physical Universe. In the introduction to her book *Problems in Astrophysics,* published in 1903, Agnes M. Clerke stated, "Queries, in the coming years, will be put to the skies very different from those here propounded; and answers of a surprising kind will doubtless be afforded to our present interrogatory." Would anyone dare to deny that the same statement is as valid today as it was more than a century ago?

We encourage you to dig deeply as you continue your exploration of the deep sky.

Doug Hube is a professional astronomer actively retired from the University of Alberta and Associate Editor of this Journal.

Warren Finlay is a Professor of Mechanical Engineering at the University of Alberta, a keen explorer of the night sky, and the award-winning author of Concise Catalog of Deep-Sky Objects.

This is the final column in Deep-Sky Contemplations. We express our appreciation, not only for the time and effort put in by Doug Hube and Warren Finlay over the past three years, but also for the insights provided from the new way of looking at the Universe. — Ed.

Through My Eyepiece

Eyepieces

by Geoff Gaherty, Toronto Centre (geoff@foxmead.ca)

Since my column is called "Through My Eyepiece," I thought it might be of interest to actually talk a bit about eyepieces. Eyepieces are the powerful magnifiers that allow us to examine in detail the images formed by our telescopes.

The original eyepieces were simple single lenses: concave in Galileo's telescope, convex in Kepler's. Telescope makers learned that they could improve the quality of their telescopes' images by improving the quality of their eyepieces, so they gradually developed an ever-more-complex set of designs that now bear their designers' names: Huygens in the 17th century; Kellner and Plössl in the 19th century; and Nagler in the 20th and 21st centuries, to name a few.

Back in the 1950s and '60s, when I first got into astronomy, the terminology used for eyepieces was a bit vague. My first telescope came with two eyepieces: a 28-mm "Kellner" and a 12.5-mm "Ramsden." I later upgraded by buying three Brandon "orthoscopic" eyepieces. As a teenager, I disassembled everything I got my hands on, and was mildly surprised that few of these eyepieces actually resembled the diagrams in books. When I got back into astronomy in the '90s, "Plössl" eyepieces were all the rage, a design totally unheard of back in the '60s. Somehow, something looked familiar — it turned out that both my Edmund Scientific 28-mm "Kellner" and my Brandon "orthoscopic" eyepieces were, in actual fact, Plössls. All four were symmetrical designs made up of pairs of cemented achromats. So I'd actually had a set of Plössl eyepieces without knowing it!

The most striking development in recent years in eyepieces has been the ever-widening apparent field of view of modern designs. For most of the telescope's history, eyepieces were in the 40° to 50° range, typified by Kellner and Plössl designs. Some wide-field designs were developed, mostly for military purposes, that were then adopted by amateur astronomers when they came on the war-surplus market; the Erfle design is a good example of a military eyepiece put to civilian astronomical use. Towards the end of the 20th century, computerized optical-design programs and exotic types of glass became available, and we saw a sudden quantum leap in the eyepieces available to amateurs, both in field of view and dollar cost!

Modern eyepieces can now be grouped by their apparent fields of view. What I'll call "normal" are around 50°, usually based on the Plössl design. "Wide angle" eyepieces are in the range of 65 to 70°. "Ultra wide angle" range from 82° up to 100°.

A second way of looking at modern eyepieces is in terms of their eye relief: how far above the eyepiece's lens you must place your eye in order to see the whole field of view. With traditional designs like the Plössl, eye relief was a little bit less than the focal length of the eyepiece. This was quite comfortable with longer focal lengths, 20-mm and higher, but increasingly uncomfortable as the eyepiece's focal length became shorter. A 4-mm eyepiece required cramming one's eyeball right up against the eyepiece's lens, downright dangerous in sub-freezing temperatures. Amateur astronomers learned to use a Barlow lens to increase magnification without decreasing eye relief, and eyepiece designers learned to build a Barlow lens into some designs so that all eyepieces in a series would have the same comfortable eye relief.

Many beginners make the mistake of believing that they need to own a large number of eyepieces, and the manufacturers cater to this by selling eyepiece kits that include a number

of different focal-length eyepieces plus a variety of filters. I recommend avoiding these kits — the eyepieces are often of poor quality and include some of limited usefulness, such as 40-mm eyepieces in 1.25" barrels, which are like looking down a soda straw, and 4-mm Plössls with absolutely no eye relief whatsoever. You will do better to buy one or two quality eyepieces, carefully chosen for the sort of observation that you do.

I discovered after I'd been observing variable stars for a while with my 280-mm Newtonian, that I was doing 99% of my observing with just two eyepieces. These were a 22-mm Tele Vue Nagler (63×, 1° 18' field of view) and an 8.8-mm Meade Ultra Wide (157×, 32' field of view). When I switched to doing most of my variable-star work with a 280-mm Schmidt Cassegrain with more than twice the focal length, I again gravitated to two eyepieces: a 40-mm University Optics MK-70 (70×, 1° field of view) and a 16-mm Tele Vue Nagler (175×, 28' field of view). These same pairs of eyepieces also work well for observing deep-sky objects on these scopes.

The only objects that require more eyepieces are the Moon and planets. In fact, I find it useful to have several eyepieces with relatively slight differences in focal length for the Moon and planets because atmospheric seeing requires close matching of magnification to seeing conditions. On my Newtonian, for example, I have eyepieces for my binoviewer yielding magnifications of 190×, 240×, 300×, and 400×, and find myself using all of these quite frequently. Most of the time the 240× eyepieces are slightly favoured. If the seeing is too poor to use 240×, it is usually too poor to bother observing at all. The powers above 240× are reserved for nights with very stable air. Fortunately, such nights are common enough to make it worth having these eyepieces handy.

When I observe with any of my smaller telescopes, I find myself using roughly the same magnifications that I use on my 280-mm scopes. The only exception is when I take advantage of the smaller scopes' shorter focal lengths to take in a wider field of view. With the dark skies I enjoy here in Coldwater, I can really take advantage of wide fields of view to observe the largest objects, such as M31 and its companions, the Small Sagittarius Star Cloud (M24), and the Veil Nebula. I never really appreciated these huge objects until I left the city for darker skies.

Geoff Gaherty is the recipient of the Society's Chant Medal for 2008. Despite cold in the winter and mosquitoes in the summer, he still manages to pursue a variety of observations, particularly of Jupiter and variable stars. Though technically retired as a computer consultant, he is now getting paid to do astronomy, providing content and technical support for Starry Night software.

Gizmos

Coming In From the Cold

by Don Van Akker, Victoria Centre (don@knappett.com)

How do you tell the difference between a professional astro imager and a Canadian amateur?

It's obvious when you think about it. The amateur is the one with hypothermia. That's because the one feature that big professional observatories all seem to have is a well-lit observer's room with heat. There is a row of computers on a long desk against one wall, and the astronomers are in chairs, a little bit sleepy, comfortable, and warm.

Think about that the next time you are waiting out an exposure in your back yard or even in your roll-off observatory, stamping your feet and swinging your arms, and wishing you had taken up stamp collecting.

What you need is an observer's room with a computer and a comfortable chair and, while you're at it, a fridge full of snack food and the ball game on the tube.

Fantasy?

You may already have it.

You need *XP Pro* on your home computer, and both it and your telescope laptop should be logged on to a wireless router.

Set up your scope, camera, and laptop — everything ready to start imaging. Go to your observer's room (the one the kids call the living room) with the computer and the comfortable

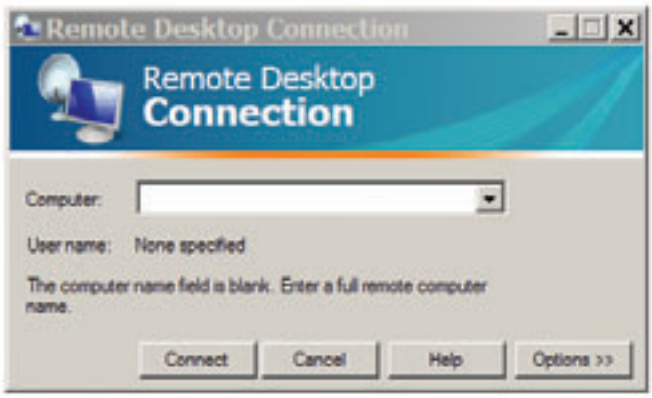

Figure 1 — A screen capture of the Remote Desktop set-up window.