As 2012 comes to a close and you toast the New Year, be sure to also raise a glass to one Vesto Melvin Slipher.

My intent is to describe what Slipher did 100 years ago in Flagstaff, Arizona and why this event can be regarded as the birth of modern cosmology.

The Lowell Observatory was founded in Flagstaff in 1894 to continue the work of American astronomer Percival Lowell who had a real interest – or rather a fixation – in Mars … and Martians.

In 1903 Lowell hired a young astronomer, Vesto Melvin Slipher. Slipher became well known by astronomers (for reasons that will become clear shortly), but he certainly wasn’t a household name like Edwin Hubble, of Hubble Space Telescope fame.

In fact many astronomers would argue that Slipher helped make Hubble famous. Slipher’s results transformed our understanding of our place in the universe, in the same way Copernicus, Kepler and Galileo transformed our understanding of our place in the solar system.

Slipher detected a fundamental property of space, not intuitive to us – the fact that the universe is expanding. Ultimately, Slipher’s results provided an observational framework for Einstein’s General Theory of Relativity and its description of our universe.

But Slipher didn’t start out to help Einstein. Far from it.

He began observations from 1909 of so-called “spiral nebulae” that Lowell believed to be young evolutionary stages of solar systems, like ours. We now know that these “spiral nebulae” are galaxies like our own. But at the time many believed our galaxy was the entire universe.

Others were waiting for definitive evidence that our galaxy was one of many similar objects – the so-called “island universe” theory introduced by the German philosoper Immanuel Kant in 1755.

The problem was that the nebulae were too faint for Slipher to initially record a spectrum. Spectra, or light dispersed into its constituent wavelengths, can reveal an object’s elemental make-up. It’s also possible to detect the velocity of the object by measuring the induced shift in features in the spectrum.

The advent of photographic emulsions allowed even such small “Doppler” velocity shifts to be detected. Slipher toiled away, only having access to the relatively small Lowell Observatory 24-inch telescope.

Yet the difficulty he faced in getting good data strangely related more to the design of then-current-day instruments than the light gathering ability of his telescope.

From 1906-1912, through ingenious modifications, and trial and error, Slipher improved his data collection. He found that faster (small f/ ratio) camera lenses in his spectrograph could greatly improve his ability to record useful spectra. By late 1912 he had made his spectrograph an incredible factor of 200 times more efficient.

On the night of September 17, 1912, Slipher observed the Andromeda nebula, for a total of six hours and 50 minutes. Later, he made even lengthier observations including two over consecutive nights, and one over the last three nights of 1912. It was a cosmic breakthrough.
Slipher had finally recorded useful spectra. In 1913 he announced that the Andromeda nebula was moving toward us at an astonishing rate of 300 km/s.

At the time, the majority of stars had much smaller velocities, measured in the tens of km/s. Slipher’s velocity was quite startling.

This observation is arguably the starting point of modern cosmology. Yet the results appeared quietly, almost hidden, in volume 2 of the 1913 Lowell Observatory Bulletin. Slipher had no media liaison or public relations officer at his disposal.

At the August 1914 American Astronomical Society meeting at Evanston, Illinois, Slipher presented his results and received, quite rightly, a standing ovation.

It was argued by some that the nebulae were just high-velocity components of a larger all-encompassing galaxy. But as Slipher increased his sample of nebulae it was very apparent that the majority had very high velocities of recession (i.e. moving away from Earth).

The universe was revealing a long-held secret to Slipher. In 1917 he wrote to Lowell, only five years on from his discovery observation, that Kant’s “island universe” theory “gains favor in the present observations”.

In 1921 he published a then-amazing recession velocity of 1,800km/s, derived from a 28-hour exposure, for a nebula in the constellation Cetus.

So, modern cosmology is turning 100. Through ingenuity and perseverance, Slipher’s results displaced our galaxy from any preferred, central location in the universe.

The few galaxies that are approaching us, such as Andromeda, are doing so because they are close and gravity wins a cosmic tug of war.

Einstein published his General Theory of Relativity in 1915, and presented it to agree with a static universe, then the preferred model.

Slipher’s results made a static universe untenable. Space was not a fixed entity that galaxies were moving into. The velocities are not telling us how fast galaxies are moving away from us, but tell us how space itself is expanding.

Galaxies are the ultimate cosmic test particles. From 1915 onwards a variety of models using Einstein’s theoretical framework were proposed.

Yet as early as 1917 Slipher had intuitively informed Lowell that his results showed the Kantian island universe theory to be valid, and thus, exposed the expanding universe.

Vesto Slipher. http://www.roe.ac.uk/~jap/slipher/

Slipher deserves much greater recognition than he normally gets. It was his efforts, with detection methods improved over numerous, long nights, that led to the greatest overhaul of cosmology to that time.

He was not one to promote himself or his discoveries. His publications were short and to the point.

History is more likely to mention the flamboyant Edwin Hubble before Vesto Slipher. Yet Hubble would not have found his later fame without first using Slipher’s velocities.

Related discussions about the historical legacies of other astronomers such as Knut Lundmark, Georges Lemaître and H.P. Robertson are best left for another day!

So when you are welcoming in the New Year be sure to include a toast to one Vesto Melvin Slipher, astronomer extraordinaire, and wish modern cosmology a happy 100th anniversary.
Cheers Vesto!