

Sermon From A Raw Convert

I've been shooting JPEG almost exclusively since I got into digital photography. I persisted in this habit even after getting my Canon EOS-10D -- a camera capable of shooting RAW without breaking a sweat. This is because I've been somewhat skeptical of the benefits of RAW in normal shooting. Now, I think I made a mistake. However, the case against RAW is a strong one: using it effectively is more than a matter of simply deciding to do so. There are issues that need to be addressed. Fortunately, there are also solutions.

Ken Rockwell [<http://www.kenrockwell.com/>] makes the case for JPEG in his usual opinionated, cranky style in a recent essay [<http://www.kenrockwell.com/tech/raw.htm>]. His main argument mirrors my formerly-held, now-abandoned views, although he characteristically takes it to the extremes. I will attempt to address each of the issues he raises, and sketch out what a workflow that does RAW without the pain can look like.



Mir Amin Palace. Canon EOS-10D with Tokina AT-X Pro 17/3.5, converted twice with CaptureOne DSLR LE, digital exposures merged in Photoshop. There's no way I could've pulled this one off in JPEG... except maybe by bracketing.

*When **not** to use RAW*

First off, there are good reasons not to use RAW. Sometimes it's just not feasible, or it provides negligible benefits over JPEG. However, unlike Ken, I believe that these situations are the exceptions rather than the rule.

Blockers: when RAW goes rotten

1. **When your camera isn't built to handle it.** If RAW freezes up your camera for ten seconds after each shot, or the buffer only holds two or three frames, the annoyance of dealing with RAW simply

isn't worth the trouble, except maybe very occasionally.

2. **When there's no good RAW workflow software for your files.** If all you have to work with is a terrible implementation of the manufacturer's idea of a RAW converter, forget it: the frustration and extra time just aren't worth it. Concentrate on improving your JPEG workflow instead.
3. **When you're short on storage space.** This should be one of the Can't Happen situations, but it does happen. It's far better to get the shot in JPEG than miss it in RAW.

When RAW adds little or nothing

1. **When quality takes back seat to throughput.** The classic case would be a PJ or sports shooter. He knows his shots will be printed pretty small, possibly pretty smudgy, and the critical thing is to zap the damn things to the editor, sometimes over WiFi, so the paper can go to press. Anything that simplifies things helps. Therefore, shooting JPEG makes a lot of sense.
2. **When you're in control of the light... and you know you won't print big.** For example, if you're shooting product photography, models, or studio portraits for a specific print size, you have the possibility to control lighting as much as you want, and you have the time to manual white-balance. If you're printing no bigger than 8 x 10, go for it -- RAW will deliver no visible benefit.
3. **When you're a total newbie to digital post-processing.** RAW conversion isn't rocket science, but if you have no clue about what a histogram is, you're probably better off with JPEG until you get the basics of post-processing down. However, once you do have them down, and do take that leap to RAW, you might regret that your "early work" is only in JPEG -- I know I do, a little.

Ken's Objections

I believe that in *every* other situation you should use RAW, and that Ken's objections to it can be easily overcome, if you take an intelligent approach to it... and maybe spend a few hundred dollars more initially, on top of the two thousand or more that you've spent on your camera, lenses, software, and computer. So, let's look at Ken's Objections (KO's) one by one.

KO1: "RAW is for tyros. Pros get it right the first time."

The fact is that it's simply not always possible to get the shot "right" in-camera. You might have mixed lighting, so much contrast that you have to underexpose to retain highlight detail (and pull up the midtones and shadows post-exposure), so little contrast that you'll have to "spread out" the tones in post-processing, you might be in a situation with fast-changing light and be underexposing to stay on the safe side, or, well, you might just make a mistake, no matter how hot a shutter jockey you are. The newbie will blow the highlights in a high-contrast situation; the experienced digital shooter will know the correct exposure technique for this -- and will get a much better result, after post-processing.



Fishermen in icy mist. Helsinki, 2004. Canon EOS-10D with EF 50/1.4 USM, converted with CaptureOne DSLR LE.

KO2: "RAW wastes your time."

Only if you're using the wrong software and have the wrong workflow. It's actually *easier* to do the basic image adjustments (tweaking white balance, correcting exposure, tweaking color balance, tweaking the tone curve) in a good RAW workflow program than in, say, Photoshop. For example, it's ridiculously easy to save different white balances and apply them to entire shoots with a single click in CaptureOne DSLR. Not only does doing the work in RAW net you better results, it's both faster and easier to make the adjustments there rather than in 8-bit editing -- and the more you shoot, the better controlled your circumstances, and the better your technique, the more efficiency and flexibility you gain. RAW can actually dramatically improve your productivity.

KO3: "RAW takes up space."

Sure, it does. A 512 MB Compact Flash is very tight when shooting RAW, while it's ample for most situations if you're shooting JPEG. Cards bigger than that cost a good deal of money.

However: if you can afford a camera good enough to be fluent in shooting RAW, do you seriously mean you can't afford a portable hard disk? Something like an X's Drive II [<http://www.xs-drive.com/xsdrive2/>] has 20-60 GB of storage space, will copy your CF card onto it with a press of a button, and costs a couple of hundred dollars. I have two 512 MB cards and a 20 GB X's Drive. This will hold a couple of thousand RAW frames -- plenty for almost any use. A PHD is such an economical and convenient solution to the storage problem that you'd be an idiot not to get one -- even if you only shoot JPEG.

In any case, in my opinion the storage space issue is something of a red herring. Buying an expensive digital camera capable of shooting RAW with ease and then not using it because you can't afford the space to store them is about as intelligent as buying \$10,000 worth of cameras and lenses and then only using Kodacolor Gold 200 in them because you can't afford professional-quality film. The argument is just fundamentally silly.

KO4: "RAWs are unsuitable for archival."

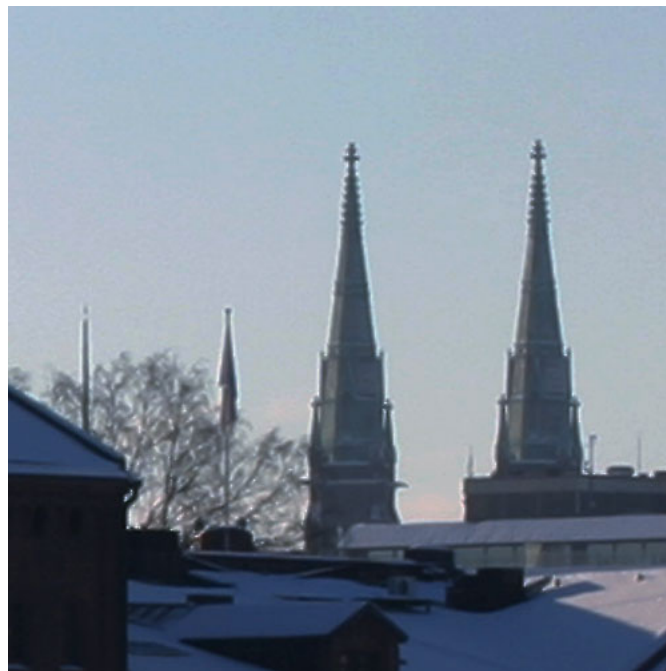
Yep, RAWs are too big for easy storage on CD-R's. However, the prices for DVD burners have come down to under \$100, and DVD-R is much cheaper per GB than CD-R. Again, even if you only shoot JPEG, you'd be an idiot not to get one -- if only for the convenience of having fewer physical media for your backups (always take two copies, though!) and the lower cost per GB of the disks. DVD-R's solve

the space problem rather handily.

How about the "proprietary" issue? Yep, that's a legitimate concern. The file formats will indeed become obsolete -- eventually. That's why it is an excellent idea to archive your RAW's twice -- once as RAW's, once as converted versions. If you adjust your workflow around it, you can create converted versions of your RAW's for archival with no extra effort. I use JPEG's: I convert my RAW's directly into my "archive" hierarchy, and burn that onto DVD's periodically. So, this objection boils down to the storage space issue again -- and if you found it possible to burn CD's of 2.5 MB JPEG's, what's so difficult about burning DVD's of 6-10 MB RAW's *and* the JPEG's? The medium is seven times bigger, while the combined file size is only maybe five times bigger. Even with the overhead, with DVD's your archival problem will be easier rather than more difficult. If you burn RAW's and JPEG's onto DVD's, you'll get higher-quality archival originals (even the JPEG's) with less time, effort, and expenditure.

KO5: "RAW looks no better than JPEG."

Even if the lighting was just as you intended and you got it perfectly on the nose in-camera, this is true only for prints up to 8 x 10 on a 6MP camera, maybe 11" x 16" on a 10+ MP one. If you need to up-rez to get to 11" x 16" x 300 ppi, sorry, Ken, but RAW *does* look better. Here are crops from the same shot up-rezzed to 300 ppi at 11 x 16 -- one is from the extracted JPEG, the other from a RAW image converted with C1, and both post-processed to get a similar tonal balance (the scene was hazy and low in contrast: I wanted to make it punchier by adding some contrast to it). And yep, this difference *does* show in print.





JPEG above, RAW below; both with added contrast in post-processing and resized by 156% to get 300 dpi at 11 x 16 inches. Notice the posterization and especially the sharpening haloes in the JPEG. This sort of thing will be quite obvious in the print.

Oh, and if you (like Ken) think that digital is only good for snapshots and "fast" work, and for anything bigger than 8 x 10 you should be using medium-format anyway... well, fine -- but the fact is that people *are* using 6MP digital professionally to make large prints, and their customers aren't complaining.

KO6: "You can't send RAWs to your clients."

Oh, puh-leeze! Do you really send unprocessed, out-of-the-camera JPEGs to your clients either? Don't you even downsample, sharpen, and compress them for easy viewing on-screen? Thought so. Well, you can do this just as easily in your RAW workflow as in your JPEG workflow. No speed bump added.

KO7: "Different software opens up the files differently."

Gee, and I guess Provia looks just like Velvia looks just like Ektachrome -- after all, slide is so popular with pros because it always nets them the same color, right?

Seriously, if you have problems with getting consistent color out of RAW, it sounds like you need to do some reading-up on color management... maybe even get a couple of profiles for your stuff. A halfway-decently color managed workflow is a requirement for working with RAW's. (In fact, I'd say it's a requirement for working with *any* images.) I'm not talking about super-high-end stuff like rolling your own profiles for everything; most of the time, canned "generic" profiles will get the job done fine, if they're reasonably good. Magne Nilsen [<http://www.etcetera.cc>] sells some very good ones for CaptureOne DSLR -- shame on PhaseOne for not getting something as fundamental as this right from themselves, and bravo to Magne for stepping up to the plate. Unless you're a tyro who doesn't understand the fundamentals of professional digital image processing and don't want to learn, of course. But no *professional* would adopt such an unprofessional attitude. Would they?

Advantages of RAW

Now that we've dealt with Ken's objections to using RAW, let's look at some of its advantages. These are threefold: in quality, latitude, and future uses.

Quality

JPEG is a "one size fits all" solution. In-camera sharpening is applied to produce a pleasing 8 x 10 print, but it may be too much for an 11 x 16 (or bigger). The demosaicing algorithms aren't as good as they could be: they may produce moiré, stairstepping, "checkerboard" artifacts, or blockiness in the red channel -- to name a few issues endemic with Canon pictures. (Nikons have issues of their own, too; all cameras do.) Most of these issues are too minor to make a visible difference on 8 x 10 prints. At larger print sizes, even "amateur" ones like 11 x 16, they do start showing up. While they probably won't be distracting to the casual viewer even at that size, they're nevertheless annoying. With RAW, many of the problems can be avoided. More to the point, the conversion settings can be tailored for the particular print size under consideration. As demonstrated above, RAW does make a significant quality difference even in "perfect" in-camera pictures, even if it only starts to show up past 8 x 10 -- and much more so in scenes that were, for example, either too contrasty or not contrasty enough to produce a "finished" JPEG out-of-camera, no matter how you exposed it.

Latitude

With JPEG, once you shoot the picture, you're more or less locked into the choices you made when shooting it. If you decide afterwards that maybe it'd look nicer with a warmer color balance, a pulled-down curve for a chiaroscuro look, a pulled-up curve to show some more shadow detail, more noise reduction for a "cleaner" look, or less noise reduction for a more "textured" look... well, you *can* do much of this in 8-bit post-processing, but your latitude is pretty severely constrained. Do too much, and your skies, other gradients, and shadows will develop visible posterization, your noise-reduction will erase texture detail, or you'll end up with blobby shadow detail. With some nifty tricks, you can push it a little further... but beyond that, well, basically, you're out of luck.



Lake Qaraaoun with Mount Hermon in background. West Bekaa, Lebanon, 2003. Canon EOS-10D with EF 35/2, converted with CaptureOne DSLR LE.

Sure, there's nothing wrong with adopting the "slide shooter" attitude for digital photography, but with the marvelous post-processing options the digital darkroom gives us, this is tying a large, unnecessary ball and chain on your leg. RAW gives latitude to adjust *everything* -- color balance, white balance, tone

curve, sharpening, noise reduction, contrast. You even get maybe another half-stop of exposure latitude in the highlights, and at least a stop, maybe two in the shadows. Negative film it isn't, but you breathe a lot more easily than with slide -- and not only if you've made a boo-boo behind the camera. The fact is that **RAW significantly expands your creative options.**

Future uses

We've already seen what advantages technological development can provide for working with RAW files. Alternative demosaicing algorithms provide different looks and feels, sometimes with dramatically increased quality. There's no reason to suspect that this development will end now. Not only that, but you might find uses for your pictures that you didn't intend when you shot them -- and the latitude RAW gives you for adjusting them may make the difference between a superb result and a so-so one. RAW converters will continue to get better, and there might come a day that you'll wish that your JPEGs were RAWs instead. That happened to me just a couple of days ago. Yep, RAW might be a bad idea for storage 50 or 100 years into the future, but it can give you a lot in the next 5 or 10 years. But do archive a converted copy of your work too.

Putting together a RAW workflow

Even if I don't think Ken's objections are showstoppers, he does identify real issues that need to be addressed. The answer is a workflow optimized for RAW: something that starts behind your camera, extends to your choice of accessories, continues onto your computer, and ends up on your back-up media. It costs a few hundred dollars to set it up. If you're not willing to spend this amount of money on it, forget it and stick to JPEG -- but if you're considering buying another lens, flashgun, printer, or maybe an upgrade to your computer (not to mention a camera!), your money might be better spent on your RAW tools instead.

What you need

There are a few things that are nearly indispensable (on top of the usual stuff -- you know, a digital camera, an image editing program, a computer, that sort of thing) if you want to put together a RAW workflow. They cost a certain amount of money: you'll maybe have to pass up a lens to get them. In my opinion, this might not be a bad way to spend your photo budget. We'll look at them individually later.

1. **A portable hard disk.** I've got the bare-bones X's Drive II [<http://www.xs-drive.com/xsdrive2/>] -- 20 GB, card readers for all the most popular formats, very simple, functional design, and pretty cheap. Costs about as much as a 1 GB CF card at this writing.
2. **Two largish memory cards.** Mine are 512MB and they feel about right.
3. **A RAW workflow program.** I love CaptureOne DSLR LE [<http://www.phaseone.com/>].
4. **Profiles for your stuff.** I downloaded the profiles for my printer, ink, and paper from the manufacturer, bought a good 10D profile for CaptureOne from Magne Nilsen, [<http://www.etcetera.cc>] used the manufacturer's profile for the monitor, and tweaked it using Adobe's calibration tool in combination with a color chart and a picture I'd taken of the color chart. It would be more accurate if I had done all the calibrations myself, but it's close enough to get the job done. In fact, the manufacturer's profile would probably be close enough for my monitor, too.
5. **A DVD burner.** This is indispensable for back-ups.

The total extra cost would wind up to somewhere around \$400 -- \$800, depending on what you already have and which choices you make. It's not an insignificant amount of money (it could buy you a rather a nice lens, for example), but in my opinion, it's money well spent -- as much as the nice lens, it'll help you make the most out of the stuff you already have. On the other hand, with this set-up you can go very far

with a somewhat limited photo editing program, such as Photoshop Elements: not having to buy Photoshop CS will largely make up for the cost difference.

Behind the camera

The RAW workflow starts behind the camera. With JPEG, your objective is to get the shot as close to the final product as feasible, since any post-processing that affects white balance or tonality will degrade the image: while you can do a good deal of stuff before this happens, you have to be very careful e.g. to avoid posterization and color shifts in skies and other smooth gradients. With RAW, your objective is to capture as much of the dynamic range as possible: feel free to underexpose a stop or even two if that's what it'll take to retain your highlights. On the other hand, if your scene is low in dynamic range, by exposing to the right [<http://www.luminous-landscape.com/tutorials/expose-right.shtml>] you can significantly improve the quality of the final image.

On the other hand, one particular annoyance of digital becomes a lot simpler: white balancing. Even if you forget about it altogether, the results will be better and (most likely) easier than white balancing in-camera for JPEG. If you remember to shoot a picture of a gray or white card every once in a while, white balancing becomes so easy and so accurate you won't even have to think about it. So, forget fiddling with white balance. Instead, once the light changes, shoot a white or gray card... and don't sweat it if you forgot, because it'll only take a minute to fix in post-processing.

Camera accessories

Since RAW does take up space, you will need two essential camera accessories: an extra memory card, and a portable hard disk/card reader. By switching between the cards and dumping the contents into the PHD as they fill, you can keep shooting with minimal interruptions. The storage space problem will be much less of an issue than with a MicroDrive but no PHD and JPEG.

On the computer

Some form of color management, even a rough-and-ready one based on canned, generic profiles and monitor calibration by eye, is essential for a RAW workflow -- otherwise, your colors will go all over the place. A Spyder is a very useful addition. Most of all, you'll need a very good RAW workflow program -- I'm head over heels infatuated with CaptureOne DSLR, precisely because it makes it *so* easy to manipulate large quantities of RAW files, so straightforward to get the essentials adjusted in a snap and even semi-automated, and the results are so good. However, I've heard good things about Photoshop CS and BreezeBrowser as well. Take your pick, but make sure it's a workflow application rather than an image-by-image converter: no matter how good the results, if it's a pain to use, you won't use it.

And, of course, while a RAW workflow program will take over some of the functions of Photoshop, you'll still need a photo editor. However, if you *don't* have Photoshop, and are editing your pictures with Photoshop Elements, it is my very strong and considered opinion that your money is better spent on, say, CaptureOne DSLR than the full Photoshop CS. The RAW workflow program will take over most of the functions the full Photoshop provides over CS (e.g. curves manipulation, 16-bit manipulation, finely controlled sharpening), so Elements will get you a great deal further.

Whatever you do, *don't* settle for the included-on-CD RAW converter, unless it's an exceptionally capable one, like the one that comes with the Sigma DSLR's.

Finally, you'll need a backup system heavy enough to handle the weight of the RAW files and converted images. This means a DVD burner for the long-term backups, and two hard disks for the current work.

Setting it up

Here's a rough-and-ready outline for a RAW workflow, from composition to back-up. Most of it I already use, the rest I'm planning to take into use as soon as I get the final missing pieces sorted out. It's just one such possibility, with some weaknesses and some strengths; however, it works pretty well for me. My trade-offs are a bit different than, for example, the great RAW advocate Michael Reichmann's [<http://www.luminous-landscape.com/>], so I think it might provide at least food for thought. I won't provide the rationale for every step: I figure that if you've read this far, you're smart enough to figure it out yourself.

Behind the camera

1. Expose for the highlights, the shadows will take care of themselves.
2. Don't stress about white balance, but shoot a white card every once in a while.
3. Keep two memory cards. When one fills up, grab the other one from your PHD/card reader, format it, stick the full one into the PHD, start the dump, and continue. If your PHD is like my X's Drive, it'll beep and shut down once it's finished copying. So, the card in the drive is always one that's been dumped onto the PHD and can be safely formatted.

At the computer

1. Dump your PHD onto your work hard disk. Organize the pictures in some sensible way. I use folders named by year/month/day.
2. Do a quick edit, erasing the obvious wash-outs. (This is good practice anyway.)
3. Fire up your RAW converter, and do a quick-and-dirty conversion to JPEG (High quality) of your keepers, into the same directory structure as your organized RAW archive. No need to do this all at once! [See Note] [[#tiff](#)]
4. Finish up in Photoshop for web saves, proofs, and such -- just as if you had started out with JPEGs, only this time the JPEGs will be a great deal better quality, so the post-processing will be a great deal simpler.
5. When your PHD starts to fill up, make a back-up copy of your working directories onto your secondary hard-disk. Then (and only then) erase your PHD.
6. When you've accumulated about 4.7 GB of RAW's and conversions, burn them onto two DVD-R's. Take one to a physically different location. (I keep mine at the office.) Only then you *may* erase one or both copies on your hard disks.

Note: Why not 16-bit TIFF? File size. It's overkill: it'll make the backup process heavier by an order of magnitude, and I have the "deep" files already -- the RAWs. If I or someone else still cares about the pictures enough to fret about bit depth once the obsolescence of RAW becomes a real issue, I figure that with the computers and back-up devices available then, converting the RAW's to whatever "deep" format is in use then will be a snap. And if nobody cares that much, the JPEGs will be much better quality and closer to the final product than those produced by in-camera JPEG.

That's all there's to it. It's actually faster and easier than working in Photoshop with JPEG's, you'll have archived conversions of your keepers that will be a good deal higher quality than if you had shot them in JPEG to start with, and there will be at least two copies of each picture on separate media at all times -- *except* the critical time during your shooting session when it's only on CF or the PHD. Yep, risky -- but no different than shooting JPEG's on smaller memory cards let alone a MicroDrive, and dumping them onto your laptop. If you're really concerned about that, why not get two PHD's, and make two dumps of each CF?

So, the bottom line: it'll cost you maybe \$500 to get what's needed to put together a RAW workflow. If you're a pro, the increased efficiency and improved quality should recoup you the investment in a matter of weeks. If you're an amateur, spending the money this way might be a better choice than buying that hot new lens, hot new camera, hot new computer, or hot new version of Photoshop. Working with RAW will get you better results faster, and most importantly, significantly expand your creative options. If you're familiar enough with image processing and do something other than studio work for maximum 8 x 10, I highly recommend you give it a shot. You can always try one of those 15-day trials on C1 DSLR to get a flavor for how it goes.

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