THE NEW ASTROPHOTOGRAPHY [orig published in Jun 2004, lightly edited in Dec 2017]

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When I was a kid, one of my favorites was the coffee-table book *The Universe* by Time or Life (or both; I can't remember if they were the same company then). It was a glorious collection of color images of mostly galaxies and nebulae taken at the professional observatories. You could get lost just staring at them.

There wasn't much scientific justification for taking such an image; the professionals that made them probably took them on off-hours for fun or because they wanted impressive images to wow their sponsors. Prior to the early sixties, color photos were rare in general and virtually non-existent in astronomy. For one thing, color photography was incredibly slow. The little color that appeared was of planetary objects.

But there in my hands I had the result of some inspired scientists or technicians who actually had realized that the universe was colorful and could be photographed that way. I saw the reflection nebulosity around the Pleiades in sky blue, emission nebulae such as the Lagoon in bloody piratical red, and spiral galaxies with blue-white outer ramparts fading off to oval yellow cores. It was a revelation to see the sky in color, especially in the high-resolution pictures of the observatories.

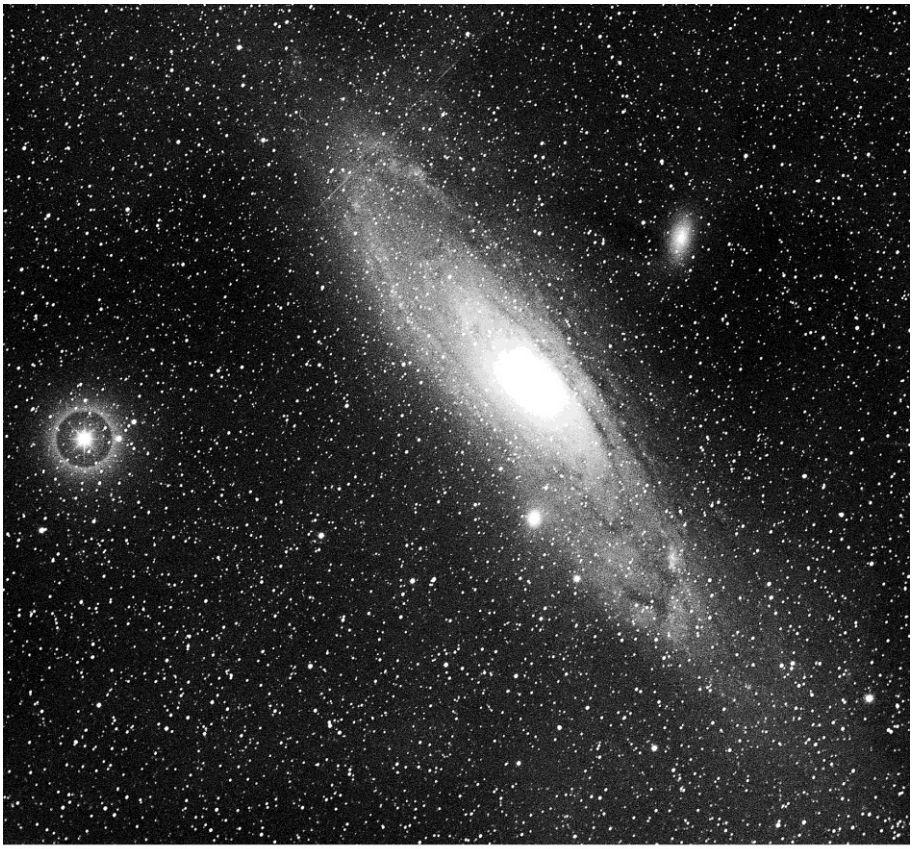
I wanted to make such pictures myself, and eventually I got the chance when I was at Ohio State University. Then I came up against the hard realities of astronomical imaging. "Difficult" wasn't an adequate word to describe that sort of imaging. "Impossible" is closer to it. I soon realized that those pictures were probably made from three or four black-and-white photos, taken through different filters or on different emulsions. Then they were carefully registered, with an inspired guess as to the real color. Observing buddy John Kerns and I were using an *f*/2.5 Schmidt camera that had a good chance of taking a color picture in a typical 20-minute exposure using the color emulsions of the late 70's. In the late 50's to the mid-60's, with slow Kodachrome ruling the color-slide world, deep-sky imaging in color through a slow Cassegrain reflector would have been unlikely. Color photography was relegated to relatively bright lunar-planetary imaging in the early days.

Figure 1: Photo of M31, M32, and NGC 205 taken by John Kerns through a 4.25-inch f/5 astrograph that I built. It was one of seven 4.25-inch richest-field telescopes that I made in the "Pringles" series. It was a half-hour exposure on hypered Ektachrome. Circa 1982

Only very bright deep-sky objects like this one could be attempted in one-shot color.

Our color deep-sky images, while workmanlike, were not often drop-dead gorgeous like the professional pictures. For one thing, bright stars seemed to balloon up into unnatural diameters at the miniature image scales we enlarged them from. Colors were shifted: the Ektachrome background was green and Fujichrome seemed insensitive to blue and green nebula wavelengths. There was nothing you could do about it except re-photograph the picture through a color filter. Such duping always increased the contrast.

We were confined to B&W plate pictures like the one below. Although pretty, they did not have the strong colors that attracted me to the *Universe* book.



Perkins Observatory 16/25 Schmidt. 12/10/79 M31 etc., UT ~ 3:00 25 min on IIaO plate T=34degF
developed 4 min in D19 solution at 74 degF. Digitized on 8-bit Epson backlit scanner Feb 2002. North Up
Contrast enhanced in Photoshop. J. Kerns, D. Suiter, D. Wereb

Figure 2. M31 taken with a IIaO plate. Plate photos had strong halation around bright stars.

I abandoned astrophotography soon after leaving graduate school. It was taking too much time and the results, measured against the effort and expense it took, weren't very satisfying. I continued on to photograph only special events, like comets or conjunctions. But I followed the technology with interest. When I had drifted out of astrophotography, there were only two real methods for taking color astrophotographs with slow telescopes, using cold cameras and gas hypering. Both were a hassle. We did some gas hypering of the monochrome film SO 115, later Technical Pan, “cooked” slightly using the very safe 2% hydrogen and 98% dry nitrogen mixture at Perkins Observatory, with mixed success. I remember one technique I used to store gas-hypered film for later use was to put the whole roll in a jelly canning jar and pump it out with a loose lid in a vacuum bell tank. When I released the vacuum in the larger tank, the smaller jelly jar pop-sealed. When I removed it, I tightened the lid just like you do for jelly. We never took the multiple-filter versions on black and white emulsions that would lead to color photographs.

Cold cameras were not based on the electrical method of Peltier coolers, but by actually stuffing dry ice against the film platen. In order to keep the film from frosting up, the most successful cold-camera users pumped the air out of the camera and imaged through a window.

In later years, people discovered some *negative* emulsions that gave good results. Most one-shot astrophotographers had previously taken only slide film because commercial photo-finishers were absolutely clueless when it came to cutting and printing astrophotographs. At least with slides you could specify that they leave the roll uncut and mount them yourself. Some people learned to process color negatives and prints themselves, taking advantage of kits and drums that made the darkroom work semi-easy, though slow, and learned the C-41 color process to develop the film. Thus they avoided it being cut in the middle by an inattentive darkroom worker. Also, films themselves evolved new chemistries and somehow became more sensitive. Still, astrophotography developed in only incremental steps for 15 years.

Then big CCDs hit. At first CCDs were underwhelming. The early ST-4 camera was really meant as an automatic guiding tool, but people started using them as the primary imaging device. SBIG and others catered to and encouraged this trend, integrating color filters right on the package and following commercial cameras in mounting denser and larger focal planes. The ST-4 grew-up into mega-pixel cameras until that magical threshold was crossed where the viewer is fooled into thinking that he is looking at reality.

At the same time, a parallel technology, but a quieter one, grew up. That is the technology of image-processing and enhancement. This is not necessarily a digital technology. David Malin in the 70s or early 80s, I think, worked out a darkroom astrophotography technique called "unsharp masking" that today is used almost exclusively in digital processing, but when he first used it he had to carefully register photographic sheets below the enlarger. His masked picture of the Orion Nebula that contained the Trapezium and the outer ramparts of the gas cloud within the same dynamic range stunned the astrophotography world. Other more esoteric techniques were worked out that today can convert a blurry image to a sharp one. Many of these became prominent during the Hubble Space Telescope fiasco, when astronomers were forced to find methods to see through the blur.

I was looking around on the web the other day, and I found a few sites that convince me that a new threshold has been reached. Amateurs are taking deep-sky pictures that would have rivaled or exceeded that old *Universe* coffee table book. Look at <Two now broken web links. There are plenty of sites in 2017> to see the quality of the images. Some of these are so astonishing that you won't be able to believe them for a little while. For example, Russell Croman's M104 seems three dimensional [note added 2018 – he seems to be a bit burned out – he hasn't added any photos lately to his site at www.rc-astro.com].

Will I jump in now that anyone can take quality photos? I don't think so. Even with autoguiders, these images are still major undertakings. Astrophotography is greatly helped by a permanently-mounted telescope. Also, it is largely a young person's sport. But I'm glad that such images are being generated. Perhaps the same excitement will be felt by other beginners that struck me many years ago.