# The 'Great Filter Debate'

Alan W. Heath

The Great Filter Debate took place in the BAA in the 1950s. As the writer was involved in the experiment, members of the Association may find the following account of interest.

Early attempts to reduce glare[1] in the observation of celestial objects define one of the reasons why in 1953 Valdemar Axel Firsoff (1910–1981) began to test the efficacy of colour filters in lunar and planetary observation.

Firsoff began with a series of observations using monochromatic and dichromatic (transmitting two colours) filters to ascertain faint colourings and eliminate spurious colour effects. He reasoned that the colouring of a marking can be determined by its intensities as viewed through red, green and blue tricolour separation filters. From several hundred determinations made over a three-year period he concluded that the Moon has less colour and the effects revealed by filters are not so dramatic. Yet many dark areas in the lunar maria and craters show traces of colouring, usually green or violet, whilst red and yellow hues predominate elsewhere.

Thus encouraged, and bearing in mind the possibility of detecting markings invisible in integrated light, as F. E. Ross had demonstrated with his UV experiment on Venus at Mount Wilson in 1927, Firsoff next turned his attention to Venus and quickly established the value of the technique in dealing with irradiation, contrast and the effects of atmospheric dispersion.[2] His pioneering initiative proved inspirational. Observers who have tried in vain to detect markings on the planet would do well to look up V. A. Firsoff's paper in the 1957 March issue of the *JBAA*, also reported in the *Chicago Astronomer* in its autumn issue of 1957.[3]

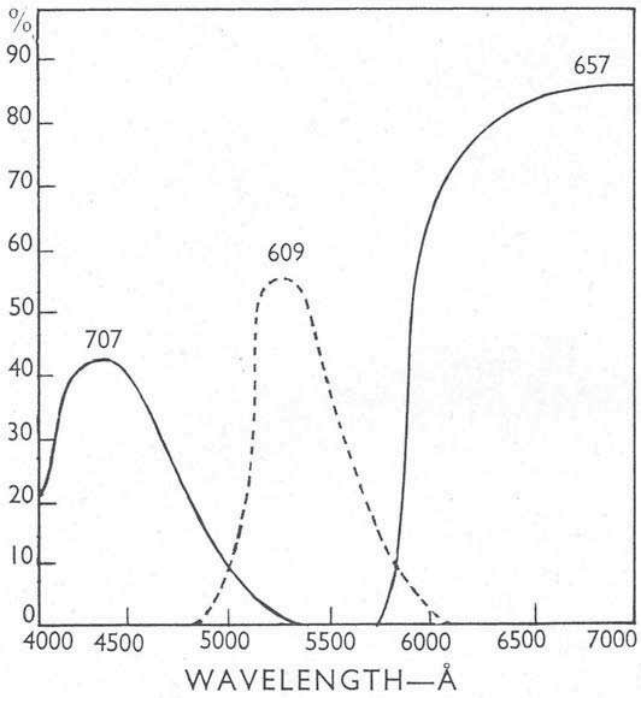
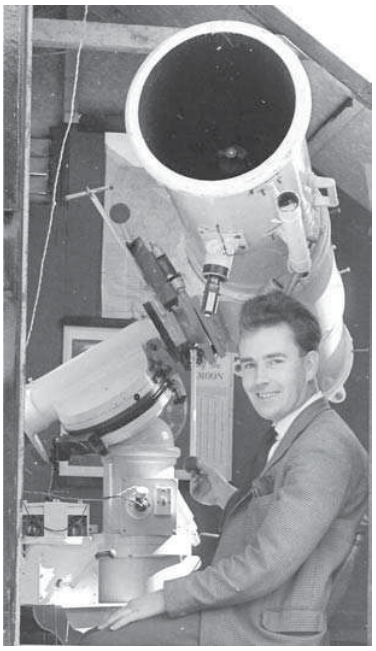


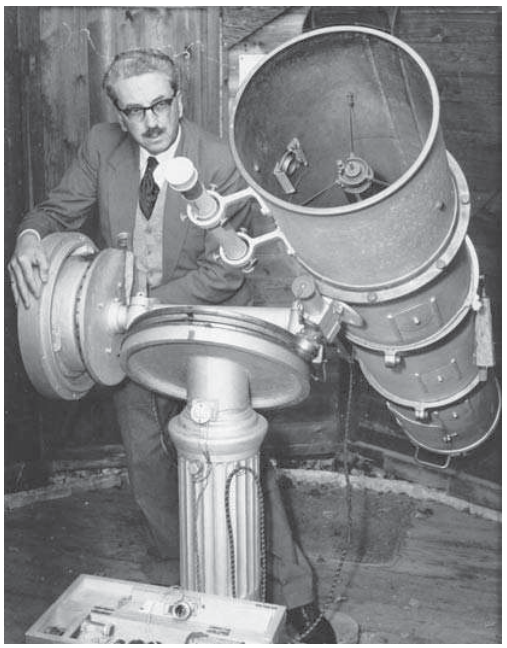

**Figure 1.** Transmission characteristics of the Dufay tri-colour filter set.

Wavelength-dependent effects can be photographed but are not visually apparent, it was argued; are they illusion or reality? And so the Great Filter Debate got under way.[4] In a way it marked what went before from what has since flowed down to us.

John Hedley Robinson (1905–1991), later Director of the Mercury & Venus Section (1965–1979), now entered the field. He had experimented with filters in 1955 after reflecting on the implication of photographs taken by Wright in 1927/'28 of Mars and Jupiter in light of different wavelengths from infrared to ultraviolet. Robinson was intrigued, and in 1956 as a rehearsal for filter observations of Mars, tried several filters on Venus. He found he could see the shortening of the cusps of Venus, which were clearly truncated in blue light, and their extension in red light. The date of dichotomy is always difficult to establish and it was shown to occur early in blue light and later in red, which had considerable bearing on the so-called Schroeter Effect. Also it has been found that the Ashen Light is clearer in red light.



A. W. Heath in 1963 with the 12-inch (300mm) Calver reflector (BAA Instrument No. 93).



J. Hedley Robinson with his 10-inch (250mm) Newtonian reflector. *Photo by D. H. Robinson, courtesy R. J. McKim.*

Robinson claimed that the use of colour filters, or colour screens as they were known, which he had previously thought to be something new for visual study, already had a venerable history. Having experimented with Polaroid filters to control the brilliance of Venus this intrigued the writer,

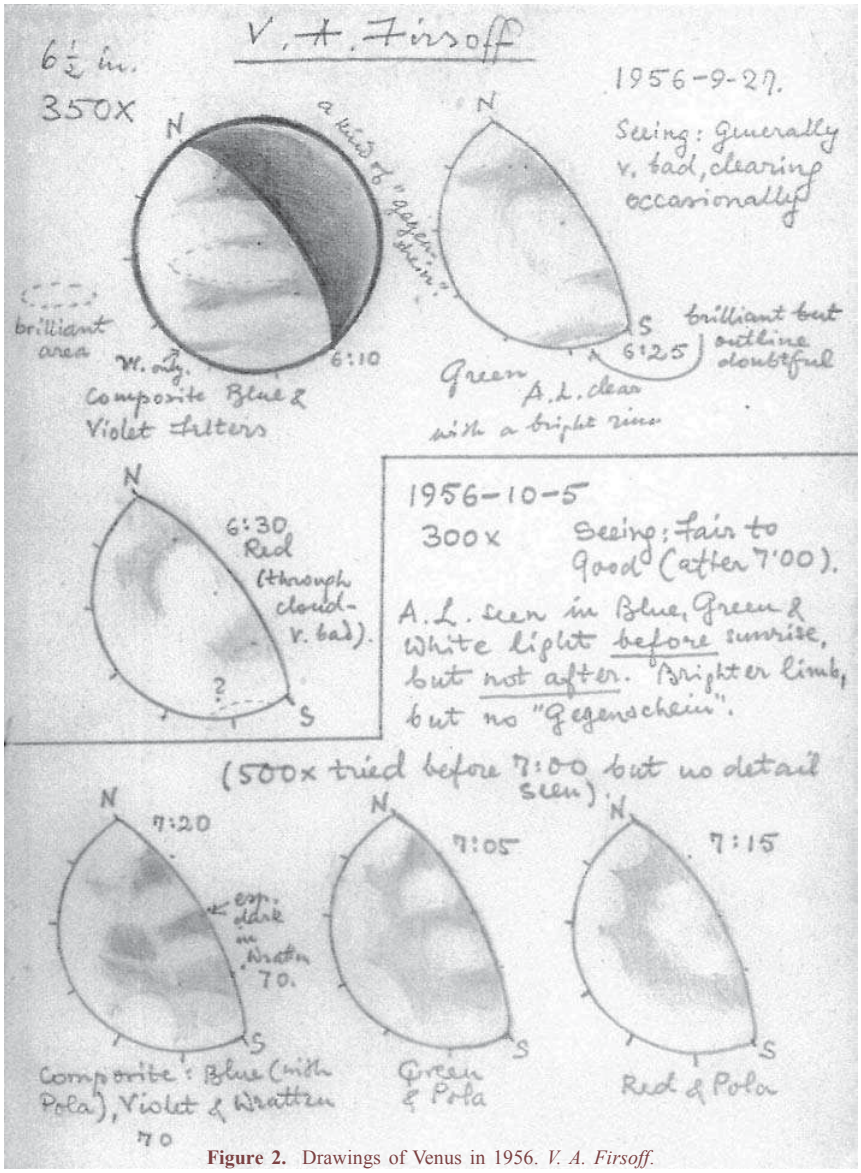



**Figure 2.** Drawings of Venus in 1956. *V. A. Firsoff.*

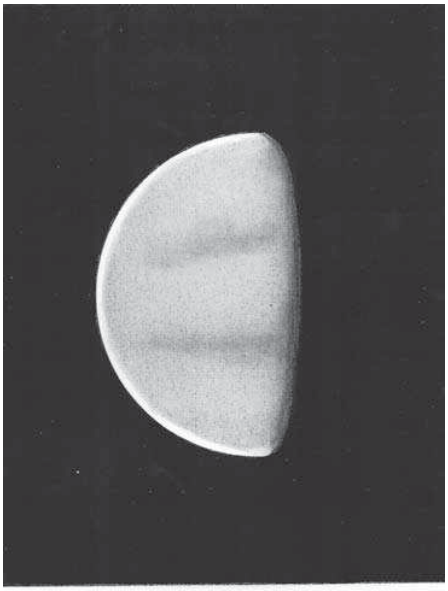



**Figure 3.** Venus in 1959, green filter, *A. W. Heath*. The bands shown were not seen without the filter.

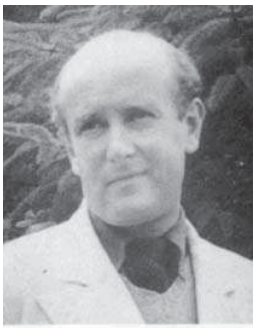
and 'Mars through colour filters' (1958) was the first result of this collaboration.[5]

Around this time, F. C. Wykes, A. P. Lenham and C. M. Pither were involved. The writer initially worked with Ilford filters but realised the need for filters which were as monochromatic as possible with no overlap. The now-unavailable Dufay tricolour set proved the most effective. Over the period 1959 May to December, numerous observations of Venus were made and drawings clearly show shadings which were better seen in one colour, the different appearance of the cusps, and certain irregularities in the terminator.

The Ashen Light in 1957 December as seen through a red filter proved of particular import in verifying what F. C. Wykes had seen using an Ilford Deep Red filter (no. 609). Throughout 1959 Firsoff, Robinson, Wykes and the writer independently kept a close watch on the planet. Their four-part paper 'Filter observations of Venus in 1959' was presented at the monthly meeting of the Association at Burlington House on 1961 April 26.[6]

The citations which follow are taken directly from the published document, with comments from others referred to the report of the meeting in the same issue of the *Journal*. Wykes was especially interested in the Ashen Light and illustrated his contribution by describing his observations in full daylight with a red filter and a day adapted eye on 1959 July 30, 17:25 UT.

Firsoff summed up by saying that colour filters reveal markings often unseen without them. In the ensuing discussion the President, R. D'E. Atkinson (1898–1982) accepted that under certain circumstances one should be ready to use whatever colour improves observation. C. M. Pither said he had experimented with polarising filters and found the cusps at the crescent phase far more extended with the filter than without. A comparable experience was cited by E. P. Duggan. A. C. Curtis was not at all convinced, but he did admit that some of his filtered observations had produced results similar to those described by Hedley Robinson and others. He added that he had sometimes noticed apparent dark bays on the terminator but had dismissed them as illusion.



V. A. Firsoff in the early 1960s.

At the Ordinary Meeting of 1962 February members were appraised of the improbabilities when F. W. Hyde & E. Fulford-Jones presented their paper 'An investigation into the use of colour filters in visual observations.' They conceded the new approach had been thoroughly examined and a good case established. Nevertheless, they believed some of the observations were questionable and proceeded to dismantle the pro-filter brief.

The normal movements of the body and the head which take place due to involuntary reflexes have a very direct bearing on the use

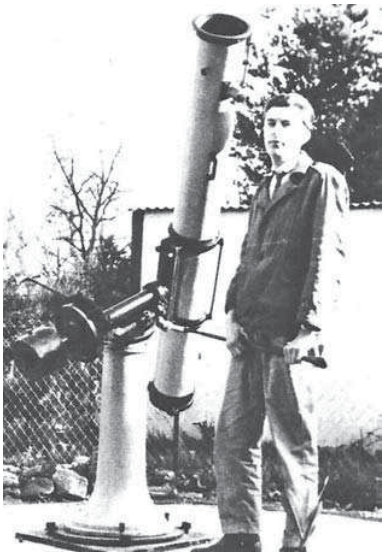
of colour filters. It is possible to demonstrate conclusively that by selective stopping down an improvement of the image can be produced such that filters are rendered unnecessary for the observation of fine detail and the detrimental effects of filters are avoided. Therefore there was a case for a more extensive investigation taking into account the physiology and the psychology of the eye-brain system.

F. L. Jackson believed the experiments showed certain facts but may not be really significant because of the differences in the colour composition of the planets. Patrick Moore made the point that Venus poses problems quite different from those of Mars and Jupiter. Hyde added that filters may help those whose eyes are less sensitive to colour but when we tried to find 'threshold points' for filters with three different observers we found no correlation.

**Figure 4.** Mars at opposition on 1965 March 9, 22:30 UT. 300mm Reflector ×318, seeing good. *Left:* no filter; *centre:* Dufay Red; *right:* Dufay Blue. *Note (from original observation):* Surface features are darker in Red whereas no surface features are seen in Blue. General brightness of the limb in Blue is an atmospheric effect which is not apparent in Red though the morning haze at the East limb is evident without a filter. North Pole Cap is slightly smaller in Red and more diffused in Blue. *A. W. Heath.*

Frank Hyde in 1961. *Photo by A. W. Heath.*

W. M. Baxter then read a letter from Firsoff who apologised for not being able to attend the meeting, but proffered two points for discussion. Surely the value of the use of filters in visual observation could not be in doubt. Colour filters were now regularly used by many observers, to mention only Kuiper and Dollfus. He continued by remarking that there are two aspects of the situation: a) optical and b) personal. With the former he argued that it was partly a matter of adequate instrumentation and partly of the sensitivity of individual eyes to such detail in which individuals differ a great deal. Observation with colour filters demands practice, especially if blue and violet filters are used. In the second case the stimuli which actuate the retina form the perception but what we are aware of is a perception, *i.e.* these stimuli as interpreted by the brain (or mind) and here surprising differences are possible.



Colin M. Pither, *ca.* 1962.

It was left to J. Hedley Robinson and particularly the writer to explain that there seemed to be considerable misunderstanding regarding the technique in question which had resulted in wrong conclusions and a totally erroneous portrayal of the facts. In his communication of 1962 June 2, the writer gave a clear and concise statement of the facts as he saw them. It is argued that filters reduce light and therefore definition, but with Venus we have ample light, so much that we can afford to lose some with advantage. Filters not only allow us to see the planet in a restricted wavelength, but reduce glare, which improves seeing. Threshold observations cannot be considered acceptable of course, but given sufficient light and aperture in the first place, then surely one cannot say that filters are detrimental.

The writer continued by saying that from the regular use of filters he has become increasingly aware that these accessories reveal many other things as well, such as variation in the size of cusp caps, variation in the intensity of bright areas and changes in the appearance of the terminator and cusps. In conclusion he noted that we must remember that many considerably more experienced observers have successfully employed filters; red for Mars is quite common practice to enhance the 'maria'. Also let us not forget the recommendation of Wratten 47b to assist in seeing the white clouds of Mars, as recommended by Dr A. Dollfus. An aperture of 8-inch (200mm) or more is recommended for such observers to avoid threshold seeing.

As we have seen it was F. W. Hyde, with the support of eye specialist Dr Fulford-Jones, who originally queried the rhetoric of the filter. Now at the Ordinary Meeting of the Association in 1963

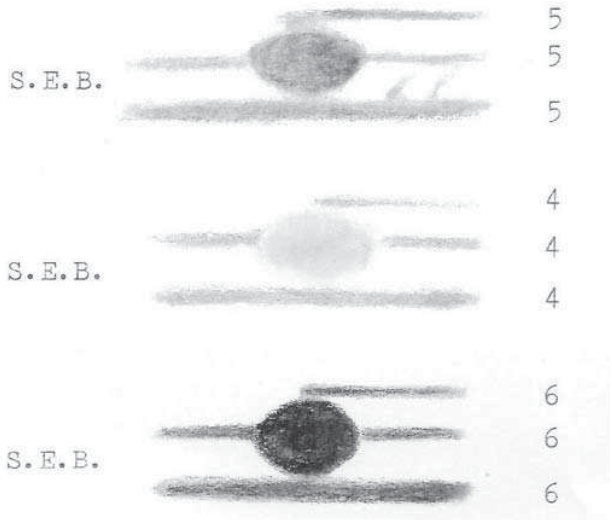



**Figure 5** *(left)*. Jupiter's Red Spot, 1975 Nov 21, 19:45 UT. ω1= 187, ω2= 36. 300mm Reflector ×190, seeing fair. *Top:* No filter, R.S. intensity 5. *Centre:* Red filter, R.S. intensity ½; note slightly darker rim. *Bottom:* Blue filter, R.S. intensity 8½. The Red Spot was visually rosy pink. *Note:* The Red Spot is a similar intensity to the nearby belts with no filter but is very faint in Red but very dark in Blue. *A. W. Heath.*

**Figure 6.** Venus, 1973 Dec 30, 16:10 UT. Red filter, ×190, 12-inch [300mm] reflector. *A. W. Heath*.

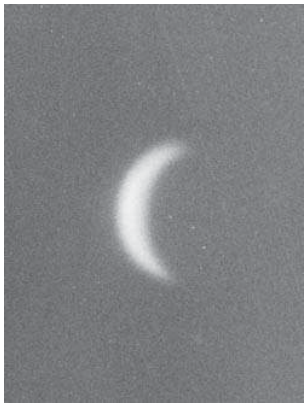


**Figure 7.** Venus, 1973 Dec 30, 16:15 UT. Blue filter, ×190, 12-inch [300mm] reflector. *A. W. Heath*.

February they came together to argue out their respective causes.

As Patrick Moore said in opening the debate, there were three schools of thought:

1 Filters would show details invisible in integrated light;
2 Filters would show normal features with increased clarity;
3 Filters were of no use at all.

Just before the meeting began the pro-filter group, comprising V. A. Firsoff, J. Hedley Robinson and C. M. Pither, retired to the BAA library where Dr Fulford-Jones tested their sight and pronounced it perfect. The theory of defective vision fell apart. Robinson then produced a set of Dufay filters which were more transparent than those used by Hyde and Fulford-Jones and explained that they resembled the response curves of the human retina. The objectors were immediately on the defensive.

Robinson gave a brief resumé of the work carried out by members of the Association since 1956. He said the value of filters had been sharply criticised, but this was totally without foundation. Hyde gave an account of the objections that had been raised and paid tribute to the energetic work of the experimenters. Firsoff exhibited unpublished photographs taken by G. P. Kuiper at the McDonald Observatory, Texas, which showed excellent agreement with drawings made by visual observers using colour filters.

On that note the so-called Great Filter Debate came to an end. In truth it was based on misconception. There was no excitement, no histrionics; nothing but a measured logical response to scepticism rooted in textbooks yet to be updated.

## Conclusion

The first two points made by Patrick Moore at the start of the final debate have been amply verified. Obvious examples include the darkening of Jupiter's Great Red Spot and features of the Martian atmosphere when viewed with a blue filter. A red filter on the other hand shows a marked enhancement of surface features. Studies of the Venusian atmosphere have disclosed markings which could not be seen without filters. Christophe Pellier's images clearly show that the 'visual' band markings differ slightly between blue, green and red light.[7] This tends to validate earlier series of drawings by Gray, whose filter drawings of 2007 April 18 are also pertinent, and Damian Peach's CCD images on the same date validate many of their features.[7]

This is also true of Saturn.[8] The bi-coloured aspect of Saturn's rings in which one ansa appears lighter than the other, an effect usually seen with a blue filter, is an appearance to which Walter H. Haas of the Association of Lunar and Planetary Observers has also drawn attention.

In conclusion tribute is paid to V. A. Firsoff, C. M. Pither, J. Hedley Robinson and F. C. Wykes. It is largely due to their determined effort that colour filters are now described as important accessories for lunar and planetary observation.

There is, however, another side to the controversy. It is further testimony to the important role the British Astronomical Association continues to play in the promulgation of astronomy, and even more telling is the emphasis it places on the utility of visual observation.

## Acknowledgments

The writer expresses thanks to Richard Baum for information he has provided and encouragement in the writing of this account of an episode in the history of the BAA. Thanks are also given to the referees, Dr Richard McKim and Martin Mobberley, for their comments and suggestions regarding this paper.

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## References and notes

1 Schiaparelli used orange filters to suppress residual spectrum in the instruments used.
2 Firsoff V. A., *Discovery* XXII, 231–236 (1961)
3 Firsoff V. A., 'Venus through colour filters', *J. Brit. Astron. Assoc.,* **67**(2), 66–76 (1957). Also *The Chicago Astronomer,* **29**, 1957 autumn
4 McKim R., 'The British Astronomical Association: The second fifty years', *Mem. Brit. Astron. Assoc*., **42**, 64–65 (1990)
5 Heath A. W., Hedley Robinson J. & Firsoff V. A., 'Mars through colour filters, 1958', *J. Brit. Astron. Assoc.,* **70**(6), 270–272 (1960)
6 Hyde F. W. & Fulford-Jones J., *J. Brit. Astron. Assoc.,* **72**, 163–175 (1962)
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*Received 2016 July 30; accepted 2016 September 6*