutter. After half-hearted attempts by several other manufacturers, the Minolta 7000 AF was the first commercially available camera to include a usable autofocus system that genuinely improved photographers' reaction times.

Image: Leica

The Leica was a state-of-the-art camera when it was introduced in 1954, with bayonet-mounted interchangeable lenses and a viewfinder that doubled as a focusing aid. Today's digital 'M' models follow the maxim 'If it ain't broke, don't fix it' and look almost the same as the original.

Sony Goes Photo

The 1980s were a busy time for the Nikon and Canon R&D departments. Minolta's autofocus systems were ahead of their time and forced the competition to take back the initiative in this sector. Back then, Sony was known more for its Trinitron TVs and Walkman portable audio products. The company only included camera development on its public agenda when it was forced to do so after acquiring Konica Minolta.

However, as it became clear that Kodak couldn't – or simply didn't want to – develop its existing technology, Sony stole a march on the American competition in 1981 by introducing the first prototype Mavica, a device that captured images using a CCD sensor and recorded them on 2-inch diskettes as an analog video signal. The images could

Image: Kodak

In 2007, Kodak introduced a new type of sensor with additional panchromatic pixels. It didn't catch on, and Kodak now concentrates on print technology.

Image: Sony

The camera that set the ball rolling: the 1981 Sony Mavica was only a prototype and wasn't even truly digital, but became the forefather of all subsequent digital cameras

Image: Canon

The Canon RC-701 'still video' camera appeared after the Mavica, in 1986, but was at least available to the public

Image: Nikon

The 1988 QV-1000C was Nikon's first commercially available digital camera, offering 0.38-megapixel monochrome image capture with a crop factor of 4 and an (equivalent) 44-480mm zoom lens. 100 units were sold.

be viewed on a conventional TV, but would have had to be digitized to view them on a home computer, had such a thing existed at the time. Computers however, were busy with other things, and the Commodore 64 that was introduced shortly after the first Mavica needed all its memory to run PacMan.

The original Mavica recorded 570×490mm images using a 10×12mm sensor and a body that enabled the use of interchangeable lenses such as the 16-65mm f/1.4. Although this sounded tempting, the term 'equivalent full-frame focal length' had unfortunately not yet been coined and because the focal lengths involved were real-world specifications designed for use with a pretty small sensor they were unsuitable for wide-angle usage. To cap it all, the system also had just one exposure time of 1/60 s.

Canon's first attempt at breaking into the market took a little longer but was more successful than Sony's. The Canon RC-701 was used in 1984 to send an electronic image of the Los Angeles Olympic Games to Japan but was not introduced to the public for another two years (before the first analog EOS) at a price of just under US$3,000. This was the first non-film camera that anyone could buy, although by the time users added a recorder, a printer, a laminator (!) and a phone unit, the

The world's first digital back, created by Kodak engineer Jim McGarvey, who built a 1.3-megapixel monochrome sensor into the pressure plate in the back of a Canon F1 for a 1987 government contract

system cost more than nine times the price of the camera alone. The lack of supporting infrastructure was the main stumbling block in the early days of the digital photography revolution.

Nikon's SVC, introduced at Photokina in 1985, demonstrated technology that was later to be built into the F-801, although Nikon was reluctant to admit that most of the onboard electronics were made by Panasonic. The QV-1000C that was eventually introduced cost around US$10,000 and had two lenses but could only capture black-and-white images. Unsurprisingly, Nikon only ever sold 100 units of its new technological miracle.

However, that was 100 more than Kodak managed to sell when it produced its first DSLR. The 'Electro-Optic Camera', built as part of a government contract, consisted of a 1.3-megapixel sensor built into the back of a standard Canon F1 SLR. The image processor had to be carried separately in a shoulder bag and the cable connecting it to the camera could be attached to the camera's strap. In spite of having this ground-breaking prototype paid for by the government, Kodak never really managed to focus its efforts and ended up introducing various Kodak-branded cameras that were actually manufactured by Nikon, Canon and Sigma. Minolta had a stronger market presence but its still video backs, introduced in 1987, had no pro-grade cameras to back them up. By the time Nikon and Canon had learned from the mistakes of their rivals, the market was ready for new products from established manufacturers.

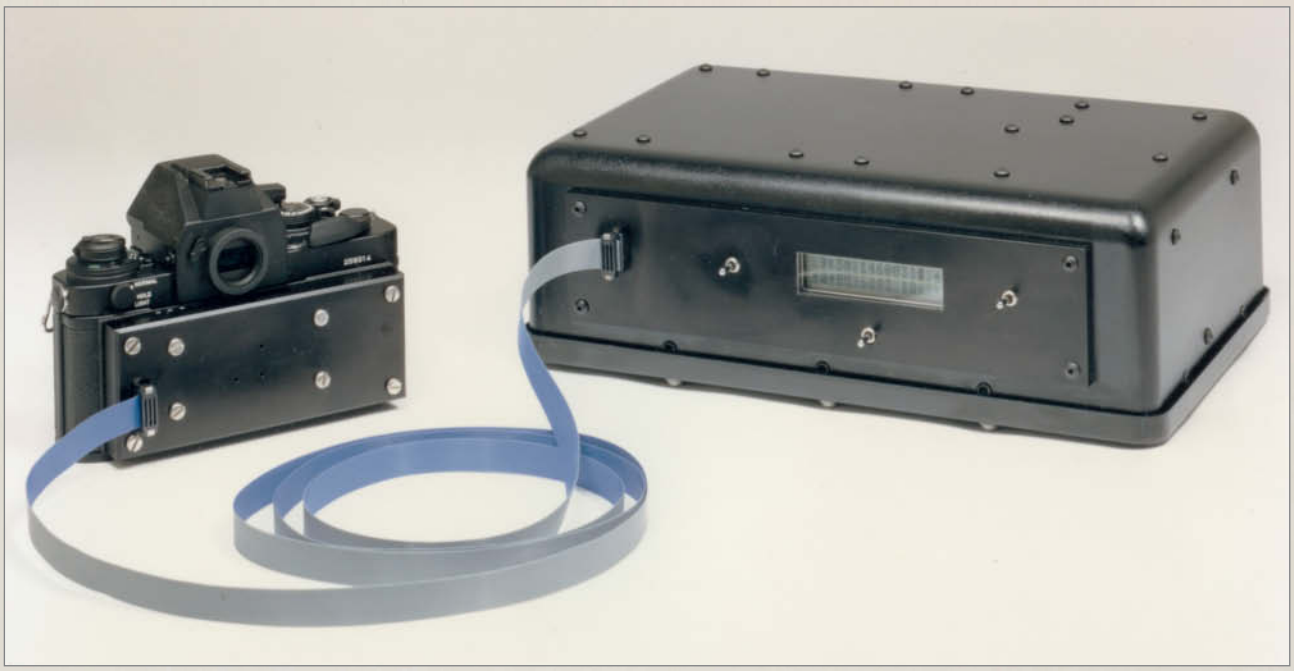
The First Pro Digital Photographers

In spite of all this technological progress, most pro photographers continued to shoot on film during the 1980s. As a mature recording medium, film was still vastly superior to the budding digital competition. There was still no way that a CCD sensor could capture anything like the resolution and color depth of a slide film and, back then, it took almost as long to load higher-quality scanned images as it did to develop a conventional color film.

At the time, the digital imaging industry had nothing useful or affordable to offer the amateur market. However, things were very different on the press photography front. The conditions under which the major press agencies worked explain their motivation for getting to grips with the cumbersome still video devices of the day. To produce newsprint, a photographer had to shoot during the day, the editorial team had to be relatively close to the action and the publisher had to print the paper overnight. Photographers had no option but to stick to the traditional workflow: shoot, develop, enlarge and then off home to bed!

Things became more complicated when images had to be transmitted via telephone wires, which involved mounting a finished print on a drum and scanning it. The process was demonstrated for the first time in France in 1907 – the original was scanned in Paris using selenium cells and the transmitted image was revealed in London using a light bulb. Nevertheless, even 80 years later, the process still included a paper print, which meant that press photographers working away from home had to carry developing gear and an enlarger with them. In view of these difficulties, press agencies were only too willing to invest in new technology when the Dixel hit the market in 1988. Developed my no less a name than Hasselblad, this machine transmitted scanned 35mm negatives in the form of text and was capable of rotating and aligning images – functions that were not yet available from the competition. Although the Dixel cost as much as a large car, its users simply had to accept its limitations.

In the meantime, Sony was developing its still video technology. While other



Images courtesy of eocamera.jemcgarvey.com

Size doesn't matter if the results are fast enough. The Kodak DCS 100 was the first commercial digital imaging system to achieve anything like decent sales volumes, and was marketed primarily to press agencies and large publishing houses. The camera itself was a customized Nikon F3 and was the smallest element in the system.

Image: Hendrik Haack/Probis

manufacturers were still building prototypes, The 1989 ProMavica MVC-5000 represented the fourth generation of Sony's digital imaging technology. The first major test of the new technology came in the shape of the student uprising at Tiananmen Square in Beijing in 1989. Although the Chinese authorities had forbidden the transmission of live TV pictures, a CNN team managed to transmit Sony images of unarmed students confronting tanks via the telephone network, and even won an Emmy for Sony in the process.

JPEGs, Lead-acid Batteries and Memory Cards

Since TV journalists were responsible for this initial success, it was clear that to succeed commercially, the industry would have to convince stills photographers of the advantages of the system. Kodak took the lead by customizing the all-time favorite photojournalist's camera, the Nikon F3. Before this, prototypes and bespoke models of the camera had already made it to space but not into the hearts and minds of the earthbound press community. The Kodak system consisted of a lead accumulator battery, a monochrome monitor and a hard disk and could record up to 600 JPEG images. It weighed a total of 5 kg (11 lbs) at a cost of around US$4,000 per kilo! Kodak sold 987 of them in three years.

Had they existed, Compact Flash (CF) memory cards would have made handling a lot easier than the hard disk solution of the time, but the first commercially viable camera to save images to SRAM memory cards was the 1988 Fujix DS-1P. Captured images were a maximum of 0.4 MB in size, so were still usable with the computers of the time. It quickly became clear that cameras with floppy disks were not destined to go far, but at the time, every manufacturer was playing its own proprietary game.

A company founded in the same year that the Fujix DS-1P appeared was destined to consolidate the multiplicity of technologies that existed. The company was called SunDisk (due, according to company legend, to one of the founder's daughters demanding a bright, fun name) and was later renamed SanDisk. When flash memory was invented in 1984, photography was already in on the game, providing the name for the technology because the erasure process of the memory contents reminded one of its inventors, Shōji Ariizumi, of the flash of a camera. Ten years later, when SanDisk introduced the Compact

Kodak based its first pro-grade DSLR (in 1991) on a tried-and-trusted workhorse – the Nikon F3, which was still the epitome of the indestructible professional press camera despite its lack of autofocus and its old-school technology

Flash (CF) card, the first step toward industry standardization had been made. Coincidentally, CF cards were the same height as 35mm film rolls. Various memory card formats have come and gone in the intervening years. The xD format introduced by Fujifilm and Olympus didn't win through, while SD (introduced in 1999) and micro SD have gone on to become virtually standard worldwide.

Two key developments in digital imaging were capture technology and the ability to view digital images. The need to view still video images on a TV was a major hurdle in the early days. Images were being scanned and processed electronically long before mass digital image capture became possible, and Rudolf Hell invented the first usable scanner in Kiel, Germany in 1958. The computer Hell used to process his scans consisted of 500 electrical valves, but the technology developed rapidly and the first drum scanner, the Chromograph, sold 2,500 units when it was introduced in 1965. Legacy drum scanners are still in use today and produce better-quality images than any subsequent capture techniques.

Turning a File into a Print

Early amateur and artistic photographers were fascinated by the magical way an image appeared from nowhere in the developing tray, and were spurred on by the endless possibilities the process offered for manipulating the resulting photos. If digital imaging were to succeed, new printing technology would have to be invented too.

Although Siemens patented the first inkjet printing device in 1951, most offices echoed to the sound of dot matrix printers well into the 1980s. Soon, however, Canon invented the Bubble Jet process, HP followed with thermal printing heads and Epson continued to develop the piezoelectric process originally introduced by Siemens. All of these approaches would probably have ended up on the scrap heap if it hadn't been for the Canon BJ80, introduced in 1985, which was the first printer designed for use with specially coated photo paper instead of the familiar rolls of cheap printer paper. Suddenly, printing high-quality photos at home seemed within reach.

While color graphics became routine in an office environment, the first pre-press proofing printers became available. The IRIS printer provided print quality that was breathtaking at the time even though it appears modest today. Such devices might have disappeared without trace if a couple of enterprising Americans hadn't seen their potential for the art market. Pioneer Cone Editions Press and, later, Nash Editions began producing limited edition prints on hand-made paper. Fortunately, Graham Nash had earned enough money as a member of The Hollies and Crosby, Stills & Nash to finance his artistic experiments, hence music CDs came to finance the beginnings of fine art photo printing.

Epson's first six-color photo printer, introduced in the mid-1990s, produced results that were printed on PE paper and looked a lot like the prints that emerged from people's darkrooms. But photographers are seldom happy with what they have and soon began experimenting with black and white baryta prints, durable pigment-based prints and extended color spaces. Most of these ideas were developed by inventive but little-known manufacturers and were taken up by major manufacturers such as Canon and Epson as soon as they were technologically mature and ready for large-scale marketing.

Paper manufacturers, too, had a long way to go before they were able to successfully market fine art inkjet paper. Having initially bought sample baryta (and other) conventional papers for market research purposes, companies like Hahnemühle took a while to work out that they could only really judge its quality once it had been printed on. Nowadays, the tables are turned and exotic inkjet papers based on the same carrier material as their analog counterparts generate sufficient turnover to allow analog papers to be manufactured at relatively reasonable cost.

The analog/digital crossover took the shape of the 1997 Durst Lambda enlarger, which was capable of printing digital files on

Image: Fujifilm

The 1988 Fujix DS-1P was only a prototype but paved the way for memory card-based digital photography for the masses

Image: Andreas Kesberger

4MB compact flash cards could hold a large number of images when they were introduced, but now can't even save a single RAW image file

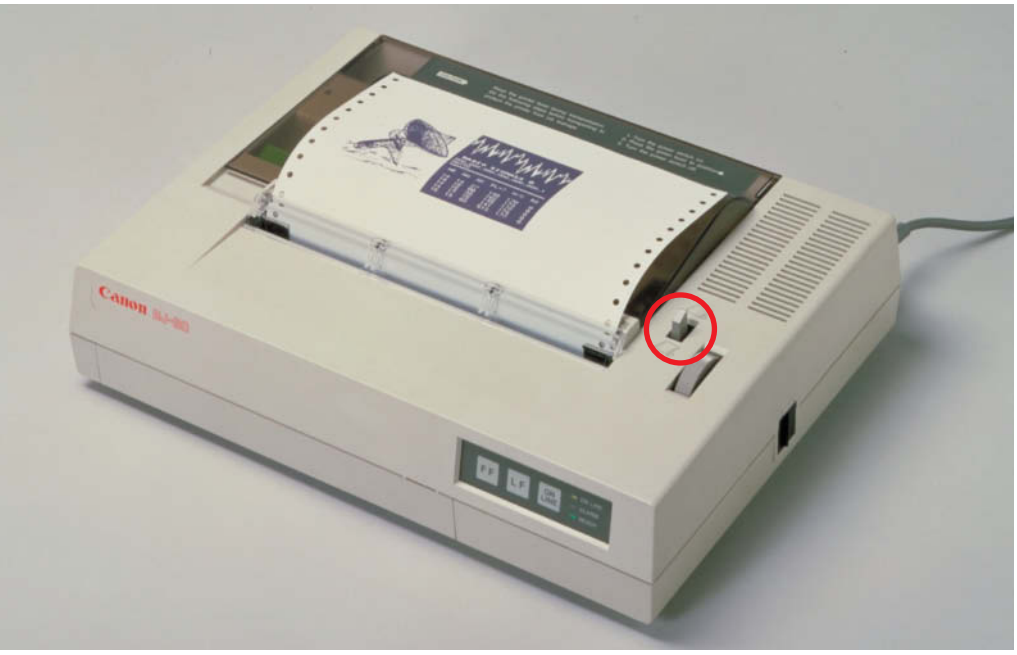


Image: Canon

The tiny lever that changed the world: the lever on the right paved the way for mass-market and fine art photo printing by enabling the Canon BJ-80 to switch from continuous to single-sheet paper feed

conventional photo paper. Together with the Océ Lightjet, with its 180cm print width, and the birth of Diasec photo mounts, the Lambda paved the way into company foyers and galleries around the world for artists like Andreas Gursky. However, in spite of all these advances, postcard-sized prints are still one of the best-loved ways to view and share the countless vacation snaps that are taken every day.

Photos and Photoshop

The most successful innovations in photography have always been the ones that offered a complete imaging package, and the rise of digital photography demanded the creation of software that analog techniques simply did not need. When *Photoshop* was introduced in 1990, the world of imaging changed forever. Thanks to Adobe, if the sky in a photo doesn't suit the rest of the image, you can simply swap it out. A quick look at the *Photoshop* version history tells a story of its own. Earlier versions took a lot longer to make adjustments than more recent ones, and the Stamp was the only real retouching tool available. Today, the Cloud, universal color management systems and online software subscriptions are the cornerstones of the new world of imaging software.

From the early 1990s onward, the R&D departments at all the camera manufacturers not based in Wetzlar, Germany had a clear picture of the immediate future of the industry. Major manufacturers were able to steer developments and profit from them, and every successful camera from Fujifilm and Kodak represented a further nail in the coffin of the traditional photo industry. Film manufacturers viewed the dawn of the 21st century with skepticism, although photo paper sales actually reached their all-time peak in 2001. As a kind of analog swansong, Kodak introduced photo CDs in 1992 in an attempt to introduce digital technology into the analog photo workflow. In hindsight, however, the move was destined to fail the moment consumers were able to purchase their own CD burners.

The APS Debacle

You can take a horse to water, but you can't make it drink. The ill-fated APS system was designed to make mass-market photography as simple and practical as digital photography was one day to become. Unfortunately, although negatives that stay put in their rolls are virtually scratchproof, they are not easy to view and are extremely difficult to scan. Worse still, the much-vaunted APS index print was already available to conventional 35mm photographers and the smaller frame format inevitably reduced overall image quality. In spite of its embarrassing demise, the APS format lives on in the form of the most popular DSLR sensor format to hit the market so far, and the image data saved on the magnetic stripe on the side of an APS film roll has evolved into today's ubiquitous Exif data.

Digital Goes Compact

1996 was the year in which digital photography really overtook its analog ancestor. At the time, DSLRs were still the preserve of pro photographers and the digital compacts available were being made by lesser-known manufacturers such as Logitech, Casio and even Apple. While it is public knowledge that Steve Jobs was extremely interested in the Lytro light field camera technology and its revolutionary ability to adjust focus electronically after a photo has been captured, what most Apple fans don't know is that their favorite computer maker also manufactured the QuickTake digital camera. However, one look at the device quickly shows why Jobs halted production immediately on his return to the company in 1996. At Photokina in 1996, while most other major manufacturers were still playing the APS game, Olympus became the first manufacturer to publicly play its digital hand. Having mostly missed the SLR autofocus boat, Olympus found it relatively easy to make a clean switch to the new technology. Additionally, Olympus' success with the mju and XA analog compacts formed the basis for its first forays into digital compacts with few user-controllable options and, back then, no more than 1 megapixel of resolution. The first cameras weren't capable of capturing images that could be enlarged to poster size, but they definitely made their users the center of attention at parties. At last, you could see an image immediately it was captured and images of sensitive subjects could be deleted at will. At this point, every increase in the

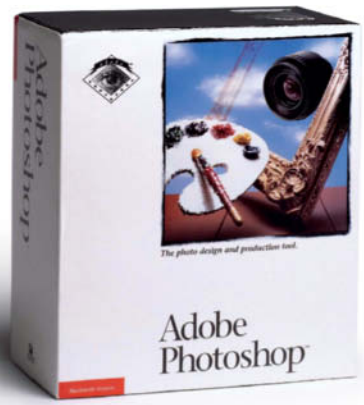


Image: Adobe

Digital imaging would not be where it is today without *Photoshop*. Software, too, has come a long way since 1990, when the box contained multiple floppy disks, and Adobe's flagship is now only available online.

Even though image quality was relatively low at the time, the 1994 Durst Lambda made it possible to laser print digital images on conventional photo paper and laid the foundations of today's digital workflows in the worlds of advertising and fine art

Image: Durst Phototechnik AG

Image: Nikon

The Nikon/Fujifilm E-Series cameras were marketed between 1994 and the turn of the last century. The condenser lens provided a kind of pseudo-full-frame format with a crop factor of 1 but reduced the equivalent (lens-dependent) maximum aperture to f6.7 (later increased to f4.8).

Image: Nikon

The first relatively affordable pro-grade camera with a familiar form factor, the Nikon D1 played a significant role in the digitization of the press. It provided a tolerable crop factor and sufficient resolution for the color images that would soon dominate newspapers.

Image: Canon

Six megapixels that changed the world. The Canon EOS 300D/Digital Rebel was the first mass-market DSLR. Its introductory price of less than US$1,000 with a kit lens seriously shook up the competition.

number of megapixels guaranteed increased sales – after all, everyone knows that three million is more than two million. Whether more megapixels actually meant better pictures didn't seem to interest anyone.

Unlike the music CD, which offered an obvious increase in sound quality and simpler handling than an LP, early digital cameras weren't easy to sell. Digital was faster but the quality wasn't as good, and the speed of capture was quickly negated by the need to take a CD to a store to have prints made. Back then, uploading photos using a modem was no fun at all!

The Digital Camera Boom

The next step was a significant increase in network speed and capacity. Once the Japanese camera industry began to count digital cameras separately from the rest, there was no stopping the ensuing boom. Production increased 20-fold in the eight years that followed. In 2002, the number of digital cameras manufactured outnumbered analog production and the same shift occurred in the SLR market two years later. In 2007, just eight per cent of new Japanese cameras were analog, and shortly after, the industry stopped analyzing analog production altogether. At the same time, there was a resurgance of public interest in photography.

The pro end of the market is not particularly relevant when it comes to calculating absolute sales figures, but the mood in the market can be fairly accurately extrapolated from readers' letters and the countless forum and blog entries written daily around the world. Around the turn of the century, no-one was really sure how the market would develop and this uncertainty led to a pinhole camera boom, a new love of traditional monochrome photography à la Ansel Adams and the low-tech Lomography trend. With developments in the present beyond their understanding, or perhaps their budgets, photographers turned to re-examining the roots of the medium

Soon enough, most amateurs shook off their concerns and happily took to photographing with compact and bridge cameras, while the pro and semi-pro sectors waited patiently for Nikon to finally come up with a serious successor to the rather odd E-Series Nikon/Fuji brand cameras. The result was the 3-megapixel D1, a camera that had sufficient resolution to keep most newspaper editors happy and spared experienced photo reporters the indignity of having to use Coolpix compacts. Canon soon joined the fray and Kodak's days as a serious contender were numbered. Its first full-frame camera simply had too many teething troubles and Nikon and Canon were quick to fill the gap in the market. One of the most important events in the rise of the popular DSLR market was the introduction of the Canon EOS300D at a sub-US$1,000 price point (including a kit lens), which instantly made DSLRs fit for the mass market. Canon could afford to make this bold step because it manufactured its own sensors and, as a bonus, the horribly cheap kit zoom boosted the turnover of its more expensive lenses. The market leaders from back then have been leading the race ever since.

The development of the photography market in general can also be measured effectively using the sales figures for interchangeable lenses. Annual worldwide sales had been constant at about five million units right up to the moment when DSLRs became cheap enough for the masses, but between 2005 and 2012, this figure shot up to around 30 million, and press releases from Canon and Nikon announcing that they would soon reach the 40-million mark quickly followed. The high-end camera market suffered due to the increasing digitization of the mass market. Medium-format cameras with interchangeable film holders seemed destined for use with digital backs, but the market reacted differently.

Although initially overshadowed by the Nikon D1, the Canon EOS D30's revolutionary CMOS sensor signaled the start of the race for ever-increasing ISO sensitivity in digital cameras

As proof of the innovative capabilities of smaller manufacturers, the 2006 Olympus E-330 was the first DSLR to offer live view shooting

Image: Panasonic

Compact overall dimensions and a design that mirrored DSLR lines – the Panasonic G1 was the world's first mirrorless system camera. In the five years following its launch in 2008, 3.3 million cameras of this type were sold.

For decades, Hasselblad and Rollei had done a great job of catering to the pro market whilst also selling to amateurs. The trouble was, in the 1990s, a digital back offered only 35mm-sized frames and wired shooting at a price that only professional advertising studios could afford.

Rollei introduced a 29-megapixel scan back in 1991, but very few of the other early digiback manufacturers (Jenoptic, Kodak, Mamiya, Leaf, Imacon et al.) are still around. The ones with workable products were taken over so often that today only Hasselblad and Phase One remain. The only other high-end camera makers still in business are Leica, Sinar and Pentax, whose survival comes thanks to to the huge turnover made with photocopiers by its parent company, Ricoh. Sheet film holders have also become extremely rare, but small bespoke manufacturers like Alpa, which continues to flourish in its extremely small niche, demonstrate how successfully ultra-high-end large-format cameras can be marketed in the digital age.

The Latest Developments

The niche role played by medium-format digital cameras has ensured that most significant innovations take place in the full-frame and APS-C sectors. In 2000, Canon's EOS D30 was the first camera available with a CMOS sensor. The market was initially skeptical as to whether CMOS sensors were superior to their CCD counterparts, but recent history has shown that CMOS is a preferable technology when it comes to capturing usable images at high ISO levels. Photographers can now shoot at sensitivity levels that even the most sophisticated analog push developing techniques cannot match. CMOS sensors also ushered in the next major advance in camera technology, live view, in 2006. The Olympus E-330 introduced this exciting new feature that at last enabled photographers to compose and focus independently of the movements of the camera's mirror.

Of course, Nikon and Canon are wary of major technological changes and are loath to risk cannibalizing DSLR turnover for the sake of new features. After all, Kodak demonstrated perfectly how dangerous ground-breaking innovations can be to the health of a large company. Now that CMOS sensors deliver a sharp live view monitor image, reflex mirrors have begun to lose their relevance. With the introduction of the G1 in 2008, Panasonic gave birth to the new category of mirrorless system cameras and Olympus, Panasonic, Sony and Fujifilm have dominated the design and production of innovative system cameras ever since. The current designs in this sector range from bold to distinctively retro, and looking through one of the current crop of electronic viewfinders no longer reveals an image reminiscent of a 1960s TV picture. The latest system camera lenses are now capable of using wide angles of view to the full and the multi-megapixel sensors built into most models have learned to use some of their photoreceptors exclusively for phase-detection autotfocusing. In view of the advances being made in the mirrorless segment, we can only assume that the only reasons DSLRs still find favor at all are the 'serious' image they communicate and the sheer number of lenses that photographers already own.

Otherwise, since the introduction of 12-color pigment ink models, there have been no significant advances in printing technology, the quality of scanners is deteriorating and, now that 36 megapixels in a full-frame sensor are no longer a rarity, the emphasis seems to have swung from developments in digital technology itself to improving the cameras and lenses that utilize it. Technological progress has once again outrun itself and we have entered another phase of evolution rather than revolution. But how many times has that already happened in the course of the last 175 years? (jr) c't

Dmitri Popov

WordPress Plugins
for Photographers

Countless blogs and web pages are based on the open source WordPress software. The program's basic configuration includes many useful features for photo bloggers, but adding some dedicated photo plug-ins makes it even better. This article shows you how.

WordPress is undoubtedly a powerful and flexible publishing and photo sharing platform, but as a photographer, you might want to enhance your *WordPress*-based blog using dedicated photography-related plugins. The official *WordPress* repository contains a huge number of plugins that cater to photographers, and this article covers several modules that can transform a generic *WordPress* blog into a platform tailored to your specific photographic needs.

Installing WordPress Plugins

To make use of *WordPress* plugins, you need to know how to deploy them. The easiest way to install an extension is to use the native plugin installation interface. To access it, switch to the Plugins > Add New section in the administration interface and use the Search field to find a specific plugin. Alternatively, you can use default categories in the tag cloud, such as Featured, Popular, Newest etc. to browse plugins in the official repository.

When you've found the plugin you need, click the 'Install Now' link next to it. Once the plugin has been installed, click the 'Activate Plugin' link to enable it, and you are done. If the installation fails due to a lack of write access in parts of the *WordPress* installation, you can install plugins manually. To do this, grab the desired plugin from the repository, extract the downloaded ZIP archive and move the resulting folder to the wp-content/plugins/ directory within your *WordPress* installation. You can then enable the plugin via the plugin installation interface.

Rocket Galleries

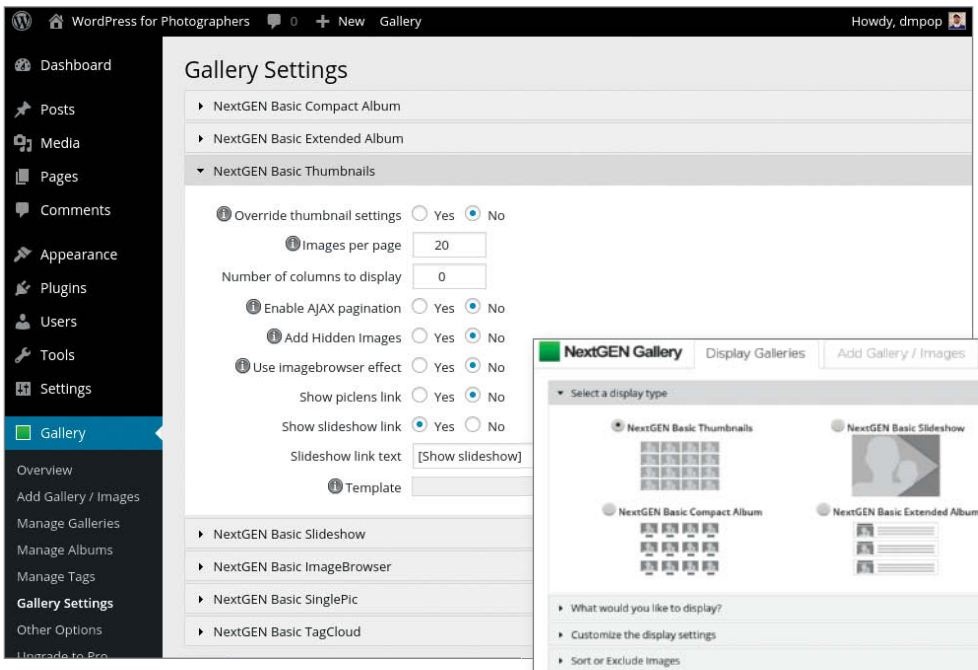
WordPress has a built-in media manager that allows you to create and embed galleries, although the feature does have a number of shortcomings. You can only create galleries when you are editing a blog article and you can't manage existing galleries. The *Rocket Galleries* plugin adds a user-friendly gallery interface that solves these problems and makes it easy to create, embed and manage galleries.

Once installed, the plugin adds the Galleries entry to the navigation bar in the administration interface. To create a new gallery, select Galleries > Add New and give the gallery a name. Click the 'Add images' button and select your desired images from the media library or upload new photos using the upload interface. Now click the 'Insert into gallery' button to add the selected photos to the gallery. You can rearrange newly added photos using your mouse or arrange them randomly by enabling the *Randomize the image order* option. When you are finished editing your gallery, hit the 'Save Gallery' button. To insert the created gallery, open a blog post for editing, place the cursor where you want to insert the gallery, click the 'Add Gallery' button, select the gallery from the drop-down list and hit 'Insert Gallery'. Alternatively, you can insert galleries manually using the [rocketgalleries id="X"] shortcode, where X refers to the ID of the gallery you want to insert.

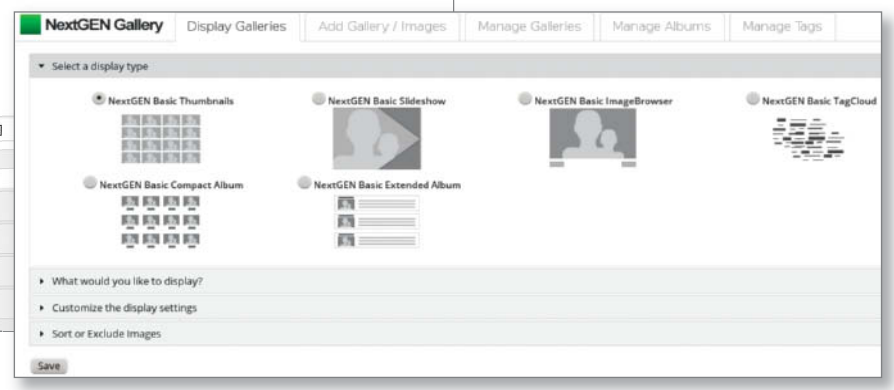
NextGEN Gallery

While *Rocket Galleries* offers a simple approach to creating galleries, the *NextGEN Gallery* plugin adds its own powerful engine that takes gallery functionality to a whole new level. Once installed and enabled, the *NextGEN Gallery* adds the dedicated Gallery menu to the navigation bar in the *WordPress* administration interface. This menu gives access to all *NextGEN Gallery* features, and the Gallery Settings section should be your first stop. The plugin features dozens of options organized into logical groups, such as Basic Thumbnails and Basic Slideshow. The Other Options section offers a slew of settings for you to tweak, including image options, lightbox effects, watermark settings and more.

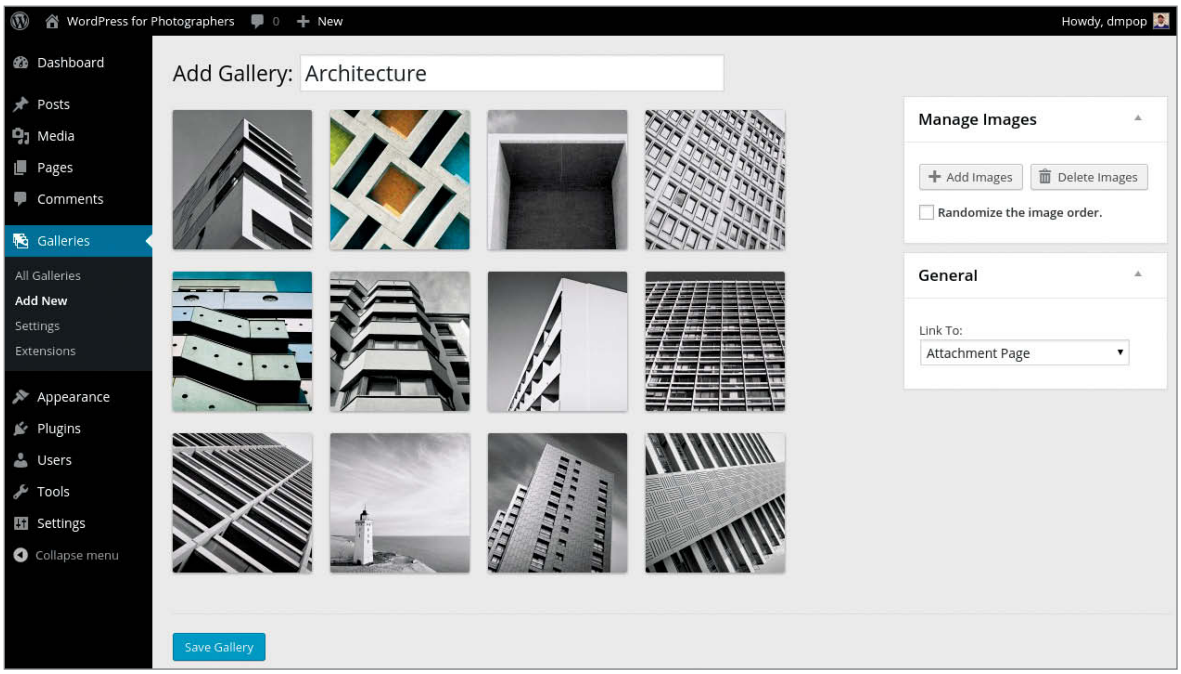
Adding *NextGEN* galleries is simple. The only thing you need to keep in mind is that the plugin can't use photos stored in the media library, so you either need to upload the required images from your local machine or use the Import Folder tool to import photos from a directory within your *WordPress* installation. The clever part is that the plugin automatically processes tags and optimizes each photo. The optimization process reduces the size of your images without affecting overall quality, thus saving bandwidth and improving load times.



The *NextGEN Gallery* options make it simple to configure your image presentation to suit your specific needs



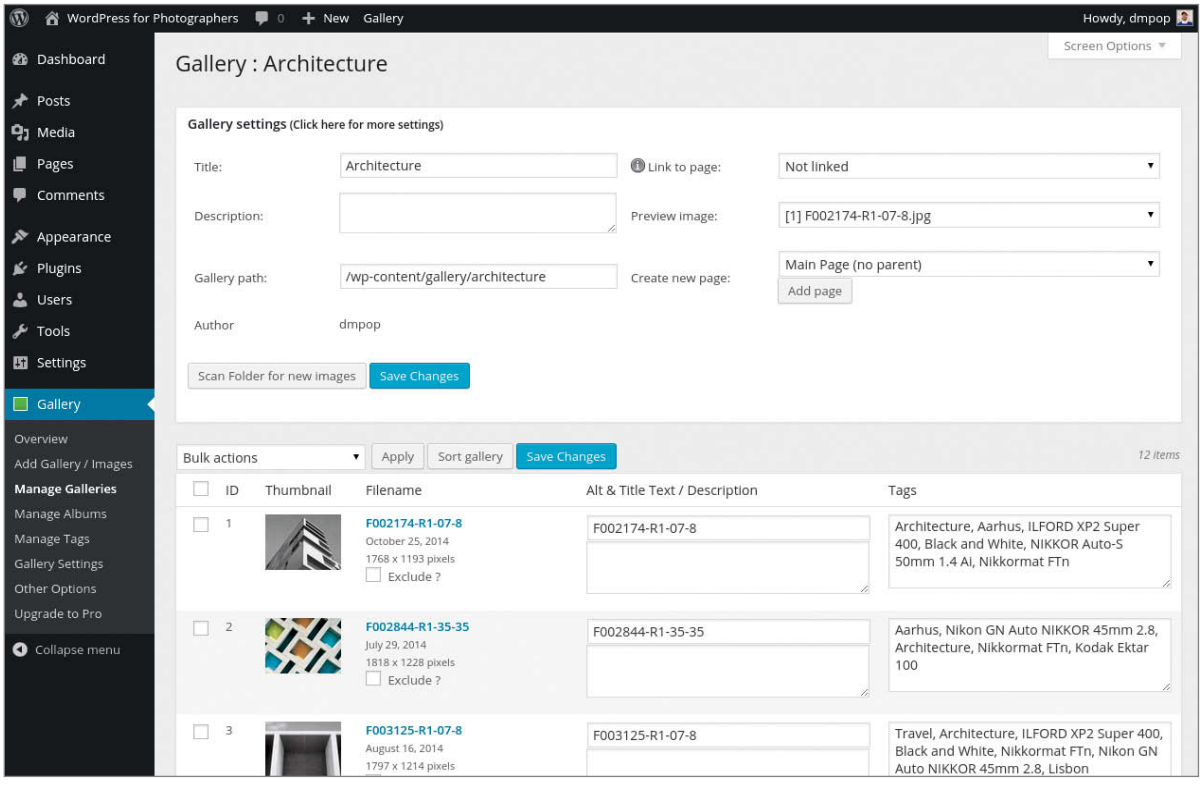
The available options enable you to tweak practically every aspect of *NextGEN Gallery*'s behavior



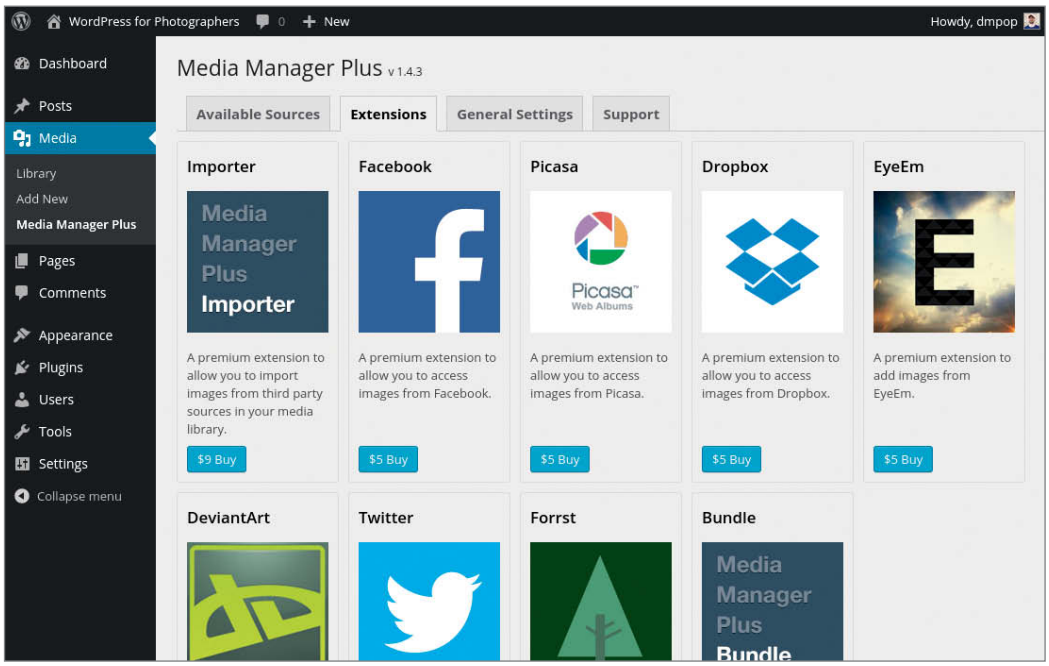
Rocket Galleries **makes it really easy to create and manage galleries and insert them into blog posts**

If you've enabled and configured the watermarking options, the plugin will also apply watermarks to your uploaded photos. NextGEN galleries can be arranged into albums, which can be useful for embedding photos from several galleries in a single blog post. To create an album, switch to the Gallery > Manage Albums section, enter the desired name into the *Add new album* field and click 'Add'. You can then add one or more selected galleries to the album using your mouse.

The plugin adds a dedicated button to the main toolbar in the editing interface that makes it easy to add NextGEN galleries and albums to blog posts. Clicking the button evokes the *NextGEN Gallery* interface, where you can pick the gallery or album you want to add and select the desired display type. The available options include *thumbnail*, *slideshow* and *image browser*, as well as *compact* and *extended album*. Instead of a gallery or album, you can choose to display photos containing specific tags. It's also possible to sort photos by date, title or other



The *NextGEN Gallery* plugin makes it possible to process and edit individual photos as well as perform batch operations



Media Manager Plus **uses extensions to pull photos from a variety of photo sharing services, including Flickr, Instagram and EyeEm**

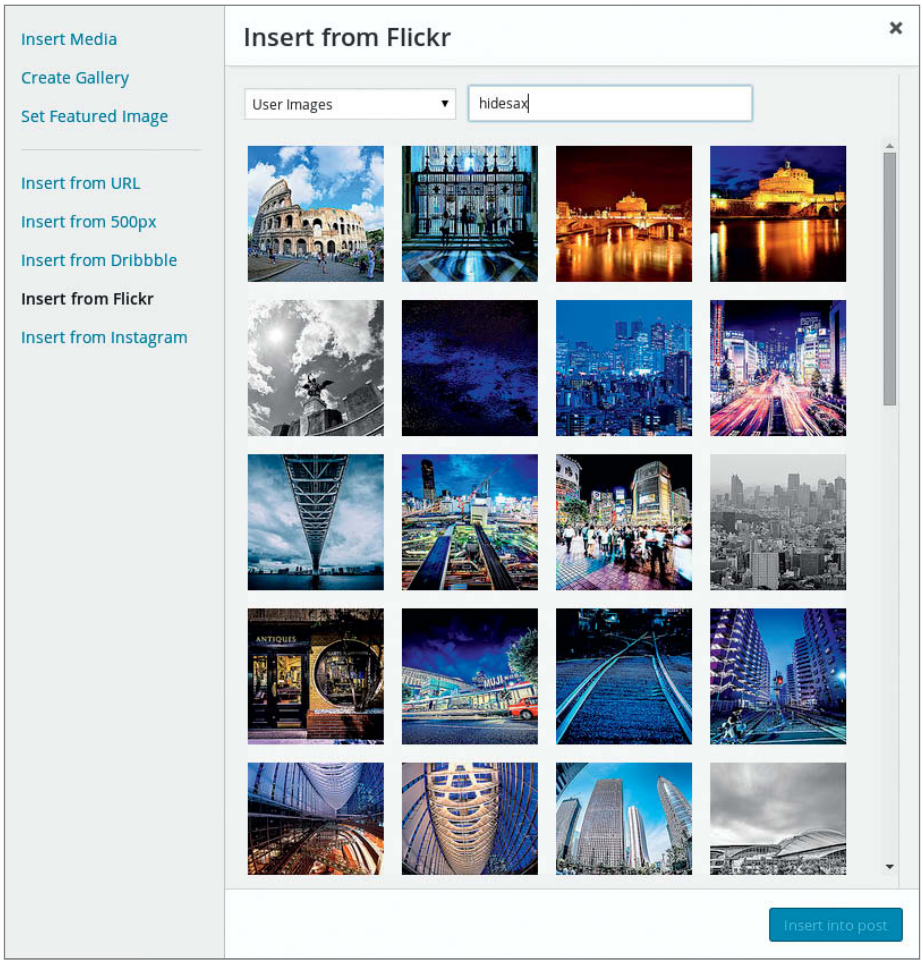
criteria, and you can exclude selected photos from the display too.

The Basic version of the *NextGEN Gallery* plugin is available free of charge. However, if the basic features don't cover your requirements, you might consider upgrading to the paid *Pro* version, which offers additional features such as the *filmstrip* gallery type, social sharing capabilities, commenting and much more besides.

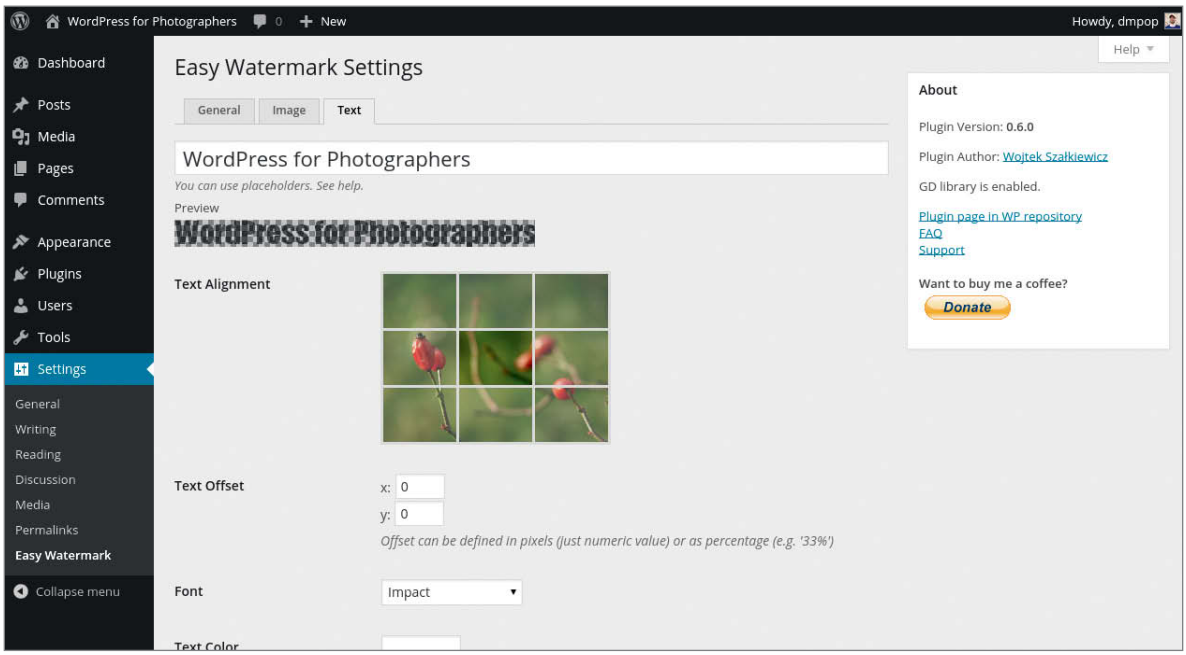
Media Manager Plus

There are dozens of popular photo sharing services out there, and chances are that you use at least one of them to host your photos. Instead of uploading the same photos to *WordPress*, it makes sense to pull them from the service you already use, and this is where the *Media Manager Plus* plugin comes in. The plugin comes with a handful of extensions that can pull photos from popular photo sharing services including Flickr, 500px, and Instagram. The plugin integrates seamlessly with the *WordPress* media manager, making it simple to access and use photos from third-party services.

Before you can put *Media Manager Plus* to practical use, you need to connect it to at least one photo sharing service. To do this, choose Media > Media Manager Plus from the navigation bar in the *WordPress* administration interface, switch to the Available Sources tab, click the 'Connect' button next to the desired service and follow the connection procedure. To configure the plugin's settings, switch to the General Settings tab and adjust the default settings as desired.



Using the *Media Manager Plus* plugin, you can search for photos using criteria such as user names and tags



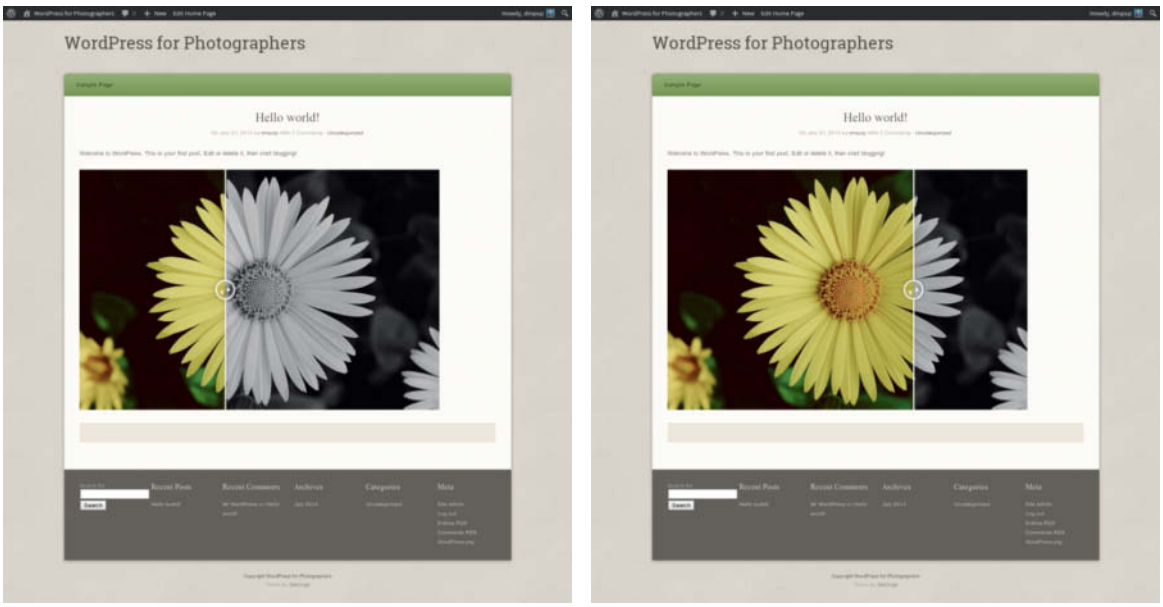
Easy Watermark **enables you to apply image and text watermarks to your photos**

The plugin can access all public photos hosted on 500px and Flickr, so you can use photos taken by other photographers in your blog posts too – assuming, of course, that you have obtained permission from the author first. Alternatively, you can use the license options filters to configure Media Manager Plus to return photos released under specific licenses, such as Creative Commons variants or free usage. You can also enable the *Safe Mode* option to exclude nude and explicit photos. When you are done configuring the plugin, be sure to click the 'Save Changes' button.

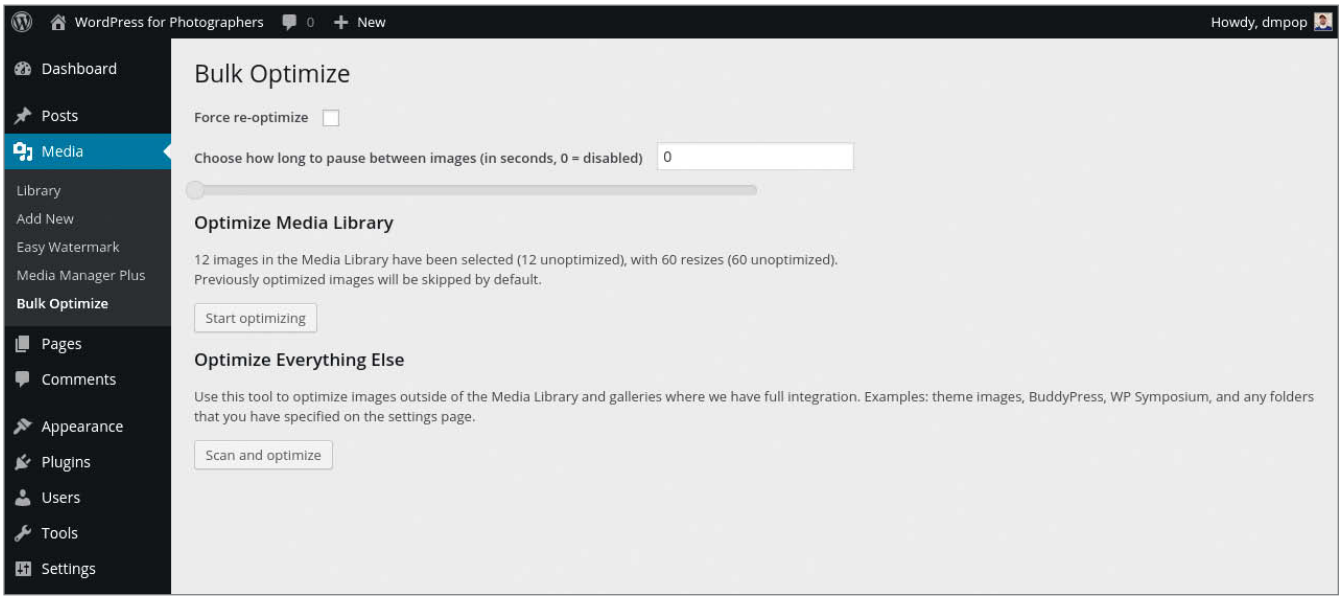
Next time you use the 'Add Media' button to insert a photo into the currently edited blog article, you will find new items such as 'Insert from Flickr', 'Insert from 500px'. When you click the 'Insert from Flickr' item, you can use a combination of search categories and specific search terms to find matching photos. For example, if you want to find all your own photos, select User Images from the drop-down list, enter your user name into the search field and hit 'Enter'. The default extensions in *Media Manager Plus* are available free of charge, but if you want to connect the plugin to other services such as Facebook, Dropbox, and EyeEm, you need to buy appropriate modules. The list of paid extensions also includes the *Media Manager Plus Importer* module which adds the ability to import photos into your blog's media library. This extension can be particularly useful if you prefer to store the photos you use in your blog locally.

Easy Watermark

Love them or hate them, watermarks remain a popular solution for protecting photos from unauthorized use. Manually watermarking



The *TwentyTwenty* plugin uses a slider to combine 'before' and 'after' views in a single image



***EWWW Image Optimizer* can optimize photos on the fly during upload and can also bulk optimize all photos in the media library in one go**

each photo you upload to your *WordPress* blog is obviously not very practical, but the *Easy Watermark* plugin is designed to do all the hard work for you.

The first thing you need to do once you've installed the plugin is to configure it. To do so, select Settings > Easy Watermark from the navigation bar in the *WordPress* administration interface. If you want the plugin to automatically add a watermark to all photos you upload, enable the *Auto Watermark* option. The plugin can handle image and text-based watermarks, and you can select the desired option from the Watermark Type drop-down list. If you choose the *Image* or *Image+Text* watermarking option, you have to upload a watermark image using the Image tab, whereas the *text only* option is configured in the Text tab, where you can specify alignment, font, color, text and opacity options. Don't forget to click the 'Save Changes' button when you are done configuring your settings.

The plugin provides several ways to watermark photos. If you enable the *Auto Watermark* option, the plugin automatically applies a watermark to the photos you are uploading. Alternatively, you can add a watermark to individual photos immediately after you have uploaded them by clicking the 'Edit' link next to the photo and clicking the 'Add Watermark' button. This then changes the status of the affected images to 'watermarked'. It's also possible to watermark photos that are already stored in the media library by switching to the Media Library interface using the 'Add Watermark' link next to each photo.

The plugin can also apply watermarks to all photos in the media library at once. To run this action, choose Media > Easy Watermark from the navigation bar in the administration interface and click the 'Add watermark to all images' button. Use this option with caution, as it does exactly what it says with no exceptions.

TwentyTwenty

Imagine you are writing a tutorial on retouching photos. To illustrate the techniques you are describing, you might want to include original and adjusted versions of your images, and this is where the *TwentyTwenty* plugin comes into play. It uses a simple slider to dynamically combine 'before' and 'after' views in a single image. Using the plugin is really easy – all you have to do is insert your original and adjusted images into a blog post and add the [twentytwenty] shortcode before the original photo and [/twentytwenty] after the adjusted one.

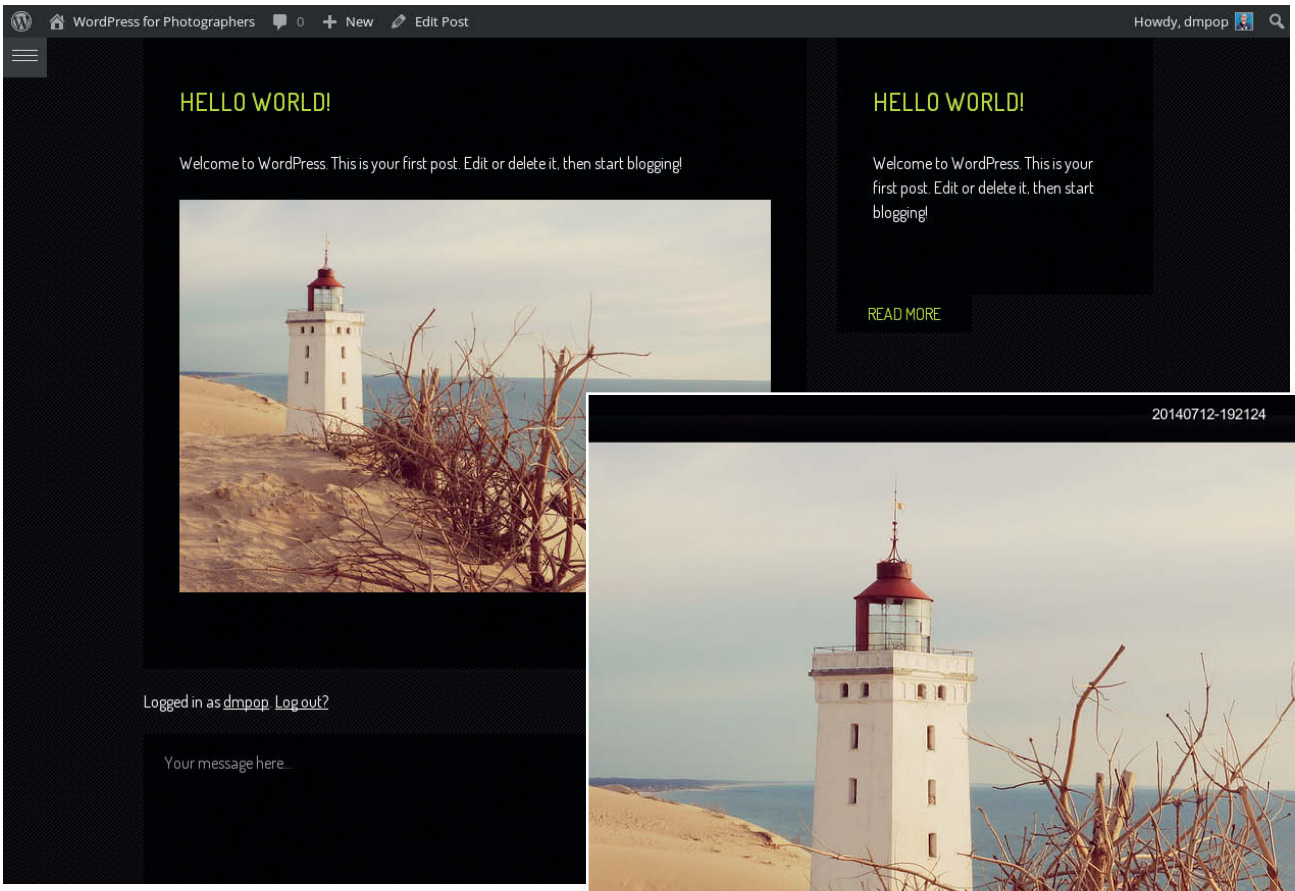
EWWW Image Optimizer

Optimizing photos published in a *WordPress* blog can improve page loading times, reduce bandwidth and help keep backups small.

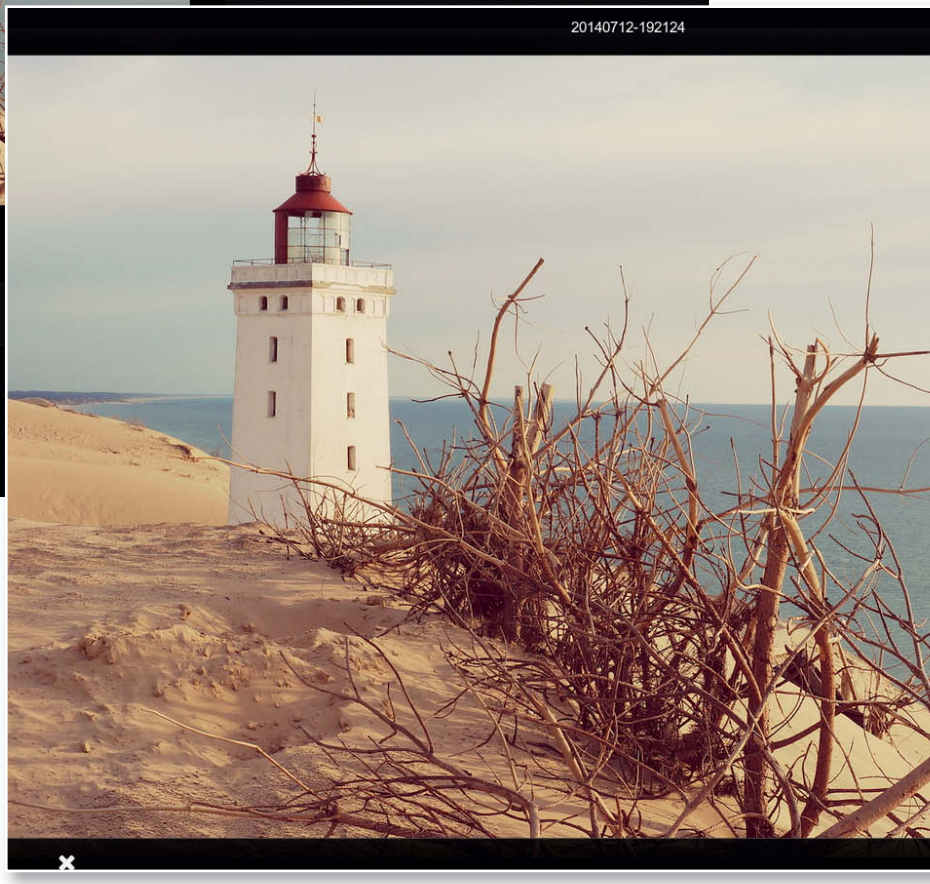
If you want to trim some of the fat off the photos in your blog, *EWWW Image Optimizer* is definitely worth a try. This plugin uses a tools such as jpegtran, OptiPNG, PNGOut and others to perform lossless optimization of images. In this case, 'lossless' means that the process doesn't affect the overall quality of the final image. Better still, the plugin bundles all the required optimization tools in single user interface, so you don't have to install them manually.

As with most plugins, you need to configure *EWWW Image Optimizer* before you can use it. As usual, once you have installed and activated the plugin, you will find the settings options in the Settings section of the navigation bar in the *WordPress* administration interface. Instead of using the bundled optimization tools, you can configure the plugin to perform optimization using an external cloud service, but to enable this feature you need to purchase and enter an API key. Unless you are working with very large numbers of images, the local tools will usually suffice.

Although *EWWW Image Optimizer* features a wide range of configurable options, it works well with its default settings, so there is no real need to tweak anything if you don't want to. If you do fancy adjusting the plugin's settings, all its configuration options contain brief descriptions, so you shouldn't have any problems figuring out what they do. Once installed and enabled, the plugin automatically optimizes all photos during upload. It also adds the 'Re-optimize' and 'JPG to PNG' commands to the Media Library interface. 'Re-optimize' lets you optimize an individual image, while the 'JPG to PNG' command converts JPG files to the PNG format, which is useful for optimizing graphics



In the standard *WordPress* view, even high-resolution images don't use all the available desktop space



***Responsive Lightbox* makes it possible to display photos in a frame-filling lightbox overlay. The plugin supports several lightbox variants that can be individually configured as required.**

(logos, banners, etc.) that you use in your blog. It is, however, less suitable for use with photos, as applying it removes all metadata.

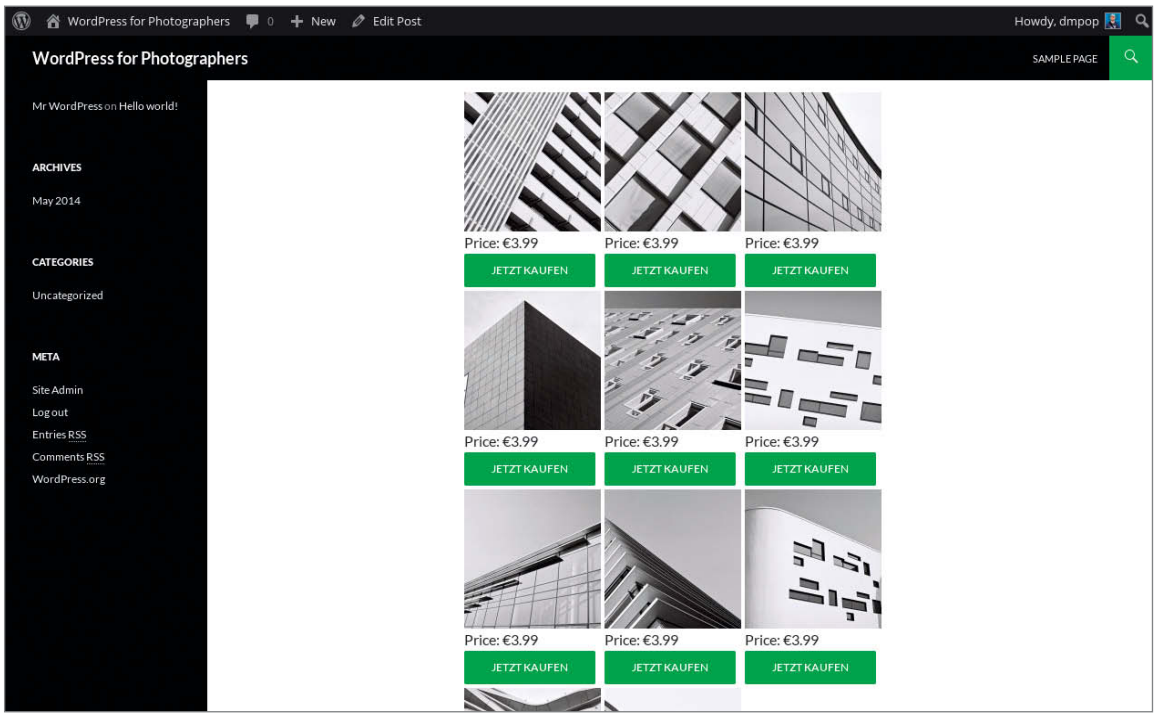
Thanks to its bulk optimization functionality, *EWWW Image Optimizer* makes it possible to optimize all photos and images in the media library in one fell swoop. When you do this for the first time, you need to import images from the media library using the 'Import Images' button. Once you've done that, load the Bulk Optimize interface. You can then optimize photos and images stored in the media library using the 'Start optimizing' button, or you can hit the 'Scan and optimize' button to optimize all images, including those stored outside the media library (for example, graphics files used in themes).

Responsive Lightbox

By default, *WordPress* doesn't offer a many options for displaying large versions of photos in a blog post, but *Responsive Lightbox* fixes this shortcoming by adding a stylish variable lightbox overlay that adjusts automatically to fit the available screen space. *Responsive Lightbox* works perfectly straight out of the box but nevertheless features a handful of options for you to play with. You can select the type of lightbox you want to use in the General Settings tab and you can adjust its settings in the Lightbox Settings tab. For example, if you select the FancyBox lightbox, you can toggle the overlay option, enable the 'Escape' button, show navigation buttons and adjust other settings too.

WP iSell Photo

WordPress is great for showcasing your photos, but what if you want to give your readers the opportunity to buy your photographic masterpieces? *The WP iSell Photo* plugin is a simple solution thtat adds a PayPal button to each photo in the gallery.



WP iSell Photo **enables you to sell photos and prints using PayPal as your payment method**

To use the plugin, switch to Settings > WP iSell Photo and fill out the required fields. You can then create a gallery in the uaual way before switching to HTML mode in the article editing interface. Locate the gallery shortcode, which should look something like this:

[gallery ids="6,7,8,9,10,11,12"]

To enable a PayPal button, all you have to do is add *amount* (price) and *button* (button label) attributes to the shortcode. For example, if you want to set the price to 5.99 and the label to 'Buy It Now', the shortcode should read as follows:

[gallery ids="6,7,8,9,10,11,12" amount="5.99" button="Buy It Now"]

The *WP iSell Photo* plugin is very simple to use, but only supports PayPal and doesn't ensure that payment is received before any data is transmitted, the way sites like fotolia.com do. It is nevertheless a great way to offer your readers the chance to make an in-blog purchase.

Conclusions

This article covers only a fraction of the photography-related plugins available in the official *WordPress* repository. Some projects never progress further than their first iteration, so it is always a good sign if a module's changelog shows a long development history with regular updates. If you dig further, you'll find plenty of other plugins that can help you to display photos, create and manage galleries, process individual images, sell prints and much, much more besides. Remember, too, that many commercial and donationware projects offer real added value. Whichever plugins you choose, have fun expanding and enhancing your blog. (sts)

WORDPRESS PLUGINS FOR PHOTOGRAPHERS

Name	URL	Available Languages	Price
Rocket Galleries	http://wordpress.org/plug-ins/rocket-galleries/	English	free (open source)
NextGEN Gallery	http://wordpress.org/plug-ins/nextgen-gallery/	English	Basic version free, Plus US$49, Pro US$99
Media Manager Plus	http://wordpress.org/plug-ins/uber-media/	English	Basic versino free, additional import modules US$5-9
Easy Watermark	http://wordpress.org/plug-ins/easy-watermark/	English, Polski, Français, Español, ру́сский	donationware
TwentyTwenty	http://wordpress.org/plug-ins/twentytwenty/	English	free (open source)
EWWW Image Optimizer	http://wordpress.org/plug-ins/ewww-image-optimizer/	English, Românește, Español, Nederlands	donationware
Responsive Lightbox	http://wordpress.org/plug-ins/responsive-lightbox/	English, Français, Deutsch, 日語	donationware
WP iSell Photo	http://wordpress.org/plug-ins/wp-isell-photo/	English	free

Ralph Altmann

Infrared Photography

Infrared photos show the world in a completely new light. Digital sensors or special film can be used to capture image data that lies beyond the limits of the visible spectrum, where you can find highly unusual color and contrast effects. This article explains what infrared light is and introduces the techniques required to capture and process your own infrared images.

Canon EOS Rebel T3i/600D | Non-specific conversion/Astronomik 742nm clip-in filter | ISO 100 | f7.1 | 1/500 s | Channel swap in Difference blend mode

We live in the midst of a flood of invisible light that is in fact just as bright as the familiar visible spectrum, which contains electromagnetic waves with wavelengths that range from 400 nanometers (blue) to 700 nanometers (red). Shorter wavelengths belong to the ultraviolet spectrum and are responsible for tanning our skin in the sun, while we perceive longer wavelengths in the form of warmth. Wavelengths that are slightly longer than visible red generate no perceptible warmth and are referred to as Near Infrared (NIR) waves. The electromagnetic waves involved in infrared photography are the 'A-band' NIR waves with wavelengths of 780-1450 nanometers (nm).

The Sun is the main natural source of infrared light, although artificial lights also produce some infrared frequencies as an unplanned side effect. Specially designed infrared spotlights and flash units that produce only invisible radiation can be used to capture nighttime photographs – of nocturnal animals, for example. Living organisms and even comparatively cold objects produce infrared radiation too, but of such long wavelengths (10,000 nm and more) that you would need to use specially made semiconductor-based sensors to capture images of them using a process called thermal imaging.

The silicon-based chips that digital camera sensors are based on can only capture a very small part of the infrared spectrum, but even these frequencies are usually suppressed for technical reasons. If you have an old digital camera lying around (and you don't mind possibly breaking it), you can convert it into a specialized infrared camera. You can then shoot handheld using exposure times very similar to those you would use under everyday shooting conditions.

But you don't have to dive in and dismantle your camera to experiment with infrared effects. With the right filter, a tripod and long exposure times, virtually any digital camera can be used to capture infrared images. But before we go into the technical details, let's take a look at what infrared (IR) photography is and what makes it so fascinating.

The Wood Effect

The world looks very different in infrared light. Leaves and grass reflect IR light almost completely and appear very bright (tending toward white). This effect was discovered by US physicist Robert Williams Wood almost 100 years ago.

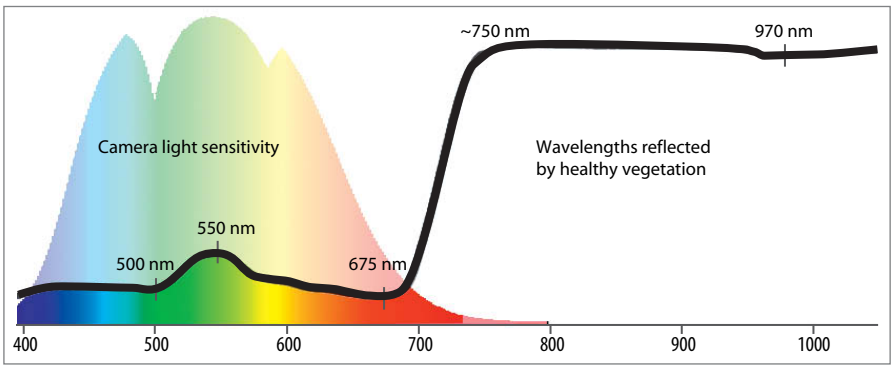
IR light is not, however, reflected by the chlorophyll in leaves, which is transparent to IR frequencies, but rather by the lower layers of spongy parenchyma that make up the flesh of a leaf. This is why patterns on the surface of leaves disappear almost completely in IR images. Many other pigments also behave as if they are non-existent in IR light: black T-shirts appear white and sunglasses become transparent. Skin takes on a smooth, waxy look and everyday blemishes disappear. IR photos also unmask dyed hair, but the purported ability to look through people's clothing using IR light is a myth and was probably only possible in the case of some early nylon fabrics.

The Wood Effect drastically alters the distribution of contrast in landscape scenes. Regardless of how dark they are in normal light, plant-based greens appear bright, so leaves and evergreen needles contrast strongly with stems, branches and other non-green material, giving IR images of thick, dark forests a translucent, finely detailed look. The unusual mood in IR images of forests is underscored by the extremely dark blue tones the technique produces. Blue skies become almost black without the use of a polarizing filter and clouds appear especially bright and three-dimensional. Mist and fog disappear completely. Many IR photos appear to have been created by inspired painters rather than by the sensor in a digital camera. Our image of the Muskau Palace in Görlitz, Germany on page 108 is a great example. These types of effects simply cannot be simulated digitally.

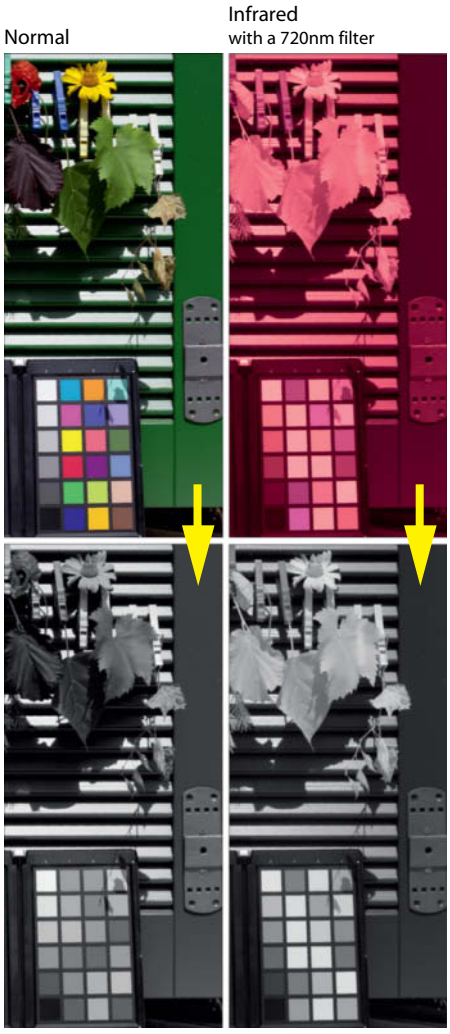
In this article

What Color is Infrared?

The fact that we perceive green as green, red as red and blue as blue actually has nothing



Viewed in infrared light, the green of plants and trees appears much brighter than it does in visible light



In black and white, infrared green tones appear darker than normal

Which colors you use to tone the IR-reflective plants and trees in your images is largely a matter of taste and depends on the effect you wish to achieve as well as the degree to which you are prepared to distort reality

Canon EOS 600D | Neutral modification/Heliopan RG 645nm filter | ISO 100 | f7.1 | 1/320 s | Post-processed in *Photoshop*

to do with the physical attributes of light waves. Color is purely interpretive and is the result of a trick played by the human brain that enables us to distinguish between various wavelengths of light when we view them simultaneously. The 'hardware' required to distinguish between different wavelengths are the rods, cones and ganglions that make up the human retina. The different types of cells are sensitive to different portions of the visible spectrum. To perform the same function in a digital camera, an array of different colored microlenses is positioned in front of the sensor, thus creating photoreceptors with differing maximum sensitivities of 450 nm (blue), 550 nm (green) and 630 nm (red). Mixtures of these three primary colors are then used to recreate all other visible colors.

The same is true for infrared frequencies, but we have no innate mechanism for 'encoding' these strange 'colors'. What we can do, however, is redistribute the colors we can perceive among the wavelengths we capture. This is simultaneously the charm and the challenge of color infrared photography. In principle, it is nothing more or less than a specific type of pseudocolor editing. Photos are often recolored for documentary purposes, but ours is a much more artistic approach. Successful infrared photos don't completely change the colors in an image, but instead skew familiar colors to give us a new view of commonplace subjects. This is a great technique for producing images with a fairy-tale feel and giving everyday objects a magical veneer.

Beyond Color

The question of which colors to assign to which wavelengths is only relevant if your camera is capable of differentiating between the wavelengths in question. The translucency of all three colors of Bayer pattern microfilters is very similar above wavelengths of about 800 nm, which means that the photoreceptors in the camera's sensor are all exposed to approximately the same degree. The result is three color channels in which the same image is captured with only slight differences in intensity – in other words, the differences in wavelength are no longer relevant and the captured image is monochrome

If captured using a daylight white balance setting, such an image will consist largely of red tones, whereas using Auto white balance usually produces blue or green tones. The closer a frequency lies to the visible spectrum, the more the red-toned photoreceptors are used to capture it. Most Auto white balance mechanisms are simply not up to the job of differentiating between major color shifts, but manual white balance (applied either during shooting or later during RAW conversion) often does the trick. However, the result is still a weakly toned monochrome image. Further manual toning can produce interesting results, but most photographers prefer to maximize the effect of the increased contrast between the sky, clouds and vegetation by converting such images to pure black and white. Monochrome IR images are often extremely effective but they don't have the surreal, artistic feel of their color counterparts.

All Plants are Pink

If humans were able to see the IR frequencies that lie close to the visible spectrum, we would most likely perceive all vegetation as bright red or pink. Normally, plants appear green because the color of chlorophyl has a wavelength of about 550 nm (a yellowish green) and doesn't absorb as much light as material with neighboring wavelengths. However, green leaves don't reflect much more than 10 per cent of the incident (visible) light. This is why it is so difficult to capture strong greens in vegetation located in the shade or under an overcast sky – without a lot of post-processing, leaves simply look gray

Once we had applied a manual white balance to the original blue-toned RAW image (left), we discovered that almost all the color nuances had disappeared (center). The best treatment for an image like this is to convert it to pure black and white and increase contrast to emphasize the details (right).

Sony DSC-F828 | Nightshot mode/B+W 093 830nm filter | ISO 64 | f2.5 | 1/20 s

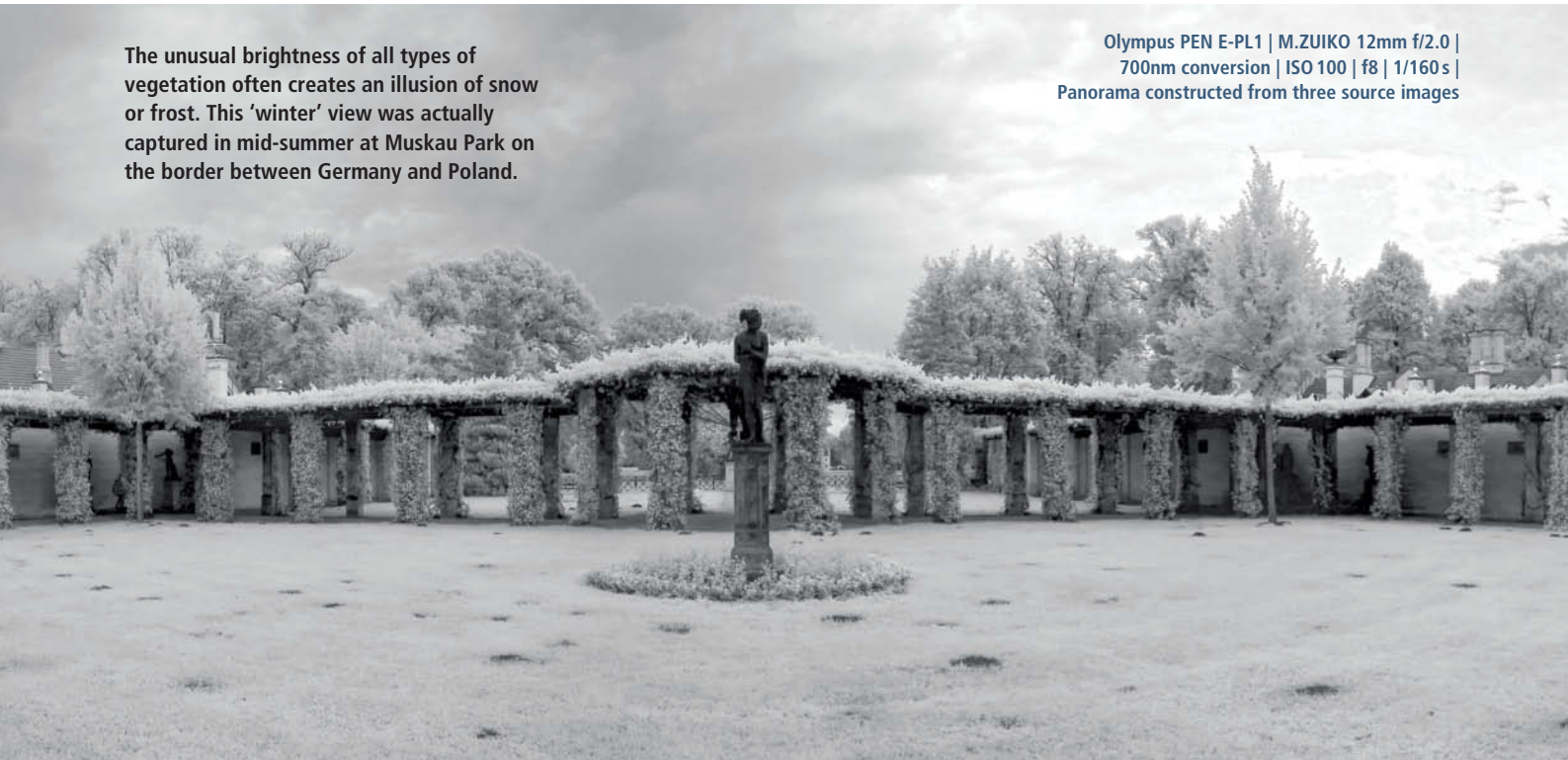
and matt. It is only at wavelengths of 750 nm and more (i.e., just beyond the visible spectrum) that the Wood Effect cuts in and vegetation begins to reflect more light. At these kinds of wavelengths, reflection is up to five times more intense than it is for visible greens, producing really bright image areas where chlorophyl is present.

Photographed in this type of light, plants appear much brighter than blue skies, which is the opposite effect to that produced in visible light. If you check out the individual color channels for a conventional landscape image, you will find that blue sky is brighter than vegetation not just in the blue channel but in fact in all three. In order to produce deep blue tropical-style skies, you will usually need to use a polarizing filter or apply an appropriate effect during post-processing.

Captured in infrared light, skies always appear dark and provide strong contrast with the cloud, producing highly effective monochrome images. If, however, we wish to shoot IR color images that show blue sky, we are confronted with the problem that unprocessed sky in an infrared photo has a reddish brown color. If we make the sky blue using a manual white balance adjustment, the rest of the image ends up looking blue too, because the translucency characteristics of the Bayer pattern microfilters are 'wrong' for capturing infrared images. Relatively short NIR wavelengths activate the red photoreceptors and longer wavelengths the green ones. The very longest ones activate the blue photoreceptors at the right-hand end of the NIR curve (see the diagram on page 114). In IR light, the weak radiation of the blue sky ends up being captured in the red RGB channel instead of in the blue channel.

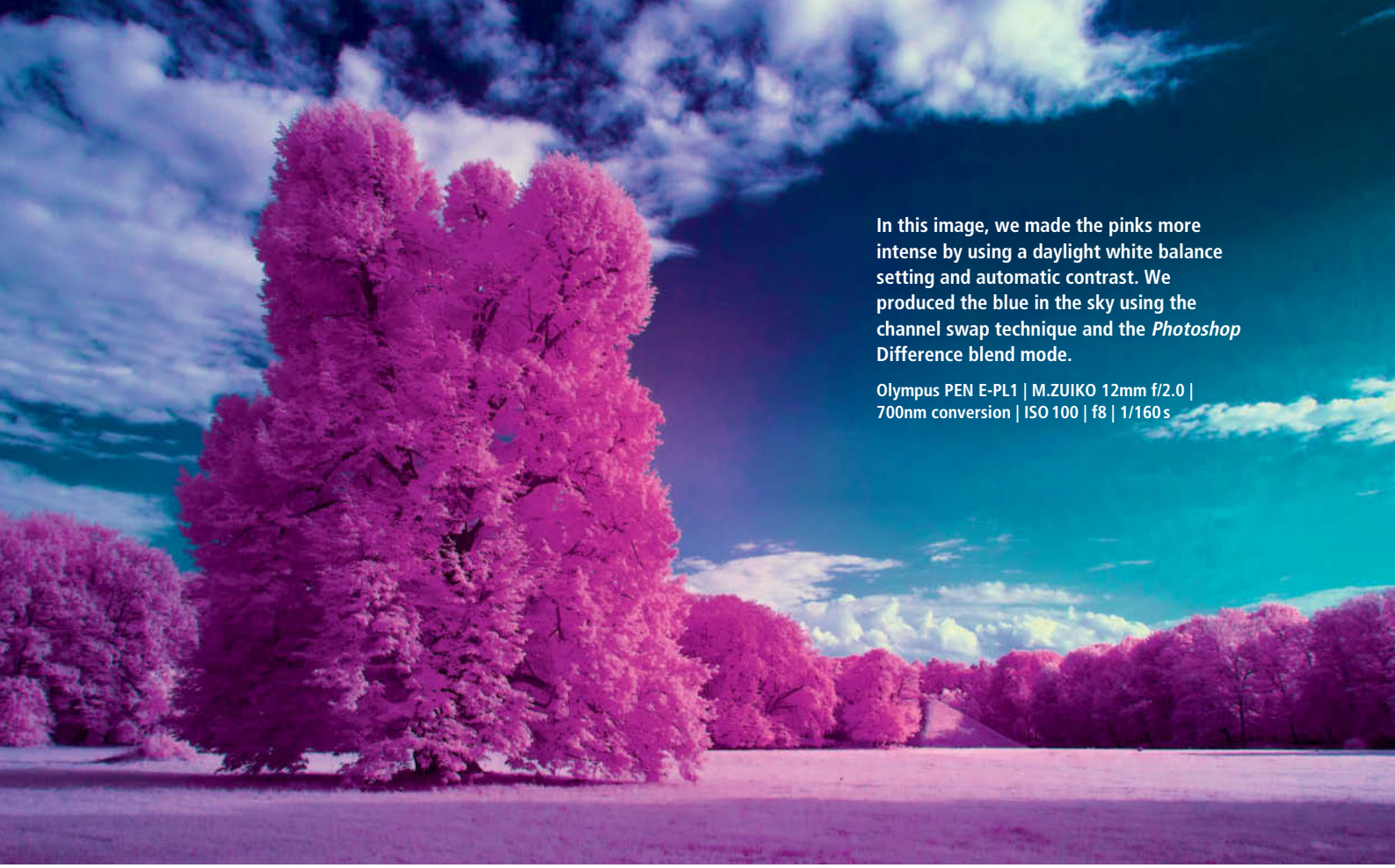
How to Rescue Blue Sky

The obvious solution to this dilemma is to swap the red and blue channels, thus assigning shorter wavelengths to the blue channel and longer ones to red, as is the case for the visible spectrum. This approach turns



The unusual brightness of all types of vegetation often creates an illusion of snow or frost. This 'winter' view was actually captured in mid-summer at Muskau Park on the border between Germany and Poland.

Olympus PEN E-PL1 | M.ZUIKO 12mm f/2.0 | 700nm conversion | ISO 100 | f8 | 1/160 s | Panorama constructed from three source images



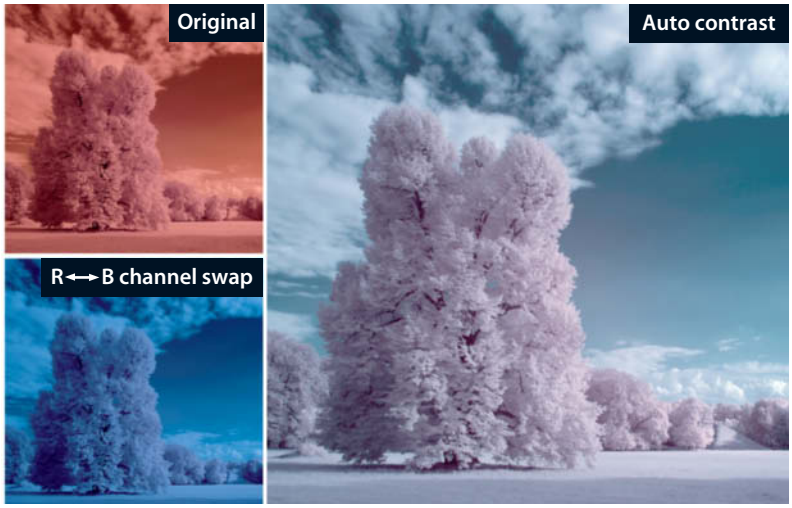
In this image, we made the pinks more intense by using a daylight white balance setting and automatic contrast. We produced the blue in the sky using the channel swap technique and the *Photoshop* Difference blend mode.

Olympus PEN E-PL1 | M.ZUIKO 12mm f/2.0 | 700nm conversion | ISO 100 | f8 | 1/160 s

the sky blue and leaves vegetation red. Unfortunately, the frequencies that the different colored microfilters allow through overlap to a fairly high degree. Red photoreceptors are sensitive to visible red light and frequencies from all parts of the NIR spectrum, while green photoreceptors only become active at the border between the visible and IR spectra (although they are also sensitive to all NIR frequencies). Only the blue photoreceptors display a degree of selectivity; they are only sensitive to IR frequencies.

The exact overlap frequencies vary from camera to camera. Typically (as shown in the graphs overleaf), the blue channel is sensitive to IR frequencies above 820 nm, the green channel to mixed sources at around 720 nm and the red channel to the entire available spectrum (the lower limit is determined by the transmission curve of the IR filter you use and the upper limit by the IR sensitivity of your camera's sensor). The IR light reflected by vegetation can therefore be found in all three channels – a situation that would produce monochromatic colors in a conventional RGB image.

Swapping channels doesn't alter the basic situation but does make the red channel the 'infrared' channel in which pure IR light is captured, while the blue channel becomes sensitive to all frequencies. This means that the original reddish-brown image is recolored in turquoise and blue tones. This effect can be countered using the Levels and White Balance tools and the result is an image with blue sky and bright, pale vegetation. This is the look found in most color IR images on the Web. You can then darken the sky and alter the color of the vegetation digitally. Many photographers like to use yellow for this. See page 122 for more details on post-processing.



Swapping the red and blue channels and adjusting contrast in the resulting channels enabled us to produce a color image from the reddish brown original. To capture such an image, you need an IR filter with a relatively low threshold wavelength that allows some visible red wavelengths to pass.

Olympus PEN E-PL1 | M.ZUIKO12mm f/2.0 | 700nm conversion | ISO 100 | f8 | 1/160 s

Infrared Filters and Their Effects

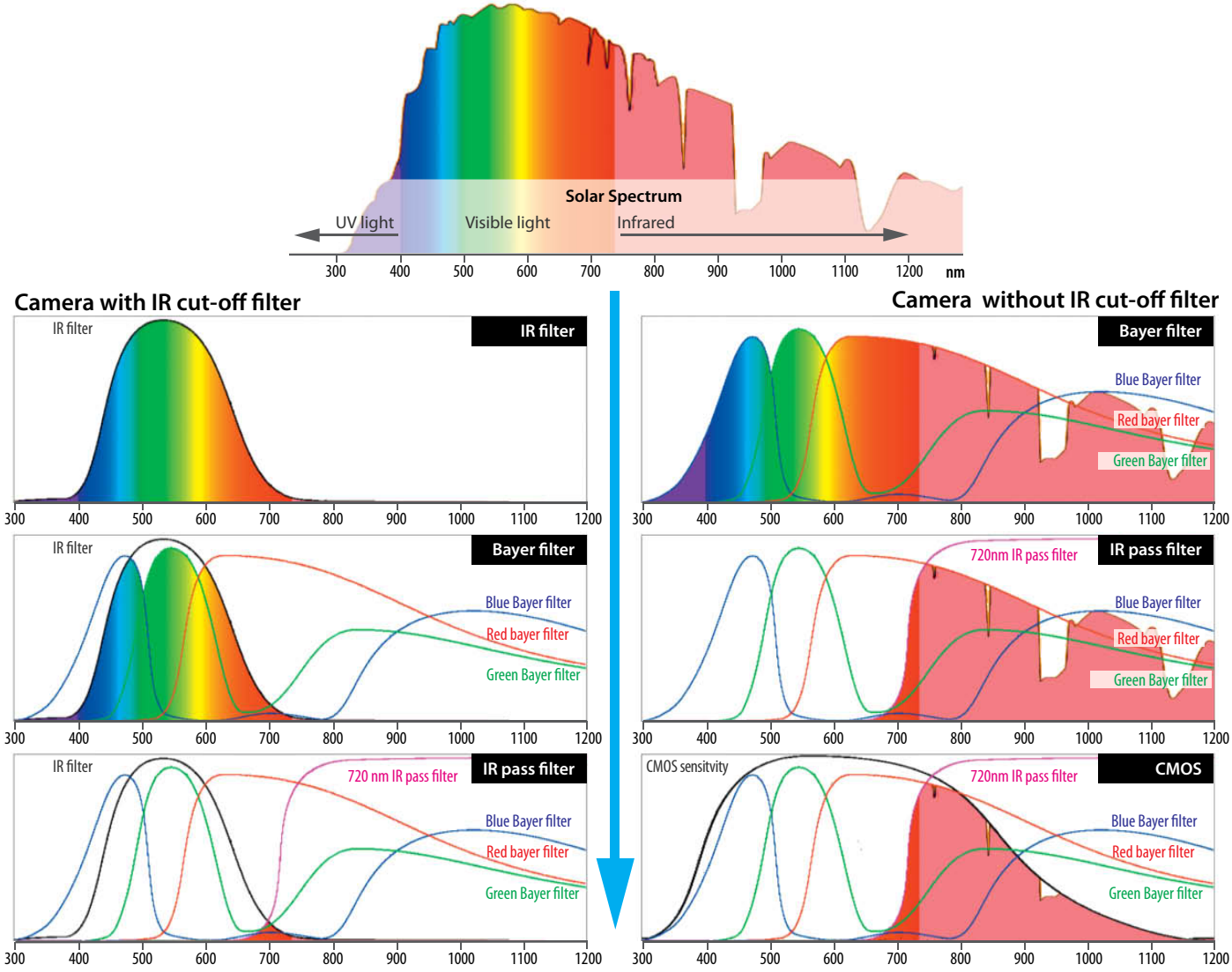
Which of the myriad of wavelengths produced and reflected by a subject end up being part of a digital image depends on a number of factors. Before we explain the effects produced by various types of IR filter, let's take a look at the hurdles light entering the lens has to negotiate before it actually reaches the sensor.

'Sieved' Light

The glass of the lens elements cuts off a lot of the shortwave ultraviolet (UV) frequencies, although the high-end coatings applied to many lenses have a two-edged effect. While they increase translucency by reducing reflection, they only work for a limited range of visible wavelengths. Coatings that work for other wavelengths are only available in expensive special-use lenses.

Conventional coatings have very little effect on IR light. In some cases, they can even create unwanted 'hot spots' in the center of the lens. This is because anti-reflex coatings work by causing deliberate interference and appear thinner to light waves hitting them at an angle. This reduces their effectiveness and can even amplify reflections. The result is that more IR light enters the center of the lens than the edges. Wide-angle lenses set to wide apertures are particularly susceptible, but stopping down can help to reduce hot spot effects.

The next obstacle for IR light is intentional and takes the form of an IR cut-off filter (or simply 'IR filter') located in front of the sensor. IR light hitting the sensor directly would create not only a significant red color cast but also a blurred 'ghost' image.



Each filter layer cuts off some of the light entering the lens. If an additional IR pass filter (in this case with a 720nm threshold wavelength) cuts out invisible light too, virtually no light will reach the sensor in a conventional unmodified camera (left). In a camera without a built-in IR filter, the sensitivity to IR light is determined by the limits of the sensor's own sensitivity (right). These diagrams are based on typical curves.

A 'hot spot' ensues when a lens allows perpendicularly incident IR light through but blocks most of the IR rays entering at an angle (i.e., at the edges of the lens)

Olympus E-PL-1 | M.ZUIKO 75mm f/1.8 | 700nm conversion | ISO 100 | f9.0 | 1/40 s

The shorter the wavelength of incident light, the 'bluer' it will be and the more it will be refracted on its way through the lens. Known as 'dispersion', this effect causes the chromatic aberrations that lead to fringing effects, especially in wide-angle and/or poorly corrected lenses. In order to capture a sharp image in infrared light you therefore have to reduce the focus distance slightly. The distance scale on some manual-focus lenses even includes a separate IR distance mark to help you re-adjust focus once you have set up a shot.

Theoretically, you have to use a small aperture to create a sharp image using wavelengths that range from short (blue) to infrared, but using too small an aperture increases the risk of diffraction blur – and the greater the wavelength of the incident light, the greater the risk. As you can see, it is almost impossible to cater for all the incident wavelengths, and an IR cut-off filter is a prudent tool to use to remedy some of the negative effects. To make everyday IR photography flexible, practical and worthwhile, there is no real alternative but to remove the camera's built-in IR filter (see page 117), although doing so also causes a new set of issues that have to be addressed. Many IR photography techniques are similar to those used by astrophotographers, who also have to deal with light waves at the limits of the visible spectrum.

In spite of all these limitations, it is still possible to capture IR photos using a standard, unmodified digital camera. The attributes of built-in IR cut-off filters vary from manufacturer to manufacturer, and most still allow some NIR frequencies to pass. Most visible frequencies have to be cut out too, and the best way to do that is by using an additional screw-on or slip-on IR pass filter with a specific threshold wavelength. Because pass filters and cut-off filters work against each other, you need to use extremely long exposure times to compensate – the 'better' the cut-off filter the longer the resulting exposure time will be.

The Bayer pattern microlens/microfilter array makes up the final filter layer. If this were optically perfect (i.e., it really did only allow pure red, blue and green light to pass), camera manufacturers wouldn't need to use cut-off filters at all, but then using conventional digital cameras for infrared photography would be out of the question too. Fortunately, the infrared translucency of red Bayer pattern microfilters drops off slowly and the green and blue microfilters allow IR frequencies through again at wavelengths above 700 nm.

The photoreceptors in the sensor are the final link in the filter chain. These are not sensitive to all light waves that reach them. Silicon-based photoreceptors can 'see' wavelengths of up to about 1,400 nm (CMOS sensors are slightly less sensitive than CCDs), which makes them unsuitable for use in purpose-built infrared cameras.

These are the limits within which we can now begin taking infrared photos.

Which Filter Is Best?

At 750 nm, the Wood Effect is about as pronounced as it gets, and the reflections caused by vegetation don't get much brighter, even at longer wavelengths. If an IR pass filter has a threshold wavelength of 750 nm, vegetation appears increasingly monochrome and detail-free, producing fantastic, fairy-tale landscapes like the one reproduced on page 112. Be careful not to select too high a threshold value – the effect of a 1000nm filter is not much different from that of a 850nm filter, but will reduce contrast and often sharpness too. The risk of producing unwanted hot spots also increases with the threshold wavelength. In order to cut through most haze, wavelengths of 800 nm or less will usually suffice.

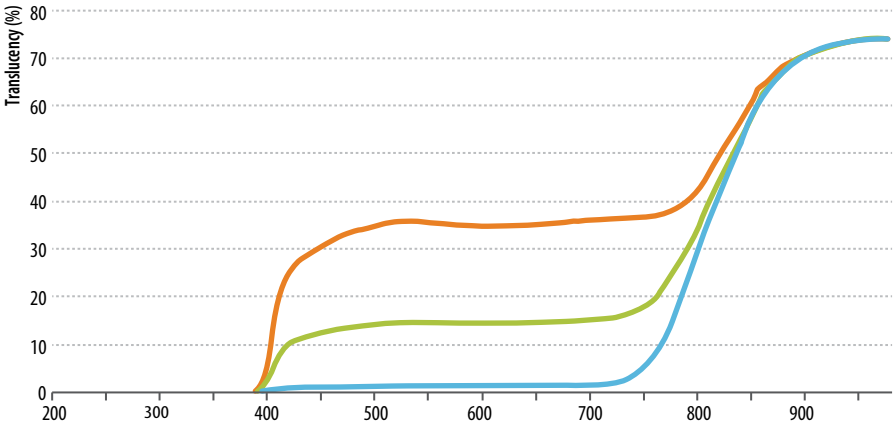
Captured using a filter with a threshold of 720 nm or less, vegetation will still appear monochrome but will be much more detailed. The more infrared ambient light in a scene, the weaker the filter needs to be in order to produce a visible Wood Effect. 645 nm is enough in bright sunlight, while 750 nm is a better choice in overcast weather. Because they require relatively short threshold wavelengths, color IR photos are virtually impossible to capture in the shade.

But not all filters are the same, even if they are engraved with the same numbers. These only indicate the wavelength at which a filter shows 50 percent of its maximum translucency but don't tell us anything about its transmission curve. A 720nm filter may allow more visible light through than a 715nm filter. In absorptive filters, the steepness of the curve depends largely on the thickness of the glass the filter is made of. The thinner the glass, the shallower the transition between

MC Vario ND open (f6.3 | 1/500 s)

MC Vario ND half open (f6.3 | 1/160 s)

MC Vario ND closed (f6.3 | 1/125 s)



The curves on the graph show the degree of translucency of the Rodenstock Digital Pro MC Vario ND filter when open (orange), half open (green) and closed (blue)

the cut-off and translucency zones. If you are replacing your camera's built-in filter, a new filter cannot be thicker than the one it replaces. Interference filters achieve their effects using coatings etched onto the surface, so their effectiveness is independent of their thickness. Interference filters are, however, only usually used for specialized astronomical applications.

Long-pass filters are the ones most widely used for IR photography. These block all light below their threshold frequency and allow all longer wavelengths to pass through. Threshold values lie between 600 nm (deep red) and 1000 nm. Heliopan makes filters with values of 610, 645, 665, 695, 715, 780, 830, 850 and 1000 nm and prices start at around US$130 for a 58mm model. Other well-known filter manufacturers offer just one or two models – for example, B+W (695 and 830 nm), Hoya (720 and 900 nm) and Cokin (720 nm). The clip-in filters from astronomik.com (see page 119) come in 742 and 807nm versions. Astronomik has announced that 'band pass' filters specially designed for IR phototography will be available soon. These block all light except that within the 650-850nm waveband.

To use a camera that has been modified for IR use for conventional photography, you need to use a cut-off filter. These are usually available as combined UV/IR filters from a variety of manufacturers. Astronomik sells clip-in OWB (Original White Balance) filters for Canon APS-C and full-frame cameras that enable a camera to simulate its original unmodified white balance behavior. These filters start at around US$160.

Special-Use Filters

Some UV pass filters are transparent to IR wavelengths and therefore function as band pass filters for two separate wavebands. This enables us to retain blue skies in color IR photos without having to swap the red and blue channels (short wavelengths end up largely in the blue channel anyway). The Heliopan UG1 and Hoya U 360 filters are made from Schott UG1 glass and are suitable for this type of application. However, there is probably no affordable lens available that is capable of focusing all the required wavelengths on a single point and some parts of the frame will always end up out of focus. If this applies to the sky and the clouds only, it shouldn't be too conspicuous in the final image.

Our experiments also revealed that some variable neutral density (ND) filters can also be used as IR pass filters. We were originally looking for a filter that prevents overexposure when shooting with the Sony DSC-F828 in Nightshot mode, but neither of the filters we tested fitted the bill. They do block visible light as planned but remained transparent to IR waves no matter how we positioned the two rotating polarizers. According to test measurements provided by the manufacturer, the Rodenstock Digital Pro MC Vario ND filter has a threshold wavelength of 810 nm in its fully 'closed' position. For the Quenox Fader model (available for about US$35 from enjoyyourcamera.com), our own tests revealed a threshold wavelength of around 830 nm and a shallow transmission curve.

The unique attribute of these filters is that you can add visible light to the IR light you capture at will, simply by increasing the degree of translucency. The downside of this approach is that it adds wavelengths from the entire visible spectrum to the mix, and the risk of short-wavelength blur once again rears its head. The relatively high threshold wavelength is also less than ideal for capturing color IR photos. We solved both issues by combining a variable ND filter with a 645nm pass filter, thus creating a hybrid filter that we could precisely fine-tune at wavelengths between 645 and 810 nm. Unfortunately, the effective range of this somewhat clumsy setup is reduced to just a few degrees. Additionally, the Quenox Fader produced inconsistent color errors in its 'closed' position. Our wish for an effective IR pass filter with a variable threshold wavelength remains unfulfilled for now.

IR Photography with Conventional and Modified Cameras

The amount of effort required to capture IR photos depends on the type of equipment you have to hand. The quality of the results, your choice of filter and overall ease of handling depend very much on whether your camera still has its built-in IR cut-off filter, as this will block most of the IR light entering the camera (see the diagram on page 114). If you do decide to remove the filter, there are various approaches you can take.

Amplifying Residual Light

Even with the IR cut-off filter intact, most digital cameras still let in a small amount of residual IR light at wavelengths above 700 nm. You can check whether this is the case for your camera by pointing an infrared remote control at it and pressing a button. If the IR diode on the front of the remote is visible on the camera monitor, your camera is capable of capturing IR photos in its stock configuration. Begin your experiments using a pass filter with a threshold wavelength of 720 nm or more. If you use one with a shorter threshold value, the visible light entering the camera will blot out the IR waves.

You can then amplify the residual IR light by using long exposure times and/or high ISO values. For our test subject, our EOS 60D selected an exposure time of 1/40 s when used with a 720 nm filter and set to f8 and ISO 3200. This represents an increase of more than eight f-stops compared with the exposure parameters the camera selected without the filter (f8, 1/400 s, ISO 100).

Sony's 'Dark Angel'

Various manufacturers have sold a number of camera models without IR cut-off filters over the years, although these were often hard to find and weren't available in all markets. One exception was the widely available Sony DSC-F828 bridge camera, introduced in 2003. In its special 'Nightshot' mode, the camera moves the built-in IR cut-off filter out of the light path. This unique mode was designed for capturing photos in the dark and quickly earned the camera the 'Dark Angel' moniker. Two IR LEDs built into the camera's pop-up flash (or accessory IR lights) illuminate a scene, and the viewfinder and monitor display a low-resolution but adequately bright live view image.

Used with a filter to block visible light, this camera appears ideal for daylight IR photography. However, Nightshot mode is only available in Full Auto and P exposure modes, and the white balance and aperture settings cannot be adjusted. The shortest available exposure time is 1/30 s, making overexposure inevitable in daylight situations. To counteract these shortcomings, you need to use an ND filter that is precisely suited to the prevailing conditions and which doesn't produce over-long exposure times. You can also experiment with a tripod or higher ISO values to compensate, although doing so will of course increase noise. Though no longer in tune with today's technology, the 8 megapixels the camera's sensor resolves deliver adequate resolution. Nightshot mode works in RAW mode too, although it takes 15 seconds to save each image! On the upside, the camera has a high-quality built-in Zeiss 35-200mm f/2-2.8 lens that focuses very quickly, even in pure IR light.

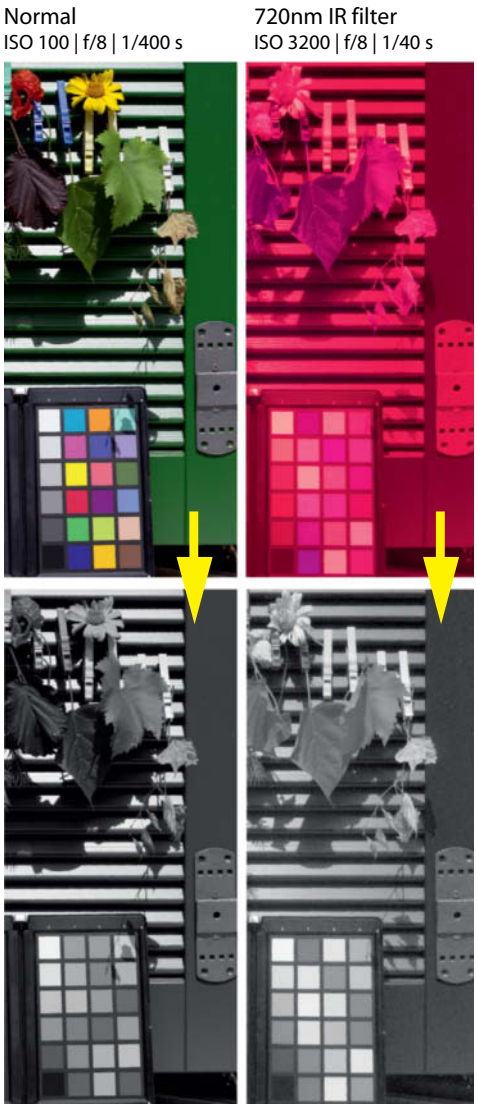
The camera is based on a 2/3" CCD sensor which, instead of the usual three RGB color microfilters, has four 'RGBE' microfilters, whereby 'E' stands for 'emerald'. This makes the camera particularly sensitive to blue tones. In IR light, the sensitivity of the blue channel begins at wavelengths below 700 nmn, so it is even more sensitive to IR wavelengths than the red channel. This makes it difficult to separate the various wavebands involved. To capture color IR photos, you need a relatively weak IR filter that allows visible reds to pass – these tones then become blue when you swap channels during post-processing. You can also use a stronger IR filter to produce black-and-white images with very high contrast.

Infrared Camera Mods

The most effective – but also the most radical – approach is to remove the cut-off filter from your camera. This gives you an IR camera that is easy to handle and guarantees great results. If you already own a camera that you are prepared to cannibalize, having it converted by a specialist shouldn't cost more than a few hundred dollars

You can, of course, dismantle your camera yourself. There are many camera modding guides available on YouTube, although it is questionable whether this approach is worth the effort and the risk. To be on the safe side, we recommend paying a specialist to do the work for you.

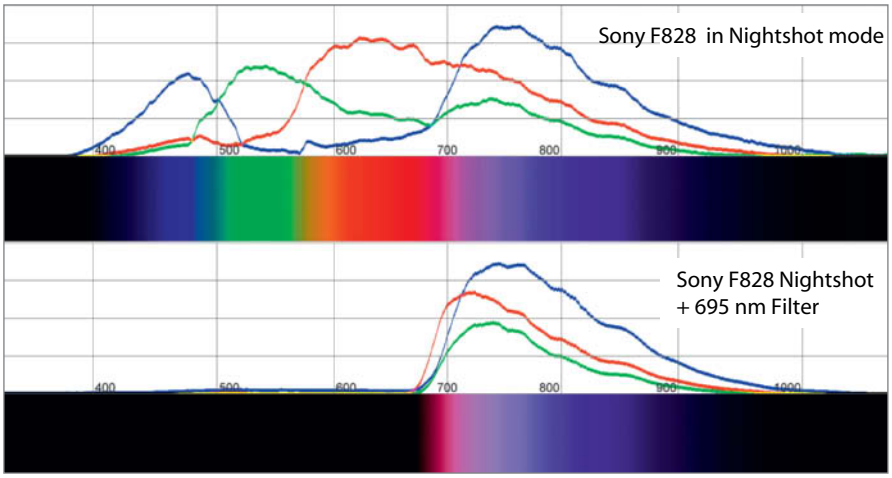
Simply removing the filter shifts the focal plane, so you also have to insert a clear glass sheet with exactly the same refractive index in its place or adjust the position of the sensor accordingly. As far as we know, only authorized Canon service centers are in a position to do this effectively. Phase-detection autofocus no longer works properly in IR light but can be adjusted. Alternatively, you can use live view, as this uses contrast-detection autofocus. This approach makes more sense if you are using an IR filter mounted on the lens, as this means you can't see anything through the viewfinder anyway. However, if you mount an IR filter directly in front of the sensor, you



Used with an IR filter and long exposure times, a conventional camera can capture images of IR light waves. The original color photos were captured using a daylight white balance setting and we increased contrast in the the black-and-white versions to improve detail rendition.

Sony DSC-F828 | Nightshot mode/B+W 093 (830 nm) | ISO 200 | f2.2 | 1/30 s | Black-and-white conversion and contrast increase performed in *Lightroom*

The 'Nightshot' mode built into the Sony DSC-F828 saves you the trouble and expense of modifying your camera. Although limited in scope, this mode enables you to get out and start taking your own IR photos immediately.



The legacy Sony DSC-F828's built-in Nightshot mode makes it unusually IR-sensitive, especially in the blue channel

can use the viewfinder as usual. As you can see, the various approaches all have their pros and cons. The following sections go into more detail on the advantages and disadvantages of each.

Neutral, Non-specific Conversion

The IR cut-off filter is removed and replaced with clear glass or the sensor is realigned (for Canon cameras only).

Advantages: The camera is sensitive to the entire spectrum from UV to IR, and specific wavebands can be selected using appropriate filters. Varying Wood Effects can be achieved using different grades of IR filter. This type of converted camera can also be used to capture UV and astronomical photos and can be used conventionally with an additional IR filter.

Disadvantages: You need at least one additional filter, if not several to fit your various lenses. With the exception of the Astronomik clip-in filters (see opposite) that are available for a range of Canon cameras but don't work with all Canon lenses, the filter has to be mounted on the lens. Because the filter is mounted in front of the mirror, you cannot use the viewfinder and you have to use live view instead. Phase-detection autofocus can only be adjusted to work for one waveband, whereas the contrast-detection autofocus used in live view mode works for all wavelengths, even if it is often painfully slow. Mirrorless compact and system camera are built to work in permanent live view mode and don't suffer from these issues.

Specific Conversion

An IR pass filter replaces the IR cut-off filter.

Advantages: You don't have to mount additional filters on the lens and DSLR viewfinders work as normal. The faster phase-detection autofocus functions too, but has to be adjusted to work with the new configuration.

Disadvantages: The camera can only be used to capture IR photos and you are limited to the threshold wavelength of the new built-in filter. If you take this route, use a filter with the lowest threshold wavelength you are likely to need – you cannot weaken the effect any further later on, although you can increase it by mounting an additional filter on the lens. For example, a built-in 645nm filter is perfect for shooting color IR photos and all you need is an appropriately graded IR filter on the lens if you want to capture high-contrast monochrome IR images.

The thickness of the built-in filter is limited by the space available within your particular camera, which can lead to difficulties in finding a suitably high-quality filter (see page 115 for more details on filter thickness and transmission curves).

Real-world Tests

We were lucky enough to be able to test five different camera conversions, made by four companies who specialize in this type of work. We compared these with our own converted Nikon D70 and the Sony DSC-F828.

As previously mentioned, converted DSLRs suffer from clunky live view-based handling. In the Canon cameras we tested, autofocus was terribly slow and power consumption increased enormously. This made the camera heat up and produce more sensor noise. If you don't want to use live view, you have to set exposure manually and, if focus is set up for use in visible light, you have to focus manually too.

These issues don't apply for the Olympus Micro Four Thirds cameras we tested.

The clip-in filters from http://www.astronomik.com/en/ are available to fit a wide range of APS-C and full-frame Canon bodies but cannot be used with EF-S lenses, which protrude too far back into the camera body

Although these cameras are not known for their super-fast AF, we were able to shoot spontaneous snapshots in visible and IR light. The pale, monochrome IR monitor image can be quite difficult to see in daylight, so the optional electronic viewfinder is a useful accessory to have. In this respect, converted DSLRs with an IR filter located directly in front of the sensor are easier to use because you can always see an unfiltered view of the subject in the viewfinder.

The non-specifically converted EOS cameras used with the Astronomik clip-in filters were easiest to handle and represent one of the cheaper ways to shoot IR with a DSLR. These cameras don't require additional lens-mounted filters, adapter rings, lens hoods or lens caps and can be used conventionally too with an OWB filter. The only limitation here is that you can only use EF lenses (EF-S lenses protrude too far into the camera body and would interfere with the clip-in filter). At the time of writing, Astronomik wasn't able to supply a clip-in filter with a threshold wavelength of 700 nm or less, which is why the Olympus PEN E-PL1 with its specific conversion ended up being our favorite test camera. On the downside, two of our favorite Olympus prime lenses showed obvious hot spots when used with this model. These were unacceptably pronounced with our M.ZUIKO 75 mm f/1.8 and just about bearable with our M.ZUIKO 12mm f/2.0. We produced much better results using a Sigma 30mm f/2.8 and we didn't bother testing zoom lenses at all.

To retain the blue of the sky in IR photos, a camera's RGB curves have to differ sufficiently in both the visible and IR spectra. In this respect too, the Olympus cameras proved to be really useful, with a blue channel that only cuts in at wavelengths above 800 nm and is therefore well suited to conversion to (infra-)red. The curves of the Canon EOS 1200D/Rebel T5 and 600D/Rebel T3i are very similar but, even under near-identical shooting conditions, we still found it difficult to create IR photos with punchy but nevertheless appealing colors.

The Canon EOS 60D loaned to us by an authorized Canon dealer proved particularly tricky to use. Although the IR cut-off filter had been removed, the sensor captured virtually no light at wavelengths above 700 nm. Other companies that specialize in IR conversions also confirmed the same issue with this particular camera model. We were unable to find a satisfactory explanation for the problem by the time we went to press.

Our own measurements revealed a transmission curve similar to that in a camera converted for astrophotography. This type of conversion is not suitable for IR photography because it extends the spectrum the camera can capture only slightly. The curve is much steeper at the red end of the spectrum, making it much easier to photograph galaxies that emanate red light. Canon offers its own factory-made astrophotography cameras such as the EOS 60Da. (All such models are characterized by an additional 'a' in the name.)

With the exception of a couple of camcorder models, Sony's 'Nightshot' feature has disappeared from the market, which is a shame. The technology it utilizes would be perfect for capturing photos across a range of spectra if it weren't for the technical limitations built into the devices that support it. We would also like to see Astronomik's clip-in filters with a broader range of threshold wavelengths and for other camera systems, such as Nikon, Sony or Micro Four Thirds.

It would be great if the IR market could grow enough to give filter makers and niche manufacturers like Astronomik an incentive to create products that fill some of the gaps we discovered.

IR Shooting Tips

Image Format

Always shoot in RAW if you can. This makes it possible to alter white balance after shooting and makes it a lot easier to retrieve highlight and shadow detail that would be lost forever in a JPG image. The ability to process images using 16-bit color depth is also important when you are capturing and editing color IR photos.

Exposure

Judging exposure is quite difficult based on the strange colors that characterize unprocessed IR preview images. Fortunately, auto exposure works fairly precisely in live view mode and you will usually only have to correct exposure by a fraction of an f-stop in order to prevent selective overexposure in a particular color channel. If you don't use live view, the exposure parameters selected by the camera can be completely off-kilter, so you are better off setting exposure manually. Always check the histogram, but remember that this is based on the camera white balance setting. If you apply a new white balance setting later, you may find that your exposure is too dark, which is bad for noise reduction but better than overexposure.

Because longer wavelengths are subject to greater refraction, you won't need to stop down as much as you would for a conventional exposure. In the case of IR photography, f8 is not the universal solution. If you are using a crop-format camera, the optimum aperture is actually a lot smaller than the f-number would lead you to think, so you can usually shoot wide open – provided, of course, that this provides sufficient depth of field.

Exposure times in modified cameras are not much longer than those required for normal daylight photography. If you are working with an unmodified camera and filters, exposure times will be much longer and you will definitely need a tripod.

White Balance

Even if you shoot RAW, the camera white balance setting still affects the monitor display. A neutral- or blue-toned monitor image is much easier to see than the reddish-brown one that results if you select a daylight WB setting. The camera's exposure meter, too, works in conjunction with the WB setting. If the exposure parameters give increased emphasis to one particular color channel (visible in the histogram), the final image will end up underexposed. Some histograms also have built-in overexposure warnings, although the risk of overexposure in an IR context is very slight.

The best WB setting to use is the one that provides three similar RGB histogram curves. The best way to achieve this is to set white balance using a sheet of white paper or sunlit grass as a reference. If you are shooting JPG, setting white balance manually is essential, as you cannot alter your images later without reducing their quality.

If a scene doesn't contain any objects that make a skewed white balance setting too obvious, you can use oddball parameters to create highly atmospheric color infrared photos

Olympus PEN E-PL1 | M.ZUIKO 12mm f/2.0 | 700nm conversion | ISO 200 | f7.1 | 1/200 s

Post-processing IR Photos

If you are shooting black-and-white IR images, you won't have to do much post-processing. Especially if you use a strong IR filter, the RAW image captured by the camera will be largely monochrome anyway. However, the white balance setting you use will strongly influence the differentiation between the individual gray tones in your images and using the wrong setting can easily cause burned-out highlights.

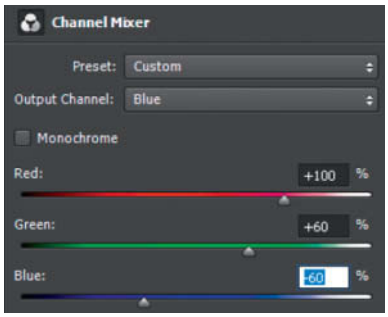
You should apply manual white balance as described on page 120 during RAW conversion at the latest. You can then convert the largely colorless image to grayscale. Some images work well if you select only the highest-contrast channel and discard the others completely.

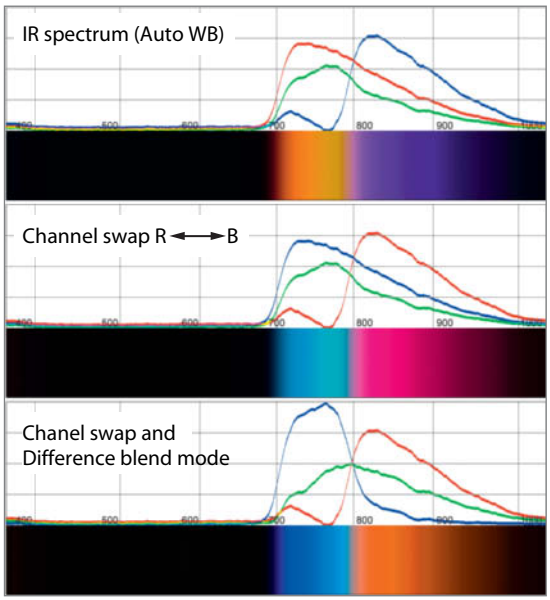
If, on the other hand, you are aiming to produce a color IR image with only partially shifted colors, the 'channel swap' technique described on page 112 is a better option. The more selectively the Bayer pattern microfilters work, the more effective this technique is. The tutorial on the next page gives some tips on how to enhance the effect yourself.

Divide and Rule

Increasing the differences between the individual color channels also increases color contrast. Usually, the red, green and blue channels contain the color data that the Bayer microfilters of the same color permit to reach the sensor. If you subtract the contents of the green and blue channels from the red channel (before swapping the red and blue channels), you will remove all the color data from the red channel that would have appeared in the other two anyway. This makes it easier to selectively adjust the remaining red tones (i.e., visible red and those at the lower end of the IR spectrum).

If, as in the illustration above, the limits of the green and blue curves are far enough apart, it can help to subtract the contents of the blue channel from the green channel too. The green channel then contains only short-wave IR color data with wavelengths similar to those of the red tones. Whether all this theory can be put into practice and the precise weighting of the individual channels required to get good results, depends on the type of camera you use and the number of IR frequencies contained in the captured scene.





Once you have swapped the red and blue channels, it is easier to separate the individual colors if you reduce the blue value

Tutorials and Examples

Our tutorial demonstrates some basic IR image processing steps and the 'channel swap' technique. To save disk space, we deleted the layer mask present in all the adjustment layers, as this was not required for the steps involved.

'Channel swapping' is the simplest way to adjust the colors in color IR photos, although other, more complicated mixtures can be used to achieve even better results that require little additional post-processing.

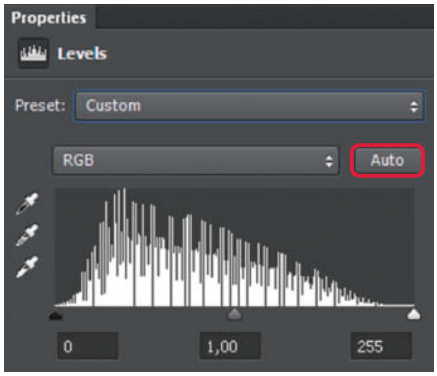
The test image we used for the tutorial was captured using an Olympus PEN E-PL1 with its standard IR cut-off filter replaced by a 700nm IR pass filter. The filter lets a little visible light through and, along with the blue tones captured under the influence of the longer-wave blue Bayer microfilters, produced ideal source material for color IR photos. The 12mm lens we used produced a mild hot spot that is visible as a slight yellow shimmer just to the right of the tree.

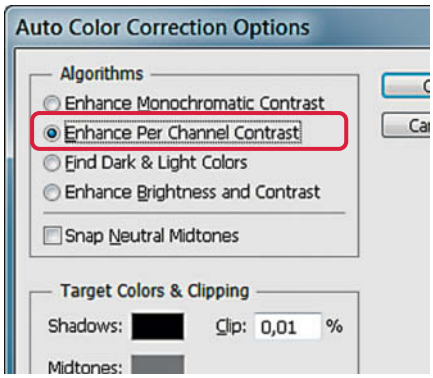
We set white balance to 2850 K in the original image, although just about any color temperature should work in this type of shot. To create usable IR source images, it is best to shoot RAW and save the results to a large 16-bit color space such as ProPhoto RGB for processing. The adjustments are then made non-destructively using adjustment layers.

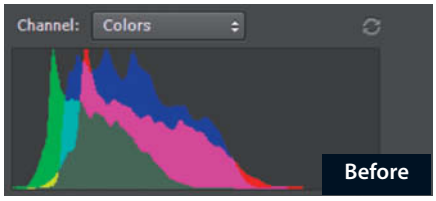
Our test image is included on this issue's free DVD, which also includes a *Photoshop* Action that automatically performs the steps detailed in the tutorial on the next page

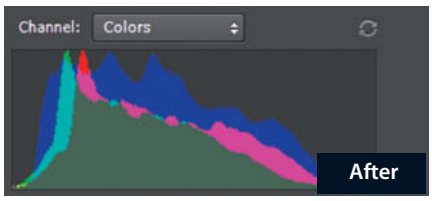
Processing Color IR Photos

1 **Optimize contrast channel by channel:** The first step is to 'stretch' the RGB channels so that the darkest and lightest pixels are represented by true black and white. To do this, create a new Levels adjustment layer and click the 'Auto' button while pressing the Alt key. This opens the Auto Color Corrections Options dialog. Select the *Enhance Per Channel Contrast* option. This has the same effect as the Image > Auto Tone command and extends the RGB curves to fill the entire width of the histogram curve. In our sample image, this makes the clouds almost completely white and gives the tree a blue tint.

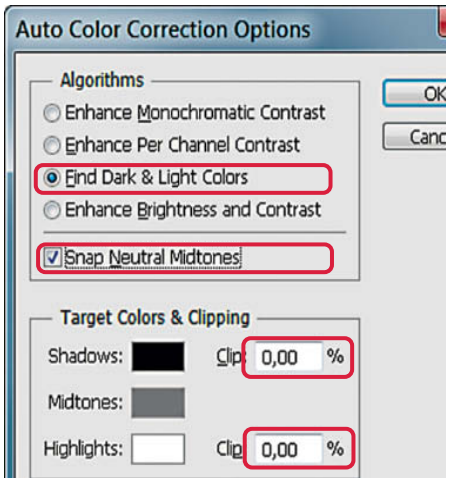




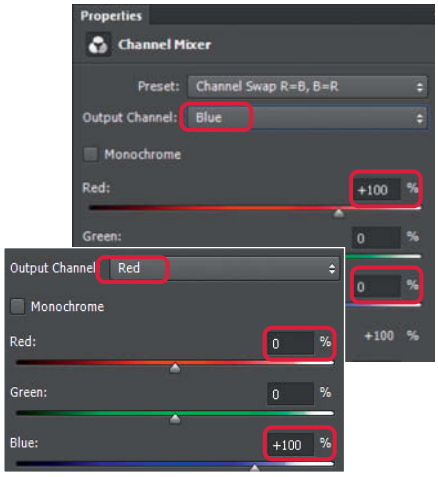




2 **Optimize the colors:** The Image > Auto Color command is another useful *Photoshop* tool that you can use to remove unwanted color casts. In our example, applying the command gives the clouds a really clean white look. Once again, we made our settings via the *Enhance Per Channel Contrast* dialog, this time selecting the *Find Dark & Light Colors* and *Snap Neutral Midtones* options and setting the Clip values to 0. This last prevents the highlights and shadows from being clipped twice. If you prefer bolder colors, or if you want to adjust your colors manually (which is easier with bold colors), you can always hide this layer.

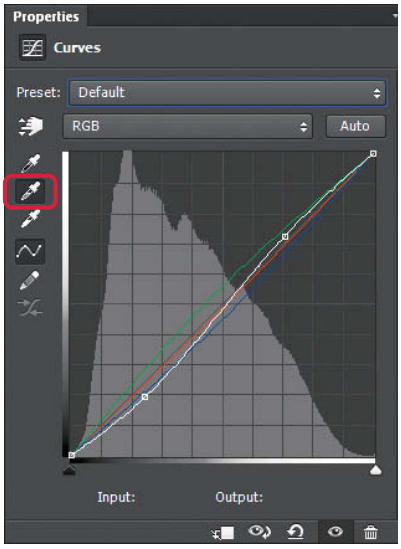


3 **Swap the red and blue channels:** Create a new Channel Mixer adjustment layer, delete its layer mask and make the red and blue channel settings shown in the illustration. This swaps the contents of the channels and often turns the sky blue while giving vegetation a yellow or red tint. Save the Channel Mixer settings as a preset to save time on your next attempt. You can, of course, try out and save your own Channel Mixer 'recipes'.

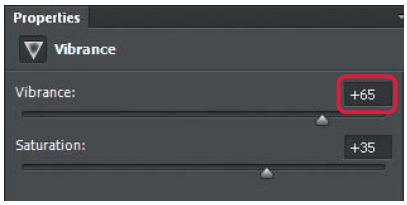


Processing Color IR Photos

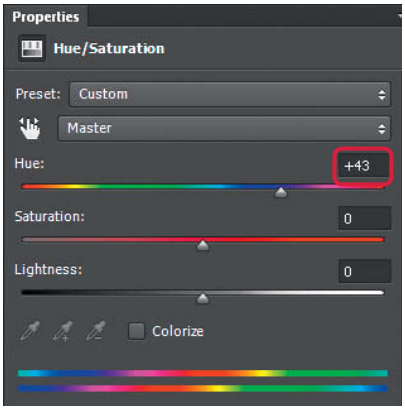
4 **Set contrast and the gray point:** We used a Curves adjustment layer to adjust brightness and improve global contrast. The settings shown here darken the sky a little and give the image a feeling of greater depth. We used the gray point eyedropper to remove the color cast from the clouds, although this shifted the tone of the sky toward green.

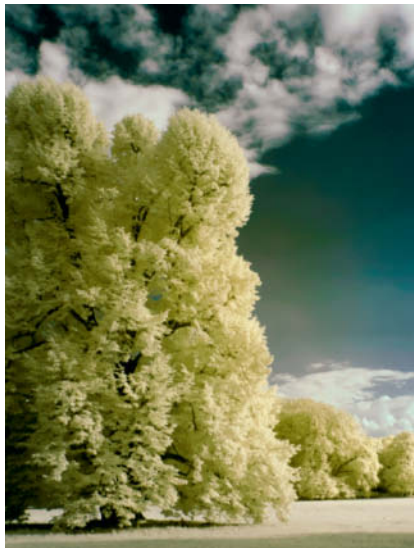


5 **Increase vibrance:** We then used a Vibrance layer to subtly increase saturation. The Saturation slider affects all colors, while the Vibrance slider primarily affects green and blue tones, leaving reds and yellows largely unchanged. The individual colors can be even more selectively adjusted using a Hue/Saturation adjustment layer, although this tool's Saturation slider works on a much coarser basis.



6 **Adjust the colors:** We used a Hue/Saturation layer primarily to shift colors. A Hue adjustment of +43 gave the sky the deep blue tone we were looking for while changing the color of the leaves to yellow. This is a typical IR look. If you want to retain the pink hue in your image, you only need to shift the color of the sky once you have selected your basic colors. To do this, use the On-image Adjustment tool (the 'hand' icon) in the Layers panel, and then use the eyedropper that appears to select the color you wish to change.





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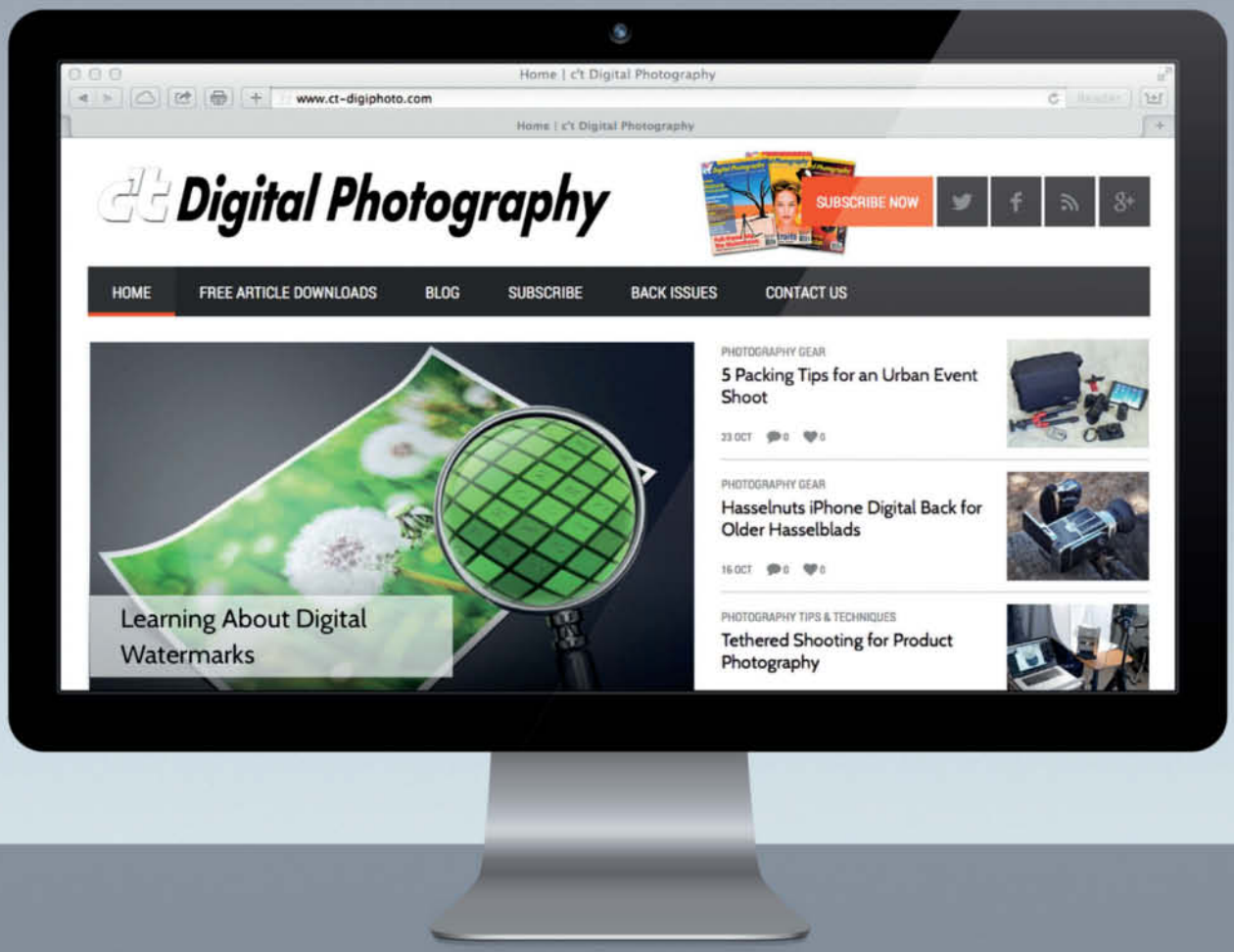


We invite you to look around the new c't Digital Photography website! The teams in both the U.S. and Germany are beyond excited to present this shiny new online home for c't Digital Photography. Apart from the sleek new look, the website boasts an integrated blog, which is continually updated with industry news and original content from our editors in Germany, the U.S., and our professional photography friends who want to share their knowledge. ct-digiphoto.com will bring our stellar online community closer together, spark lively and important discussions about this quickly changing photo industry, and offer artistic support and knowledge for those seeking it.

ct-digiphoto.com

Uwe Steinmueller

Enhancing **Lightroom** with plug-ins and add-ons

Lightroom has a powerful set of built-in image processing tools but still leaves some gaps in the all-in-one digital imaging workflow. Dedicated plug-ins and additional software are the way forward if you want to give it that extra edge. There are many ways to add functionality, and you can even use layers. Read on to find out how.

It is with deep regret that we learned of the death in August 2014 of our respected colleague and co-author Uwe Steinmueller. Uwe's friend and publisher Gerhard Rossbach remembers: "Uwe was truly passionate about photography and, although his popular *Outbackphoto* website often concentrated on the technical side of things, he was a truly creative photographer at heart." Uwe's creative virtuosity found an outlet in his fantastic image processing work, and he shared his profound knowledge of the innermost workings of the 'digital darkroom' in countless books and articles. *Enhancing Lightroom with Plug-ins and Add-ons* was his final contribution to our magazine. We will miss him sorely.

Lightroom is a combined image management and processing application that includes a powerful set of editing tools although, as an 'all-in-one' solution, it still has some gaps in its arsenal. This article explains how to use some of the many plug-ins and add-ons available to enhance the *Lightroom* workflow.

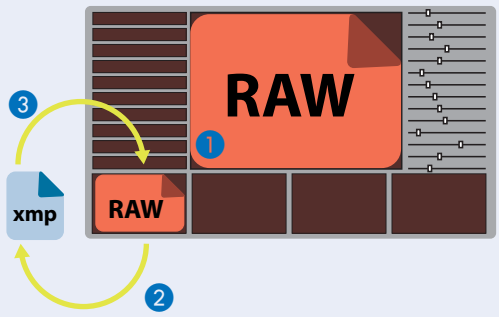
How Lightroom Works

In order to fully understand how *Lightroom* integrates plug-ins and add-ons, you have to know how the program itself functions:

Standard Lightroom Editing Process

1. RAW image processing
2. Changes are saved in the Lightroom catalog or an xmp sidecar file
3. Changes are applied to the RAW image

This process does not create a new image file. Export to TIFF or JPEG once processing is complete is optional. The entire workflow is covered by a single image file and a single sidecar file.



Editing Using a Plug-in or External Module

1. RAW image processing in Lightroom (optional)
2. Export as TIFF/JPEG
3. Image processing in the Plug-in
4. The TIFF/JPEG file is re-exported to Lightroom
5. Any further Lightroom adjustments to the TIFF file are saved in a separate xmp file

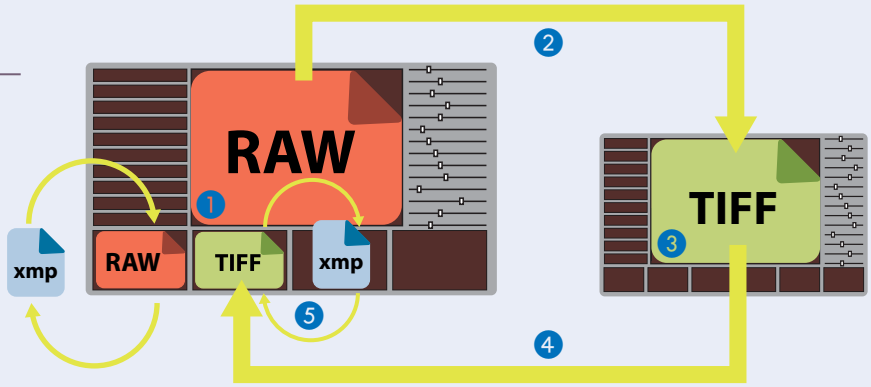
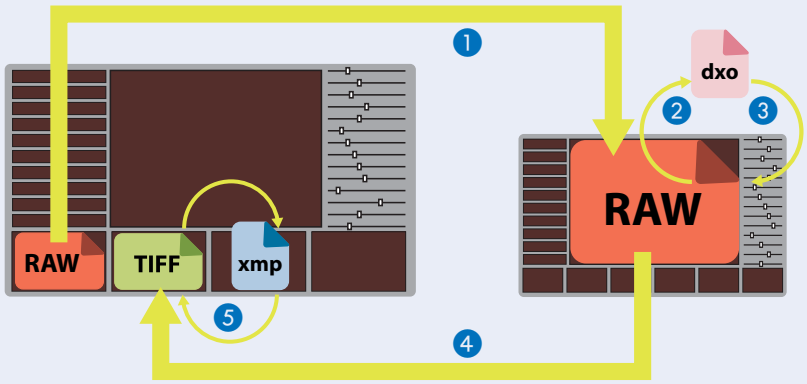
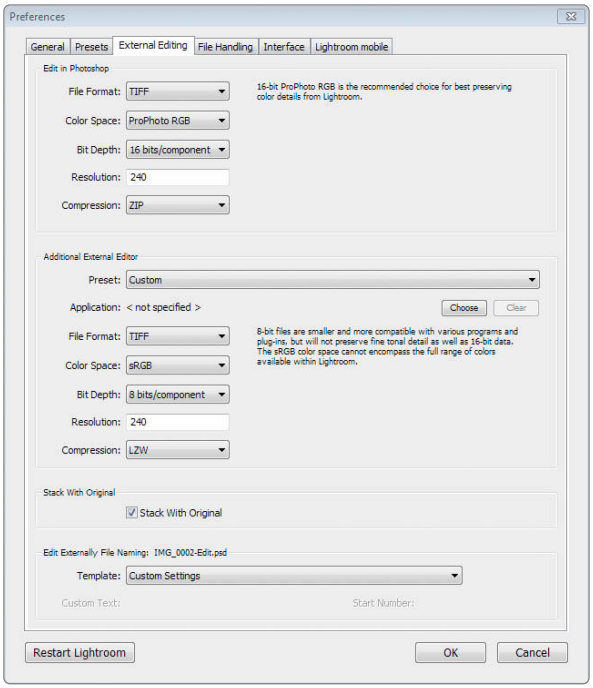


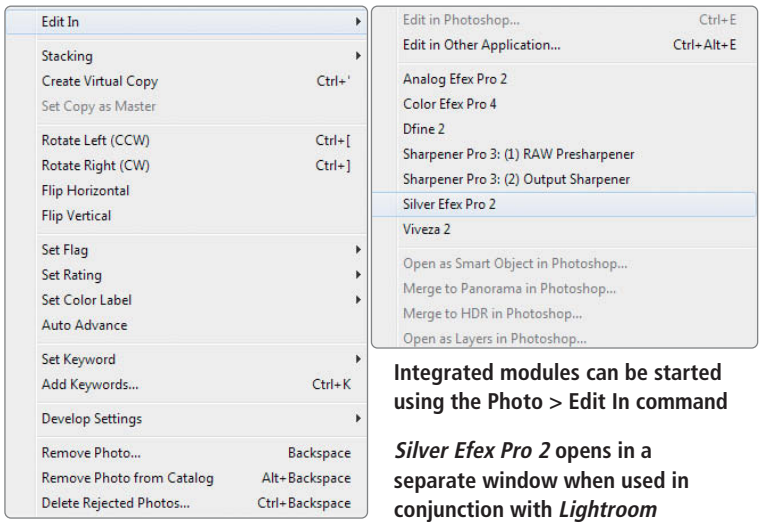
Image Processing Using DxO Optics Pro

1. The unprocesseed RAW file is read by DxO Optics Pro
2. The RAW file is processed in DxO Optics Pro
3. Changes are saved as DxO metadata
4. The processed file is exported to Lightroom as TIFF/JPEG
5. Any further Lightroom adjustments to the TIFF file are saved in a separate xmp file





The *External Editing* options enable you to determine how *Lightroom* hands over images to external modules



Integrated modules can be started using the Photo > Edit In command

Silver Efex Pro 2* opens in a separate window when used in conjunction with *Lightroom

1. *Lightroom* edits images non-destructively. It reads from but does not write to the original image file and never actually alters the original image data. Changes to files are saved in the application's catalog file or, if you wish, in a separate xmp-format 'sidecar' file. This applies to RAW, TIFF and JPEG files. *Lightroom* is capable of writing metadata tags to files saved in open formats such as DNG, TIFF and JPEG but cannot write tags to camera manufacturers' proprietary RAW file formats.
2. *Lightroom* only adds images to its catalog file via explicit import operations, so you cannot add a file to your stock simply by dragging it to a folder that *Lightroom* manages. These folders have to be re-synchronized and new images imported in a separate step.
3. *Lightroom* makes edited images available to other programs via explicit export operations.

So how do we integrate other programs and modules into *Lightroom*? To apply external editing steps to images included in the *Lightroom* catalog (whether they have already been edited in the Develop module or not), you have to perform the following steps:

1. Export your image to TIFF, PSD or JPEG. (RAW images can only be exported to *Photoshop* from *Lightroom.)*
2. Open and edit the exported image using the plug-in or application of your choice.
3. Save the result as a new TIFF, PSD or JPEG file.
4. Import the new image file to *Lightroom*. This updates the catalog.

This is a complex procedure but fortunately, there are various ways to automate it.

Using the *Edit In* Command

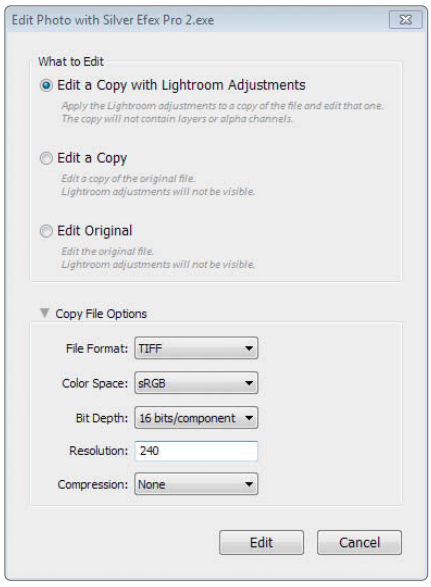
The most direct way to use an external module is via the Edit In command in the Photo menu. To enable this functionality, you have to register your external application via the External Editing tab in the Preferences dialog.

The first section of the tab (see the illustration at top left) is dedicated to *Photoshop* settings. *Lightroom* automatically recognizes the version you have installed and embeds it in its settings. The options included here determine the format and color space you wish to use when handing over files.

In the second section, you can embed any number of other external plug-ins and applications, each with its own image format and color space settings.

The *Stack With Original* option enables you to save edited files in the same folder as the originals, which makes them easier to find.

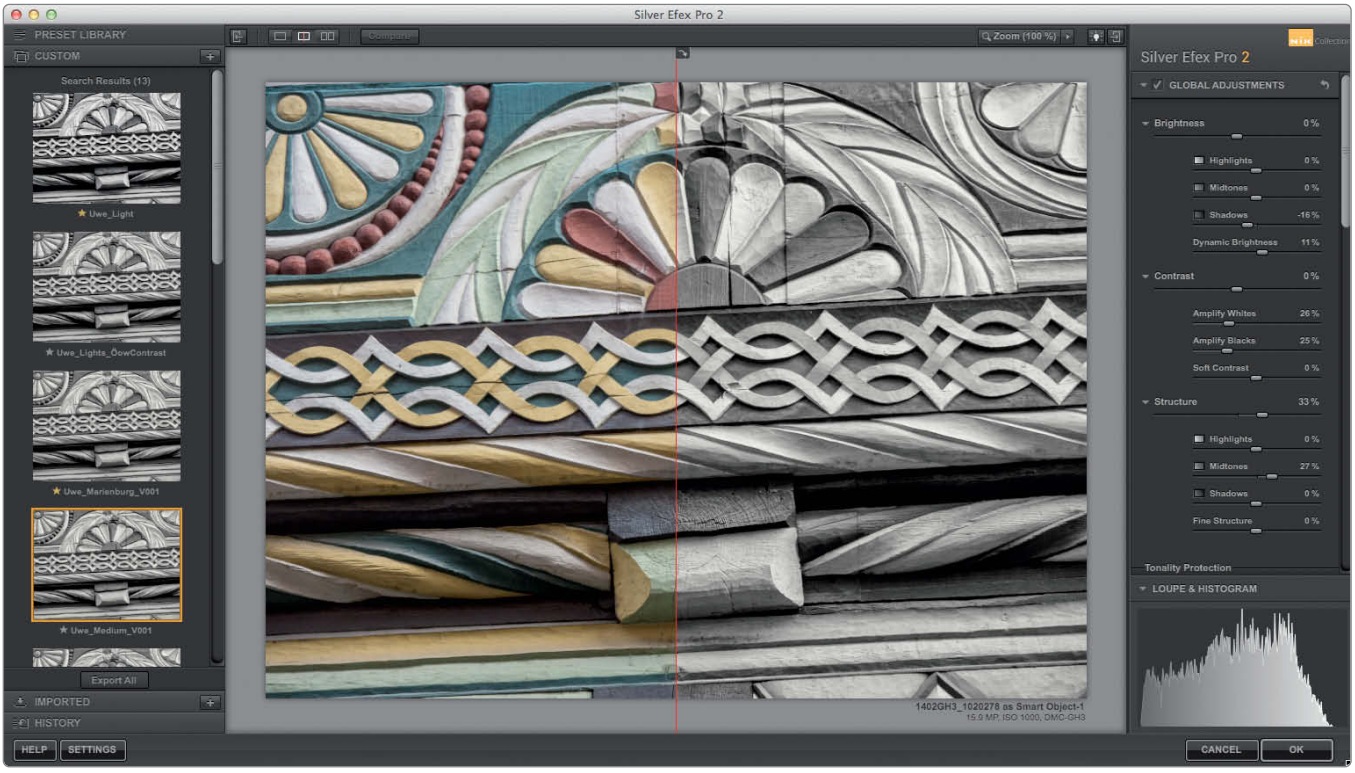
The final section determines the convention used to name new files. It is a good idea to use a suffix that makes it clear which tool was used to edit an image, although this particular option functions globally and doesn't allow you to define separate suffixes for each embedded plug-in. However, you can work around this limitation



***Lightroom* can only edit copies of RAW files but has direct write access to other formats**

Lightroom Plug-ins

Many popular 'plug-ins' are in fact standalone applications that register themselves automatically during installation and are integrated into the *Lightroom* interface via the program's built-in 'Edit In' functionality. Dedicated plug-ins are often more powerful than external applications. They usually have direct access to *Lightroom*'s image management functionality and are often capable of accessing multiple source images. This type of functionality makes it possible to create HDR images from within *Lightroom* (see page 130).



***Silver Efex* is a powerful plug-in with a wide range of black-and-white conversion options**

using export options, which we will explain later on.

Once an external application is registered, you can open it using either the context menu or the Edit In command.

In this example, we will be using Google's *Nik Silver Efex Pro 2* software, which specializes in black-and-white conversion. The dialog that follows when you start a plug-in varies depending on the format of the original file. *Edit a Copy With Lightroom Adjustments* is the only option for RAW files, which is consistent with *Lightroom*'s 'no direct access' policy. With TIFF, PSD and JPEG files, you can choose between editing the original or a copy. Although this might appear to contradict *Lightroom*'s non-destructive editing policy, it is possible because the file is being accessed by an external program rather than *Lightroom* itself.

This means that if you shoot in JPEG and manage your images using *Lightroom*, you have to take care not to unintentionally alter your original image files when using an external editor. When image files are edited externally, *Lightroom* does not alter the preview thumbnails immediately. If you alter metadata externally, *Lightroom* won't acknowledge this unless you intervene directly. The best approach is always to edit your metadata from within *Lightroom* if you want to avoid synchronization issues.

Once you have selected your processing mode, the external module will open. Confirming your choice with OK in the external module then opens the content you have selected in a *Lightroom* stack.

Stacks are a great tool for grouping similar images and can be displayed using a thumbnail of the uppermost image only or of all the images in the stack.

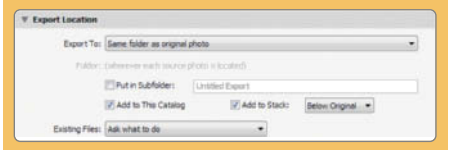
The Edit In command significantly simplifies the use of external processing software but is limited by the global file naming system, which makes it difficult to track your work if you use multiple plug-ins.

Embedding a Plug-in Using Export Options

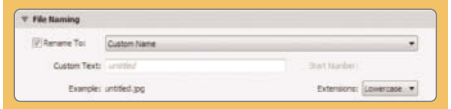
Using export options is one way of working around *Lightroom*'s file naming limitations. The following sections detail the most useful export options settings.

While Edit In always selects the folder that contains the image you have chosen, you can use the export options to select any folder you like. You can also use export options to add a new image to the catalog and stack it with the original. Note that all images in a stack have to be stored in the same folder, and selecting a different folder (or even a sub-folder in the same folder) grays out the *Add to Stack* option.

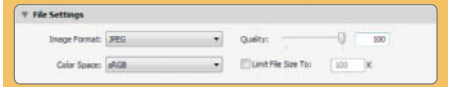
The new images can be named according to any of the options otherwise available in *Lightroom*, making this a much more flexible approach than that offered by the Edit In command.



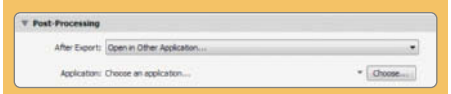
The Export options dialog enables you to freely select your export location



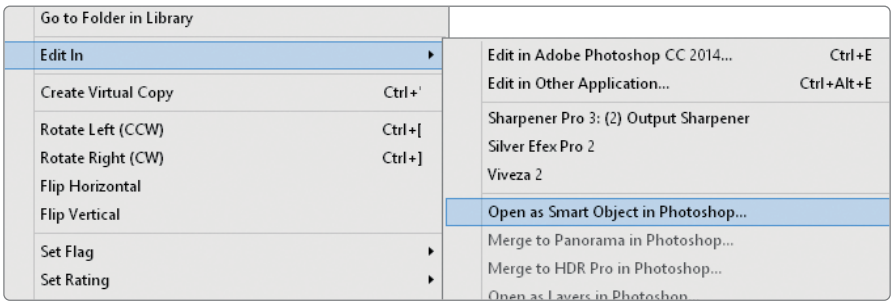
It also offers flexible file naming ...



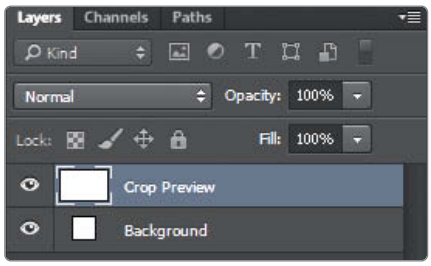
... and file format options



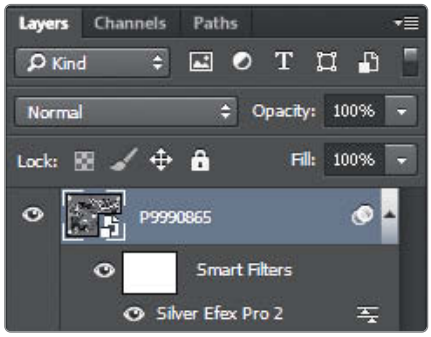
The Post-Processing option allows you to select which application opens the exported image



Using the Edit In command to open an image as a *Photoshop* Smart Object



The selected RAW image is shown as a Smart Object in the *Photoshop layer* stack



***Silver Efex Pro* can be used as a *Photoshop* Smart Filter**

Although the Edit In options usually suffice, the export options dialog also includes settings for output sharpening, watermarking, metadata transfer options and altering the size and quality of exported images.

For our purposes, the most important section of the export options dialog is Post-Processing, where you can select the application you wish to use to open your exported image(s). The options available here include *Photoshop* Droplets, which are Actions packaged as standalone applications. If you open an image in a Droplet, *Photoshop* automatically performs the editing steps it contains.

Using Photoshop Smart Objects

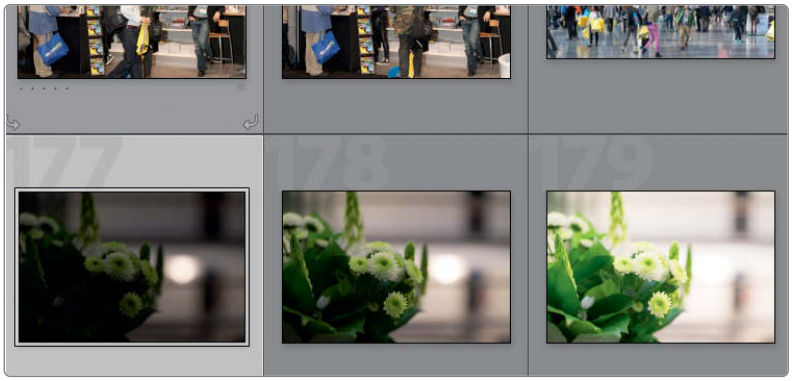
The processing methods described so far are limited to one-way processing. This means that the steps you perform with your external application are not recorded and cannot be undone, so if you don't like the result, you have to start all over again. The only workaround that we know of is to use the *Photoshop* Smart Filter functionality. This enables you to work iteratively, although here too, there are certain limitations that you should be aware of.

Smart Filters can be applied to Smart Objects, which are *Photoshop* layers that contain embedded image objects. Smart Objects behave just like conventional layers but also enable you to alter the embedded object separately from the rest of the image at any stage in the editing process. Conventional filters work destructively on a pixel level, whereas an unsharp mask (or other effect) applied using a Smart Filter can be adjusted later to suit any subsequent editing steps you take. In effect, Smart Filters offer the same non-destructive functionality that is a fundamental part of the *Lightroom* program architecture. Just remember that although Smart Objects work non-destructively, *Photoshop*'s architecture is based on destructive editing processes and certain functions, such as cropping, are always destructive, even if they are performed on a Smart Object. An image that has been edited in *Lightroom* can always be returned to its

How to Create HDR Images in Lightroom

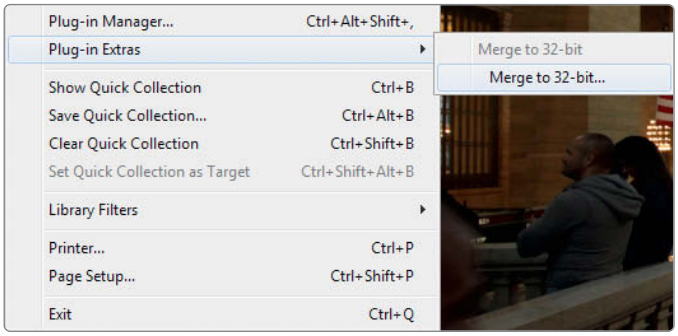
***Lightroom* cannot create HDR images out of the box, and Adobe generally recommends that you hand over images to *Photoshop* for HDR treatment. However, other software manufacturers offer solutions that enable you to create HDR images without using *Photoshop*. The HDR creation process involves creating a 32-bit HDR version of your image and then tone mapping it to an appropriate 8- or 16-bit file format. Since the release of Version 4, Lightroom has included tone mapping functionality for 32-bit HDR images that have been saved as TIFFs, but cannot create the required 32-bit source images. To work around this limitation, HDRSoft (the manufacturer of *Photomatix)*, has developed the *Merge to 32-bit HDR* plug-in.**

1 Select your source images, which should preferably be available in RAW format

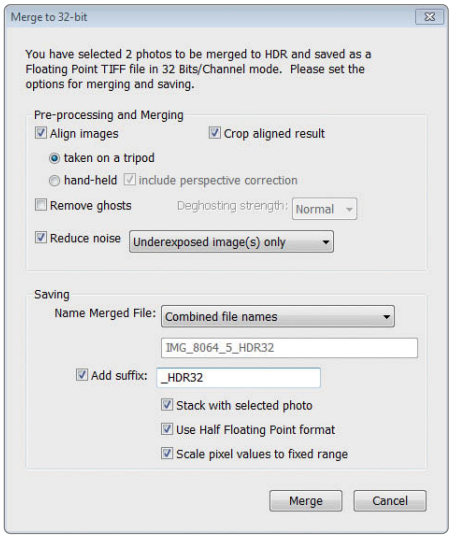


HDR in Lightroom (continued)

2 Select the Merge to 32-bit HDR command in the File menu



3 The resulting dialog contains the following options:

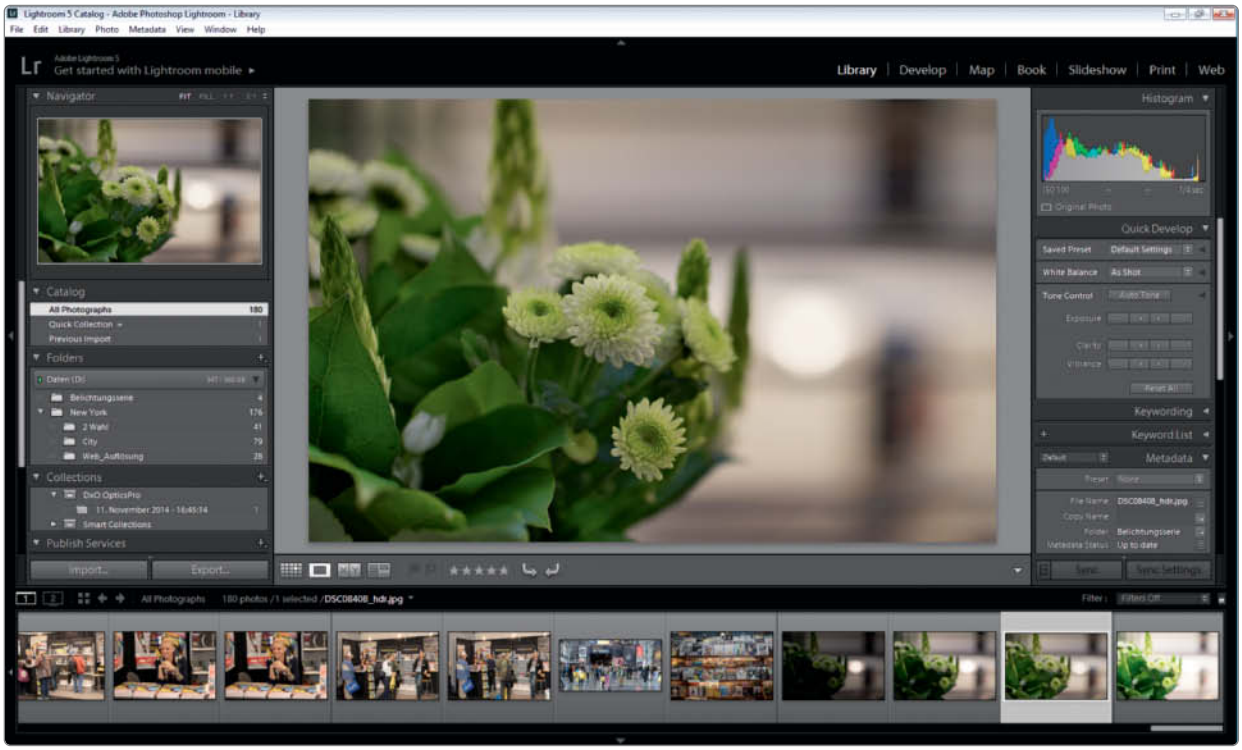


- Align Images: Always check this option
- Ghosting: Only check this option if you need to remove ghosting effects
- Reduce Noise: It sometimes makes sense to reduce noise before creating a 32-bit image

Set up the other options as shown in the illustration or according to your own personal preferences.

Click 'Merge' and wait for the plug-in to display the completed 32-bit image in the main Lightroom window. You can then apply Lightroom's native tone mapping functionality to your image. If you are already familiar with *Photomatix*, you can use the additional *Photomatix* plug-in included with *Merge to 32-bit* instead.

4 (Below) Tone mapping in Lightroom.



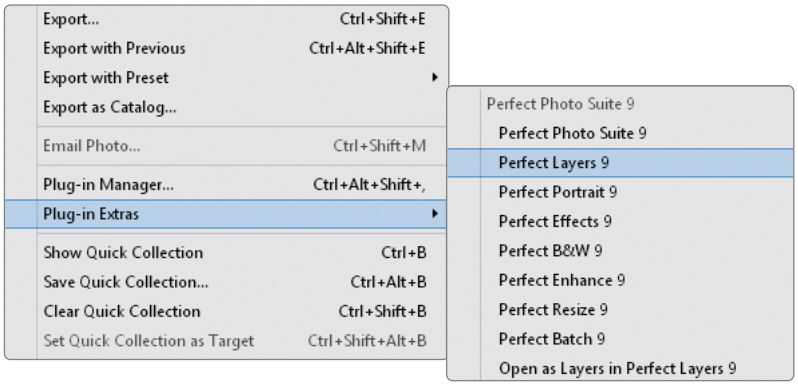
Adding Layers Functionality to Lightroom

Layers functionality is available in *Photoshop* but is not a part of the standard *Lightroom* toolset. To redress the balance, onOne Software has developed the *Perfect Layers* plug-in as an offshoot from its *Perfect Photo Suite*.

The following steps demonstrate how to use the plug-in to add color from the original (far right) to a monochrome version of the same image (right).

1 Because *Lightroom* can only recognize and adjust single layers, you have to use multiple source images to create a multi-layer image. To begin, select your source images in the Filmstrip.

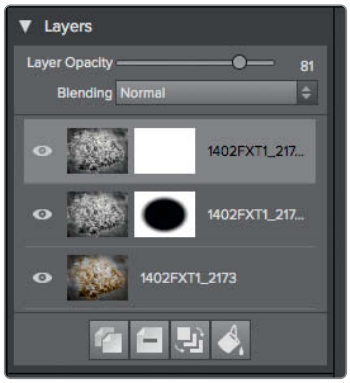
2 Now open the plug-in via the Plug-in Extras command in the File menu



3 The two layers are then automatically loaded into the plug-in interface, where you can add the black-and-white version as a new layer above the color version of the image

Layers in Lightroom (continued)

The bottom layer is the original color image and the monochrome version (and its layer mask) are located above it in the stack. *Perfect Layers* enables you to create layer masks using various tools. Using the two layers shown here, we re-colored the center portion of the image. To keep the colors subtle, we added a second black-and-white layer to the top of the stack and reduced its opacity. Increasing opacity then increases the strength of the colors that 'show through' from the lower layer. *Perfect Layers* is not quite as comprehensive as *Photoshop* layers functionality but still makes a really useful additional *Lightroom* tool.



4 The plug-in creates a separate PSD file for each open image and these are stacked with the originals. Any redundant PSD files (in our case, the original black-and-white image) can simply be deleted. Re-opening the PSD files created by the plug-in recreates the layer structure and enables you to make further adjustments to the edited multi-layer image.

Perfect Layers is a conventional plug-in solution made up of a standalone application that is called up when necessary from the *Lightroom* interface. It is a useful accessory but is still a long way from providing the fully integrated layers functionality that most *Lightroom* users would like to see.

original state, whereas this is not always the case in *Photoshop*. Smart Objects are nevertheless an elegant way to try out a number of filter effects without running the risk of spoiling your original.

If you use *Photoshop* to open a RAW image that you have already processed in *Lightroom*, the changes you have made are handed over to *Photoshop* along with the image file. Double clicking the Smart Object opens the *Adobe Camera Raw* (ACR) module and enables you to re-adjust any or all of the adjustments you made in *Lightroom*. But take care: editing steps you perform in ACR cannot be handed back to *Lightroom* and the only way to alter any further edits you make in *Lightroom* is to re-export the file to *Photoshop*. In other words, it is impossible to reproduce the seamless *Lightroom* workflow when switching between *Lightroom* and Smart Objects. Using Smart Objects is nevertheless the most powerful and flexible way to export *Lightroom* image data.

Photoshop loads a Smart Object as a new layer in the layer stack and any filter you apply to it will automatically be activated as a Smart Filter. However, not all *Photoshop* filters have Smart capabilites and the filter developer has to explicitly include appropriate functionality in a filter's code. To test whether a filter has built-in Smart capability, simply select the filter you have applied to your Smart Object and double click it. If it opens with the settings you originally applied, it is Smart capable.

Smart Filters are a great way to work around the limitations of destructive image editing but of course mean that you have to pay for *Photoshop* to use them. They also create much larger files than conventional filters do, so you will need more disk space and memory too.

Using Other RAW Converters with Lightroom

Lightroom becomes more powerful with every release, but some users still prefer to use other RAW converters when handling files created by specific cameras. Unfortunately, the only method we know of to hand over RAW images from *Lightroom* is to export them to *Photoshop* as Smart Objects, as described above. However, the RAW functionality built into *Lightroom* is identical to that in *Photoshop's Adobe Camera Raw* module, so using both makes no real sense. The only way to hand over RAW images to a different third-party RAW converter such as *Capture One* is using the following steps:

1. Import your images to Lightroom to ensure that they are included in the catalog.
2. Open the same RAW images in your chosen RAW converter via your computer's file system, not via Lightroom.
3. Export your processed images as 16-bit TIFFs to the same folder as the originals. To avoid conflicts, use a meaningful filename suffix for your new images ('_C1' for Capture One, for example).
4. Import the new TIFF files to *Lightroom* using the Library > Synchronize Folder command.
5. Perform any additional processing steps in *Lightroom*.

These are in fact the same steps that most *Lightroom* plug-ins perform automatically. The next section describes how one

Color Management

Not all image processing and RAW conversion applications are fully color managed. If this is the case, we recommend that you save your images using the sRGB color space. To check whether a third-party application supports Adobe RGB, simply export an Adobe RGB image to your external application and check whether the colors look the same. If not, switch to sRGB before continuing.

particular software manufacturer has automated the process for its own RAW conversion software.

Embedding DxO Optics Pro

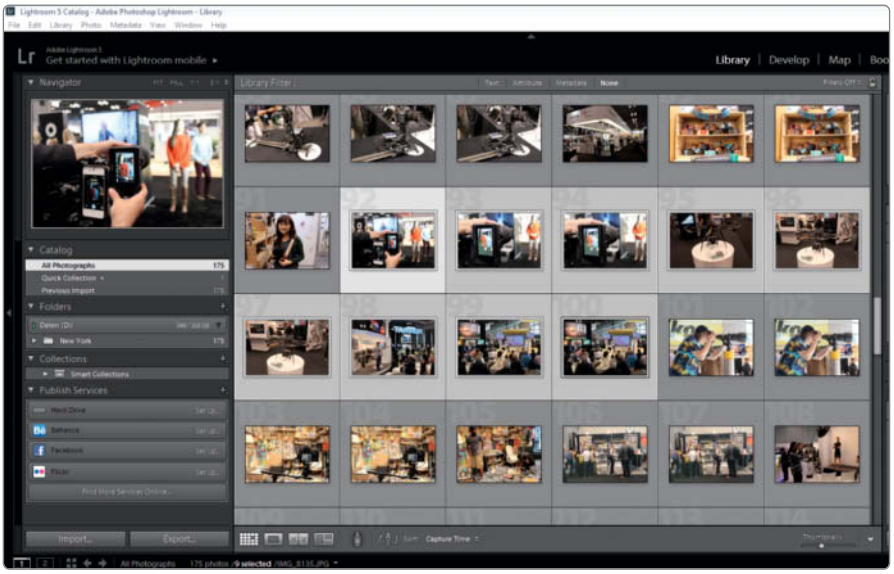
Although Adobe hasn't taken any steps to enable the embedding of third-party RAW converters in *Lightroom*, DxO, with version 9.5 of its *Optics Pro* package, has added functionality that integrates relatively seamlessly with the Adobe software.

Although *Optics Pro* doesn't offer any ground-breaking alternatives to the tools included in *Lightroom*, it does interpret RAW files more thoroughly, and its noise reduction and sharpening tools have a very good reputation among enthusiasts. Unlike Adobe, DxO's lens profiles cover a specific combination of camera AND lens – an approach designed to ensure the best possible correction of lens errors such as distortion and chromatic aberration. DxO also includes a perspective correction tool that has no *Lightroom* equivalent. The steps required to use Optics Pro this way are as follows:

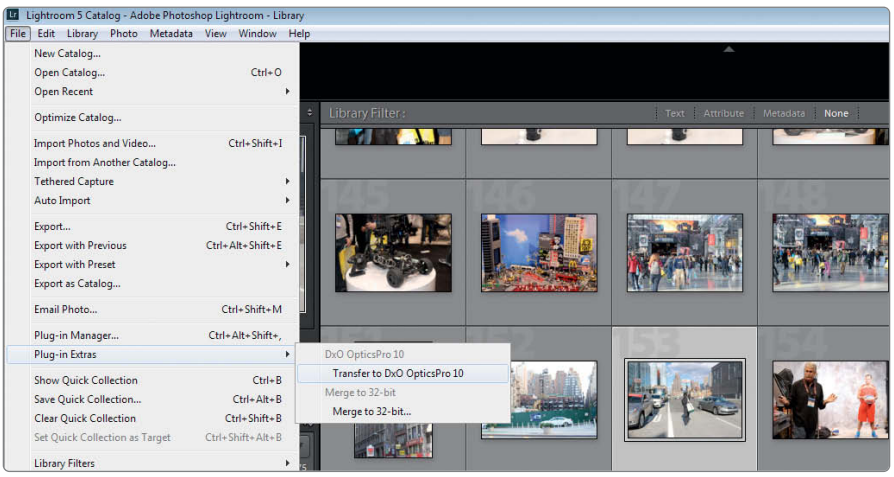
1. Hand Over Lightroom Images to DxO
   Begin by selecting the images you wish to process in the *Lightroom* Library. The corresponding RAW files remain in the same location during the entire process. Unlike most plug-ins, the DxO integration process doesn't convert the selected images to TIFF – in other words, it has direct read access to the original RAW files.
2. Process in DxO
   Once you have opened your selected images in *Optics Pro*, you can process them as desired. Any adjustments you make are non-destructive and are stored in a DxO sidecar file. This means that your changes are automatically loaded the next time you open your image(s) in *Optics Pro*.
3. Export from DxO to Lightroom
   Once you have completed processing your images, use the dedicated button to re-export them to *Lightroom*. This process can take place in various formats, but we recommend 16-bit TIFF for the best possible image quality. JPEG works too, especially if you have performed your main processing steps in *Optics Pro*. In spite of this relatively tight integration, the processing engines of the two programs work entirely separately, making it impossible to swap adjustment data between the two. Images processed in *Optics Pro* have to be explicitly exported and re-imported into *Lightroom* (a step that is automated the DxO plug-in) before they can be further processed.

Optics Pro saves the processed images in a new collection that it creates during export. As previously mentioned, the original images remain in their original location and the new images are stacked with them, making it simple to compare the results. You can, of course, make further adjustments to the processed images using *Lightroom*'s built-in tools.

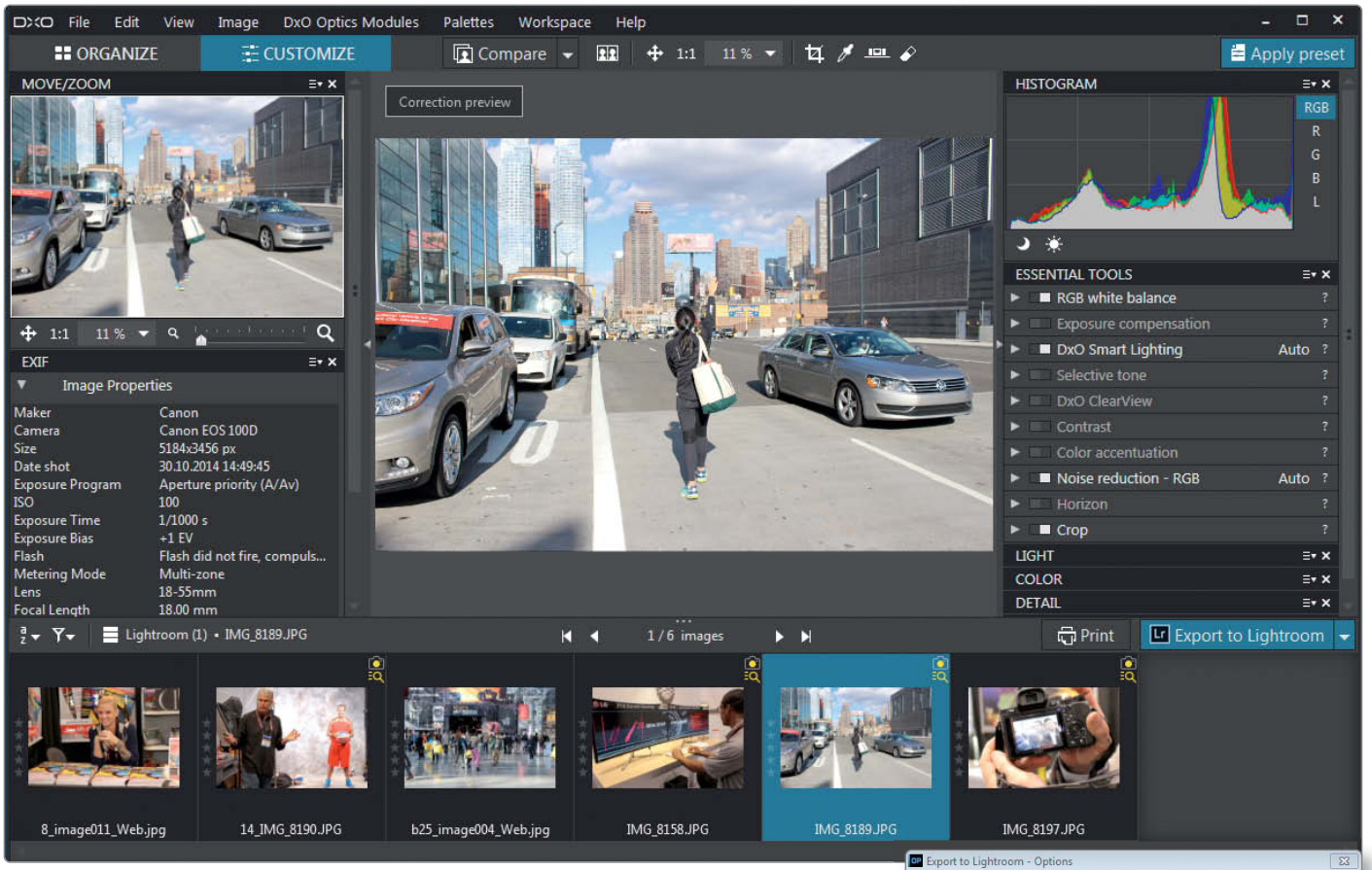
The plug-in works smoothly and provides RAW-sharing functionality that many photographers have long hankered for. It does not, however, provide full, seamless integration and you have to choose explicitly between the two sets of tools at each stage in the RAW editing process.



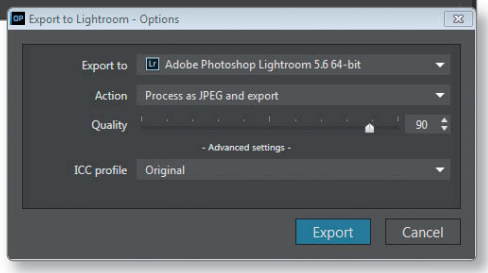
Images that you wish to process in DxO *Optics Pro* have to be selected in the *Lightroom* Library



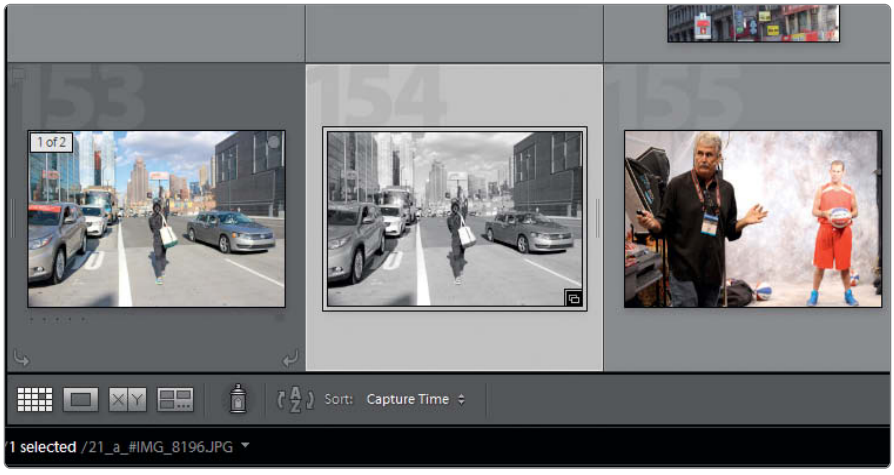
Hand over the selected images using the File > Plug-in Extras command



DxO Optics Pro **opens a separate window with its own completely independent RAW workflow. In spite of the automated handover process, you have to decide whether to use the DxO or Adobe tools to process your images. You cannot use both without first saving and re-importing your work.**



DxO **exports the converted and processed image back to** ***Lightroom***



Lightroom **sorts similar images into stacks**

Conclusions

Plug-ins, add-ons and other external applications are a great way to extend and enhance *Lightroom*'s already powerful toolset. The downside of using software extras is that the workflow is not as smooth as the *Lightroom*-only approach. Many plug-ins also force you to manually export and re-import image files. *Lightroom*'s built in tools can be applied in any order, and their effects can be undone or adjusted at any stage in the editing process. In contrast, no-one has yet come up with a way to fully integrate plug-ins into the all-in-one architecture, so you have to consider very carefully in advance which third-party tools you wish to use and in which order. (sts) c't

Book Reviews

Picture Perfect Posing

The Art of Posing for Photographers and Models

Roberto Valenzuela's posing system launches photographers on a steep learning curve. Instead of presenting hundreds of poses that you would have a tough job remembering, he has created a system comprising 12 decision points (plus a further three for posing couples) that both novice and experienced photographers will find straightforward and easy to follow. His clear teaching also explains what to do about common issues that often arise when shooting.

The individual points are elaborated chapter by chapter, beginning each time with a brief discussion of issues and their solutions, such as how the shoulders, spine and breathing contribute to good posture. This is followed by the main text and plenty of sample photos to illustrate each concept. Substandard photos are included deliberately, as showing what not to do is an effective way to illustrate how to do it right. Key points are summarized in boxes along the way and the uncaptioned 'good' and 'bad' photos at the end of each chapter are a particularly helpful learning tool. The author urges readers to 'grade' these using what they have learned. The most enjoyable way to do this is with a friend who is also reading the book.

The final chapter deals with hands and arms, taking a three-step approach. According to Valenzuela's 'Hand/Arm Context System', freedom for the abdomen is key, three ideas are enough (one hand/one arm is sufficient; hands and arms can cooperate or offset each other; hands can indicate invitation or rejection) and there are only five basic ways to style hands and arms.

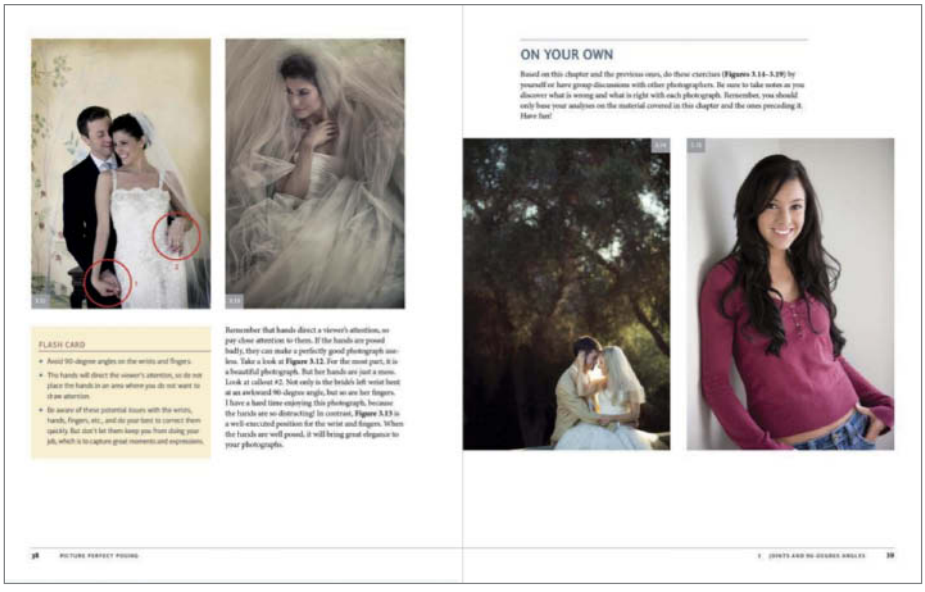
Because they are introduced in such a structured way, it is easy to remember the tips presented in the text. For example: never have both hands at the same height; avoid 90-degree angles; understand which parts of the body dominate and why. Valenzuela also warns against getting carried away and trying to manipulate the model like a mannequin. Instead, he suggests that you let the subject get comfortable in front of the camera before you make your own adjustments according to what you have learned from his system.

Whether you read this book as a photographer or model, you will find it an easily navigable treasure trove of ideas. (jr)

Picture Perfect Posing

Roberto Valenzuela
Published by New Riders
336 pages, color illustrations
10 × 8.1 × 1.1 inches
Hardcover
US$39.99
ISBN: 978-0-32196-646-9

Roberto Valenzuela really knows what he's talking about when it comes to posing, and he also has the gift of getting his message across. The book clearly lays out his system, using boxes to summarize the main points. At the end of each chapter, an 'On Your Own' section encourages you to put what you have learned into practice.



Roberto Valenzuela, Picture Perfect Posing (New Riders)

Compendium

The Work of Michael von Hassel

Compendium is a monograph of the work of Munich photographic artist Michael von Hassel, who was awarded the prize for Best Contemporary Artist at the Hot Art Fair in Basel in 2009.

This heavy, large-format book contains mainly photographs of landscapes and selected localities. Most of the images have been so extensively processed that the colors are often seriously oversaturated and high-contrast edges are rife with sharpening artifacts. Von Hassel calls his images 'hyper-realistic', which is accurate in one sense. His extreme processing, whether in the form of color saturation, contrast or focus, gives strong emphasis to specific details in each subject.

He shows viewers his interpretation of things, sometimes in a highly exaggerated fashion. For example, in the 'Virtues' series, he juxtaposes photographic collages with words: a heap of banknotes and condoms with the word 'trust', or an image of tabloid magazine covers with the word 'decency'.

Von Hassel's landscape and nature images are not quite so striking. Although they have obviously undergone a lot of post-processing, his images of forests present a much more realistic view of the world than his portrayals of Berlin and Istanbul.

Compendium provides a comprehensive overview of von Hassel's wide-ranging work. Some of the images cover entire two-page spreads, and the book's large format contributes to their hard-hitting effect. However, the oversaturated colors and over-the-top contrast make looking at many of these images hard work. von Hassel and his publisher have tried to alleviate this effect by mixing stark compositions and comparatively sedate landscapes with the writing of prominent commentators like Kai Diekmann, Joko Winterscheidt, Alexander zu Schaumburg-Lippe and Frank Elstner, but the huge variety of subjects and image styles means the result is not always successful.

Working through this volume in one sitting could leave you feeling overwhelmed, and this is definitely not a book for those who prefer a more documentary, naturalistic style of photography. (tho)

Compendium

Michael von Hassel
Published by teNeues
208 pages, hardcover
Text in English and German
14.8 × 11.7 × 1.2 inches
US$125
ISBN: 978-3-8327-9860-4

From *Compendium* by Michael von Hassel, published by teNeues. Early Morning Fog, 2012

This photo from the 'Timberland' series is one of the more soothing images from Michael von Hassel's extensive body of work

Coming up in Issue 19

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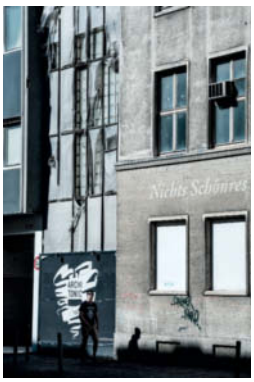

Photos: Meike Fischer

Serial Photography

Presenting photos as a sequence or photographic essay underscores the story they tell and often gives them a whole new meaning – the trick is capturing the right kinds of image and grouping them appropriately. Our in-depth workshop explains what to look out for when developing your ideas and shooting themed photos. We also offer hands-on tutorials on how to find a subject, develop a concept and put together the final sequence.

System Flash

The high power and wide range of settings available in system flashes make them perfect for mastering complex lighting situations. We test some of the today's top models and check out their strengths and weaknesses in real-world shooting situations.

Image: Metz

Photo: Peter Rees

Food Photography

Pro photographer Peter Rees reveals some of his favorite food photography 'recipes'. Hands-on examples show you how to use straightforward setups and simple gear to produce photos that are guaranteed to make you hungry. Lighting diagrams provide all the details you need to create successful effects, and the tips and tricks Rees demonstrates will help you develop your own ideas too.

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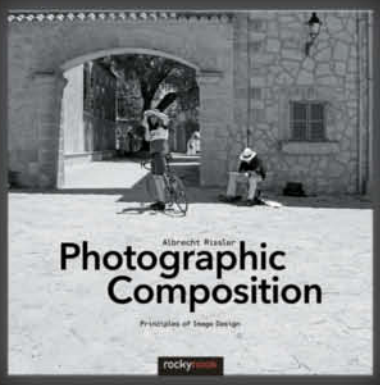

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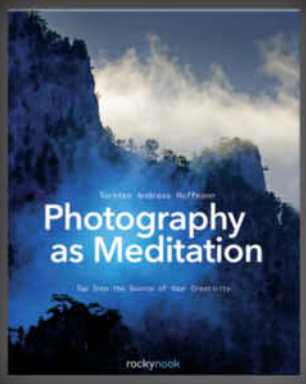

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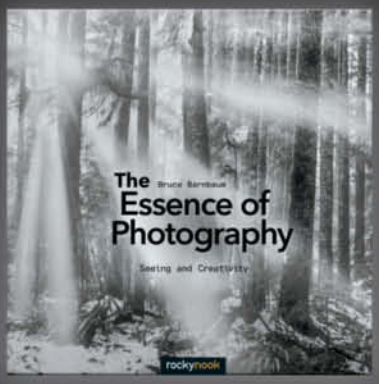

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