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**Video Podcast
Hubblecast 17 Special Edition: New Views of the Skies**

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00:31

[Dr. J.]

Welcome to this special episode of the Hubblecast celebrating the International Year of Astronomy in 2009. Four hundred years ago Galileo Galilei looked at the night sky through a telescope for the first time. So we have decided to produce a special series of podcasts about the telescope – this magnificent instrument that has changed our perception of the world around us.

00:56

[Narrator]

By taking our sense of sight far beyond the realm of our forebears' imagination, these wonderful instruments, the telescopes, open the way to a deeper and more perfect understanding of nature.

—René Descartes, 1637

01:13

[Narrator]

For millennia mankind gazed out into the mesmerising night sky without recognising the stars of our own Milky Way galaxy as other suns...

or the billions of sister galaxies making up the rest of our Universe...

...or that we are merely punctuation in the Universe's 13.7 billion year-long story.

With only our eyes as observing tools we had no means of finding solar systems around other stars, or of determining whether life exists elsewhere in the Universe.

Today we are well on our way to unravelling many of the Universe's mysteries, living in what may be the most remarkable age of astronomical discovery.

Dr. J in studio

Script on screen

TWAN footage



01:58

[Narrator]

Four centuries ago, in 1609, a man walked out into the fields near his home.

He pointed his homemade telescope at the Moon, the planets and the stars.

His name was Galileo Galilei.

Astronomy would never be the same again.

02:36

[Narrator]

Today, 400 years after Galileo first pointed a telescope to the skies, astronomers use giant mirrors on remote mountaintops to survey the heavens.

Radio telescopes collect faint chirps and whispers from outer space.

Scientists have even launched telescopes into space, high above the disturbing effects of our atmosphere.

And the view has been breathtaking!

03:13

[Dr. J]

However Galileo did not, in fact, invent the telescope. That credit goes to Hans Lipperhey, a slightly obscure Dutch-German spectacle maker. But Hans Lipperhey never used this telescope to look at the stars. Instead, he though his new invention would mainly benefit seafarers and soldiers.

Lipperhey came from Middelburg, then a large trading city in the fledgling Dutch Republic.

In 1608 Lipperhey found that when viewing a distant object through a convex and a concave lens the object would be magnified, if the two lenses were placed one just the right distance from one another.

The telescope was born!

In September 1608 Lipperhey revealed his new invention to Prince Maurits of the Netherlands.

He could not have chosen a more advantageous moment because at that time the Netherlands were embroiled in the 80 Years' War with Spain.

The new spyglass could magnify objects and so it could reveal enemy ships and troops that were too distant to be seen by the unaided eye. A very useful invention indeed!

But the Dutch government never granted Lipperhey the patent for his telescope.

The reason was that other merchants also claimed the invention, especially Lipperhey's competitor Sacharias Janssen. The dispute was never resolved.

Image of Galileo Galilei



Australian Telescope Array



Dr. J. in Virtual Studio



Zoom on Middelburg



Scene from 80-year war



Portrait of Janssen



And to this day, the true origins of the telescope remain shrouded in mystery.

04:58

[Narrator]

Italian astronomer Galileo Galilei, the father of modern physics, heard about the telescope and decided to build his own.

05:07

[Deep male voice]

Galileo: *About ten months ago, a report reached my ears that a certain Fleming had constructed a spyglass by means of which visible objects, though very distant from the eye of the observer, were distinctly seen as if nearby.*

05:26

[Narrator]

Galileo was the greatest scientist of his time. He was also a strong supporter of the new worldview advocated by the Polish astronomer Nicolaus Copernicus, who proposed that the Earth orbited the Sun instead of the other way around.

Based on what he had heard of the Dutch telescope, Galileo constructed his own instruments. They were of a much better quality.

05:54

[Deep male voice]

Galileo: *Finally, sparing neither labour nor expenses, I succeeded in constructing for myself so excellent an instrument that objects seen by means of it appeared nearly one thousand times larger than when regarded with our natural vision.*

06:11

[Narrator]

It was time to train his telescope on the heavens.

06:17

[Deep male voice]

I have been led to the opinion and conviction that the surface of the moon is not smooth, uniform, and precisely spherical as a great number of philosophers believe it to be, but is uneven, rough, and full of cavities and prominences, being not unlike the face of the Earth.

06:45

[Dr. J]

A landscape of craters, mountains, and valleys. A world like our own!

A few weeks later, in January 1610, Galileo looked at Jupiter. Close to the planet he saw four pricks of light that changed their position on the sky night after night along with Jupiter.

It was like a slow, cosmic ballet of satellites orbiting the planet. These four pricks of light would come to be known as the Galilean moons of Jupiter.

Galileo's portrait



Galileo's drawings of the phases of Venus

What else did Galileo discover?

The phases of Venus! Just like the Moon, Venus waxes and wanes from crescent to full and back again.

Strange appendages on either side of Saturn.

Dark spots on the face of Sun.

And, of course, stars. Thousands of them, maybe even millions. Each too faint to be seen by the naked eye.

It was as if mankind had suddenly thrown off its blindfold. There was a whole Universe to discover out there.

07:57

[Narrator]

News about the telescope spread across Europe like wildfire.

In Prague, at the court of Emperor Rudolph II, Johannes Kepler improved the design of the instrument.

In Antwerp, Dutch cartographer Michael van Langren produced the first reliable maps of the moon, showing what he believed to be continents and oceans.

And Johannes Hevelius, a wealthy brewer in Poland, built huge telescopes at his observatory in Danzig. This observatory was so large that it covered three rooftops!

But the best instruments of the time were probably constructed by Christiaan Huygens in the Netherlands.

In 1655, Huygens discovered Titan, the largest moon of Saturn.

A few years later, his observations revealed Saturn's ring system – something Galileo had never understood.

And last but not least: Huygens saw dark markings and bright polar caps on Mars.

Could there be life on this remote, alien world? The question occupies astronomers to this day.

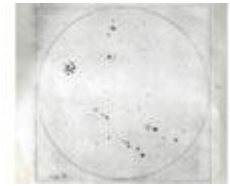
09:10

[Dr. J]

The earliest telescopes were all refracting telescopes that used lenses to collect and bring together the starlight. Later the lenses were replaced with mirrors. This reflecting telescope was first built by Niccolò Zucchi and later refined by Isaac Newton.

Now in the late eighteenth century the largest mirrors in the world were cast by William Herschel, an organist turned astronomer, who worked with his sister Caroline.

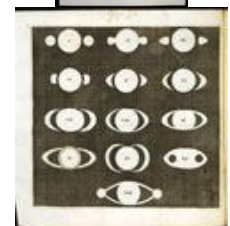
In their house in Bath, in England, the Herschels poured red-hot molten metal into a mould and when the whole thing had cooled off, they would polish the surface so that it would reflect starlight.



Hevelius



Huygens



Refractive telescope



Reflecting telescope



Herschel's telescopes

During the course of his life, Herschel built more than 400 telescopes.

The largest of these was so huge that he needed four servants to operate all the various ropes, wheels and pulleys that were required to track the motions of the stars across the sky, which is of course caused by the Earth's rotation.

Now Herschel was like a surveyor, he scanned the heavens and catalogued hundreds of new nebulae and binary stars.

He also discovered also that our Milky Way must be a flat disc. And he even measured the motion of the Solar System through that disk by observing the relative motions of the stars and the planets.

And then on the 13th of March in 1781, he discovered a new planet – Uranus.

It was over two hundred years until NASA's Voyager 2 spacecraft gave astronomers their first close-up look of this distant world.

10:51
[Narrator]

In the lush and fertile countryside of central Ireland, William Parsons, the third Earl of Rosse, built the largest telescope of the nineteenth century.

With a metal mirror a whopping 1.8 metres across, the giant telescope became known as "The Leviathan of Parsonstown".

On the occasional clear, moonless nights, the Earl sat at the eyepiece, and sailed on a journey through the Universe.

To the Orion Nebula – now known to be a stellar nursery.

On to the mysterious Crab Nebula, the remnant of a supernova explosion.

And the Whirlpool Nebula? Lord Rosse was the first to note its majestic spiral shape.

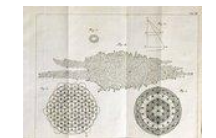
A galaxy like our own, with intricate clouds of dark dust and glowing gas, billions of individual stars, and – who knows – maybe even planets like the Earth.

The telescope had become our vessel to explore the Universe.

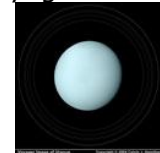
11:58
[Dr. J.]

Thank you for joining me in this first episode of this special series. Today we have talked about the creation of the first telescopes and how they facilitated man's first steps out into the Universe. Next time we will see how astronomers used bigger and bigger mirrors to see further than ever before.

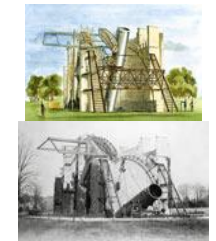
This is Dr. J. signing off for the Hubblecast. Once again nature surprised us beyond our wildest imagination.



Voyager 2 image



The Leviathan



Rosse's drawings compared with real images



12:22 OUTRO		
12:45 END		