THE BAA OBSERVERS' WORKSHOPS

Cambridge	*Winchester*	*York*
2003 February 15	*2003 April 26*	*2003 September 6*

Guy Hurst urged us all to search the skies for novae at the York workshop.

Nova patrolling

by Guy M. Hurst

Workshop No. 3:
The Priory Centre, York
2003 September 6

Introduction

For nearly 2000 years Chinese observers meticulously recorded special events in the sky. The objects which we now know as novae and supernovae were historically regarded as 'guest stars', but their cause was not known until comparatively recently.

The event of AD 1054,[1] when an apparent 'new' star appeared in Taurus, is remarkable for the fact that no definite European record has been found despite its reaching about magnitude –3, although it was comprehensively noted in the Far East. We now know this to have been the supernova for which the famous Crab Nebula is the remnant.

The Rev Thomas Anderson, who lived in Edinburgh, made his mark on one of the key aspects of searching for 'new' objects. On 1892 January 31, he found a 'new' star in Auriga by naked eye observing. This demonstrates the value of always carrying out a naked eye check of the sky before starting your observations, as such objects can appear within 24 hours or less.

Anderson went on to find another such object with the naked eye on 1901 February 21, when he detected what is now catalogued as GK Persei. It reached a maximum brightness of about magnitude 0.2, but is still monitored by BAAVSS members as it continues to fluctuate near magnitude 13.

It is only during the last hundred years or so that observers began to realise these objects were not new, but very faint stars, which suddenly increase quite dramatically in brightness. However the task of distinguishing between novae and supernovae only gradually emerged when Walker,[2] as late as 1954, studied the spectrum of Nova Herculis 1934 and found it to be a binary system. Further research showed matter flowing from a cool star to a white dwarf creating a shell around the latter, which eventually blows off this outer layer. The star survives but the event causes a temporary increase in brightness, often equivalent to eight magnitudes or more.

Supernovae, on the other hand, refer to the complete destruction of a star, but today's workshop discussion is aimed at searching for the objects which we now know as novae.

The UK Nova Patrol and its methods

The late George Alcock was remarkably successful in finding novae. His tally of five were all found visually using binoculars. In particular his detection of a nova in Vulpecula in 1976 (now catalogued NQ Vulpeculae) was to be the inspiration for the formation of the UK Nova Patrol. This was started by John Hosty and the present author, with the aim of finding novae either by visual means (naked eye or with binoculars) or by the use of photography. The aim was to keep the equipment requirements simple and indeed most people who apply already own the necessary equipment so no large extra expenditure is required.

George Alcock had been successful, in part, because of his remarkable talent of memorising vast areas of the Milky Way where most novae occur. Most observers could not do this, so the galactic plane was divided into 121 areas of approximately 10° square stretching down to declination –30° – the area of sky which most Europeans are able to reach. Each observer is allocated a small number of areas so that a team approach is adopted to coverage of the Milky Way. The other aim is to check to a limit of magnitude 8, as it is believed that a dozen or more novae probably reach this brightness each year, although in reality the discovery rate worldwide only averages about 2 novae per year.

HS Sagittae

John Hosty, as co-founder, was successful almost immediately with the discovery of a nova in Sagitta on 1977 January 7. The object, of magnitude 7, was very low when found from his location in Huddersfield but crucially he was only using one half of a pair of broken 10×50 binoculars, effectively a monocular.[3] The simplicity of equipment needed was proved!

Visual searching

After various experiments, it is generally agreed that the use of binoculars, such as 8×40 or 10×50, is ideal for visual searching. A relatively wide field of view helps with sweeping and being able to use relatively lightweight handheld equipment is an advantage.

Normally each person joining the visual patrol is allocated four areas to learn. These are selected so that two are favourably placed in summer months and the others in the winter. This does not mean the coverage of all areas should not be extended over as much of the year as possible, since novae can occur in the morning sky. The technique of area allocation is intended, however, to make it as friendly as possible to newcomers.

Photographic searching

Continuing the aim of a simple approach, photographers have successfully recorded large areas of the Milky Way simply by

Figure 1. Mike Collins studying his vast library of patrol slides.

using a camera on a photographic tripod without the need for a drive. 30 second exposures at full aperture with a 50mm lens, typically operating at f2, will reach about magnitude 8.0 from most locations provided a relatively fast black and white film is used with a speed of ISO 400 or higher. Using this method the whole visible Milky Way can be covered.

However the use of a 135mm telephoto lens with an SLR camera gives a field of about 10° square, similar to the regions allocated to visual observers. If no drive is available, then 10 second exposures avoid significant trailing although naturally restrict the limiting magnitude. The addition of a drive, often achieved by mounting the camera piggyback onto an existing telescope, allows a limiting magnitude of 9–10 to be reached by exposing for 1 minute at full aperture on films of 400 ISO.

An important point is that the film needs to be developed and checked as soon as possible after the exposures were taken. The same night is ideal but failing this the following day. Novae can not only appear suddenly but also sometimes fade very quickly, so early detection is essential which also allows us to notify professional astronomers.

Whichever photographic method is used, it is essential that two photographs are always taken of each area so that flaws can be eliminated. Even so any potential new object on both should also be examined under a high power magnifier to ensure the characteristics and shape match that of nearby stars.

Using the telephoto technique and allowing for duplicate photographs, a 36-exposure film can allow 18 areas to be covered in a night.

Master charts

For visual searchers the area of sky allocated can be learnt by regular sweeping as the brain tends to recall various small patterns. However master charts can be made either by referring to star atlases already owned or by generating them from astronomical software. The author regularly uses *Guide 8* by Bill Gray which can be set to generate a specific 10° area (level 5). Given the aim of finding something new to mag 8, it is recommended the limiting magnitude be set to 9.5 before printing to allow a margin for stars near the limit of binoculars.

The disadvantage of some atlases is that stars brighter than the stated limit may be missing. This can only be overcome by plotting such objects over a period of time once you are satisfied they are not new. The other hazard is that variable stars which are not plotted may brighten above your search limit. Again, good software such as *Guide 8* has all catalogued variables marked, although where they are based on photographic magnitude ranges, the red colour of some variables can mean they are much brighter visually when near maximum, as is the case of the Mira variables.

An alternative to star atlases and software is to obtain master photographs yourself along the lines of the telephoto patrolling already discussed. By using a 135mm telephoto lens a field of view of 10° is obtained. If this is not possible, the author can supply copies from photographs contributed by others. Care is still needed with variables, which may have been near minimum when the photographs were taken.

Checking techniques

The big advantage of visual searching is that recognition of an intruder in your area can be instant. However, apart from considering a variable star as a candidate, it is also important to eliminate bright asteroids. Equally many bright novae have been reported which turn out to be planets and reference to the BAA *Handbook* or similar should eliminate these false alarms.

For photographers the technique is clearly different. The best comparison is between the latest two photographs and a master, taken with the same equipment, preferably secured at least several months earlier. The usual checks for variables, asteroids and planets still need to be made.

To make comparison of the photographs easier, various techniques have been employed. It is possible to obtain two cheap slide projectors and mount the master and new slide in frames. The two photographs are alternately projected on to a screen by adding a rotating bar in front of the lenses, although the author has done this by using as simple a device as a hand. An intruding object will appear to 'blink' in and out on the screen. Others, such as Mike Collins (Figure 1), view both the old and new negative through eyepieces and rely on the stereoscopic effect to spot an intruder which is absent from the master frame.

Action on detection of a possible nova

When an apparent new object is found visually or by photography immediate action is required. The essential checks for variables, asteroids and planets must be carried out quickly. Reference to master photographs should hopefully eliminate stars omitted from atlases.

If the object is being observed visually, it is recommended that a drawing of the

star field is made and an approximate position of the object in right ascension and declination obtained. In addition, the magnitude of the object at this early stage is very valuable information. Assuming magnitudes of nearby stars are not immediately available, choose four stars and label them A, B, C and D. Compare the nova with pairs of stars from this list and make at least two estimates. If the nova is fainter than A and brighter than B and judged about halfway between in brightness, then this would be recorded as:

A(1)V(1)B

Here the comparisons 'A' and B' are defined stars with 'V' as the variable object or nova. The numbers in brackets imply the nova is equally fainter than A and brighter than B. Always record the date and time together with the instrument used e.g. '10×50B'.

The next stage would be to ring the author who acts as the coordinator for the patrol. The contact details appear at the back of each *Journal* under 'Other Officers'.

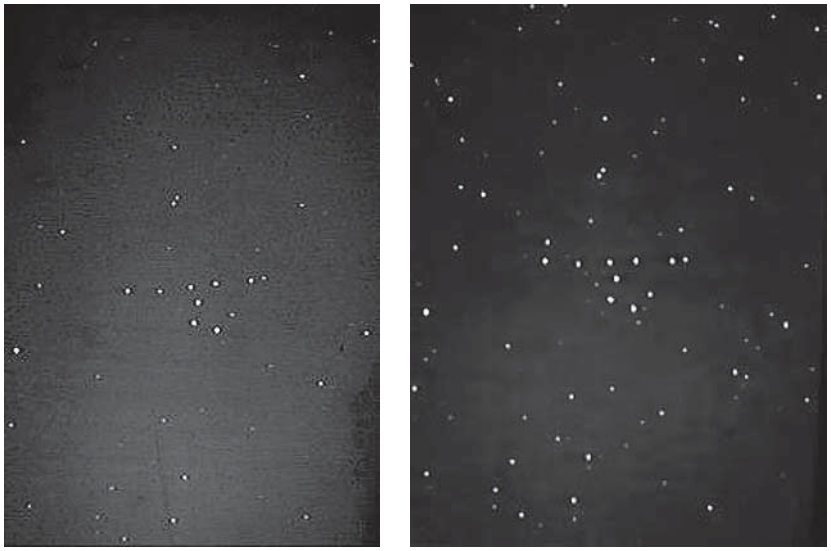

Figure 3. NQ Vulpeculae (Nova Vulpeculae 1976), 300mm telephoto lens, photographs by Peter Birtwhistle. *Left:* pre-nova, 1976 July 28; *right:* nova present, 1976 Oct 23.

Recent patrol developments

Although this discussion is aimed at those wishing to start out with relatively simple equipment such as a camera or binoculars, it is perhaps interesting to briefly consider techniques being developed by those who have patrolled for some time.

The disadvantage of photography can be the need to set up temporary darkrooms and handle messy chemicals. For those fortunate enough to own a CCD, attaching a 50mm lens (with appropriate space tubes), allows instant images to be obtained. Unfortunately the field of view is usually smaller as in the case of the MX516 used by the author which gives a 5° area, and therefore more images are needed to achieve the coverage of a photograph (Figure 2).

However not only can the system allow images to be checked instantly on a computer, but blinking software such as *AIP* by Berry and Burnell[4] provides a highly efficient way of comparing the new pictures with the master.

The other area for those with large telescopes is to try to find novae in other galaxies. They are naturally very faint due to the large distances involved, but successes in finding objects in Messier 31 by Tom Boles[5] and Martin Mobberley demonstrate that it is possible.

The above is mentioned to illustrate future potential. I would stress that you do not need to become involved in the purchase of such equipment at the outset, or in order to join the patrol.

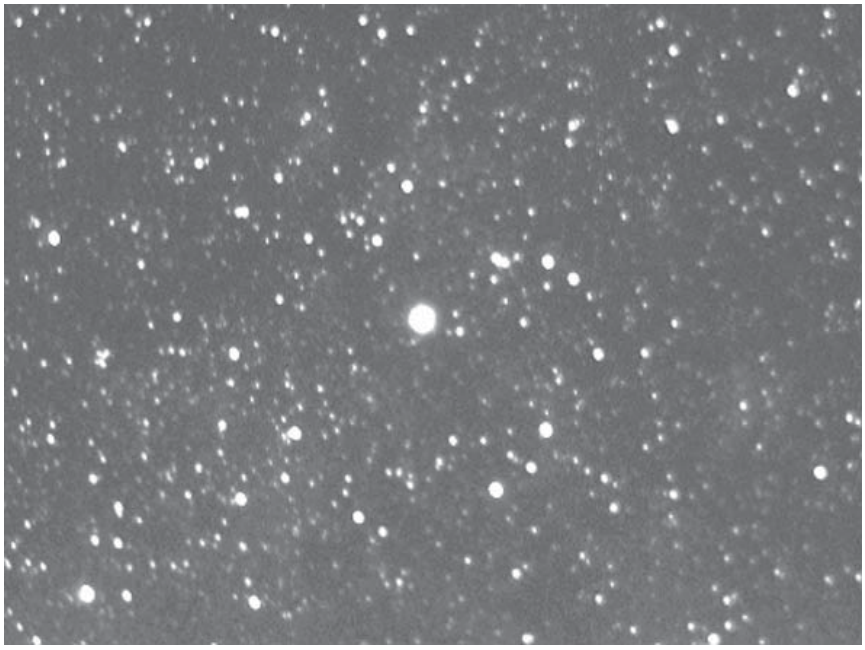

Figure 2. Area of Gamma Cygni, 2000 Nov 19. 50mm lens + MX516 CCD. *Guy Hurst*

Spot the nova and join the patrol!

Finally two pictures of the field of Nova Vulpeculae 1976 (Figure 3), as shown at the York workshop are included. Frame A shows the famous 'Coathanger Group' and does not include the nova, whereas frame B includes it near maximum. Can you identify the intruder? If so do not hesitate, but contact the coordinator now for a simple patrol application form to complete. We need your help!

Guy M. Hurst, Patrol Coordinator

Address: 16 Westminster Close, Kempshott Rise, Basingstoke, Hants. RG22 4PP. [guy@tahq.demon.co.uk]

References

1 Stephenson F. R. & Green D. A., *Historical Supernovae and their Remnants*, Oxford University Press, 2002, p.117
2 Walker M. F., *PASP*, **66**, 230 (1954)
3 Hurst G., *J. Brit. Astron. Assoc,* **113**(3), 143 (2003)
4 Berry R. & Burnell J., *The Handbook of Astronomical Image Processing*, Willmann–Bell Inc., 2001, p.608
5 Hurst G., *J. Brit. Astron. Assoc*, **113**(6), 367 (2003)