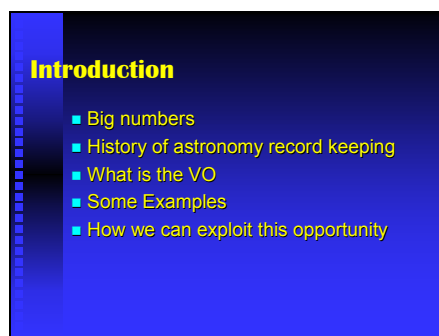


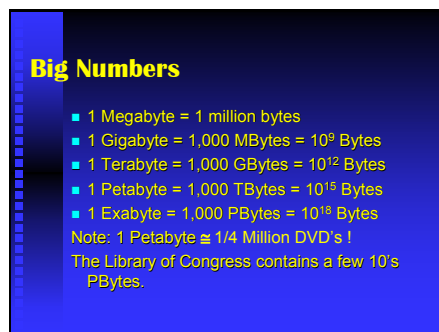
Slide 1



Slide 2

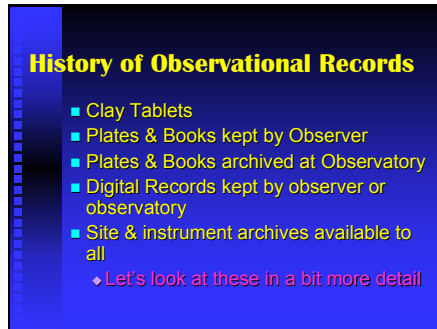


Slide 3



1 Floppy Disc = 1.4MBytes  
1 CD 650 Mbytes  
1 DVD = 3.7 GBytes

Slide 4



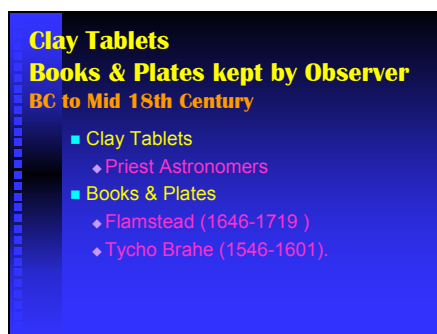
**History of Observational Records**

- Clay Tablets
- Plates & Books kept by Observer
- Plates & Books archived at Observatory
- Digital Records kept by observer or observatory
- Site & instrument archives available to all

◆ Let's look at these in a bit more detail

Expand this into

Slide 5



**Clay Tablets**  
**Books & Plates kept by Observer**  
**BC to Mid 18th Century**

- Clay Tablets
  - ◆ Priest Astronomers
- Books & Plates
  - ◆ Flamsteed (1646-1719)
  - ◆ Tycho Brahe (1546-1601)

Dates are very approximate with lots of overlap

Clay Tablets & Similar records - not a lot known but it seems likely that the observations were jealously guarded - story of 'Astronomer' who lost his head because he failed to predict an eclipse.

Observations were carefully guarded - John Flamsteed the first Astronomer Royal refused to publish his catalogue of star positions but eventually Isaac Newton then President of the Royal Society forced publication - he wanted the observations to help with his theories of gravity. However after they had been printed in 1712 Flamsteed got a court order to have them destroyed - the observations were eventually published in 1725 after Flamsteeds death. A similar situation existed in Denmark where Tycho Brahe would not release his observations

Slide 6

**Books & Plates kept by Observer**  
**Mid 18th to Early 20th Century**

- Lone observers kept their own records
- Start of 'National Observatories'
- Observers took their own observations and then took records away for analysis

People who owned their own Telescopes such as Huggins in Tulse Hill kept their own records and only published the results of their work. The 'raw data' most probably disappeared when they died though in some cases it was given to institutions such as the RAS.

Observers started using National Telescope facilities - they commonly took the raw data away with them and it was frequently lost after the results were published.

Slide 7

**Plates & Books archived at Observatory**  
**Digital Records kept by observer / observatory**  
**Early to Late 20th Century**

- Start of Libraries of Observations
  - ◆ Particularly Surveys
  - ◆ Plate copies supplied or plates loaned to other observatories
- Digital Records lagged behind due to a lack of standards

National facilities started keeping libraries of Observations - particularly surveys that were of use to lots of people - typically they were contained in plate stores where thousands of photographic plates were kept.

They would sometimes be loaned or copies would be supplied to other observatories.

Standards for digital involve both data format and also the mechanical format i.e. Magnetic Tape, Floppy Disc, DAT Tapes etc.

Slide 8

**Site / instrument archives**  
**available to all**  
**Mid 20th Century to now**

- The Digital Revolution
  - ◆ Driven by Space Observatories
  - ◆ Standards for Information Format
  - ◆ Records kept in Observatories or Data Centres
- Available to all over the Internet
- What will happen in the 21st Century ?

Space missions created a large quantity of data - very expensive to reproduce

Mission stores started in the 1980's

Advances in digital technology allows data to be kept and shared over the Internet

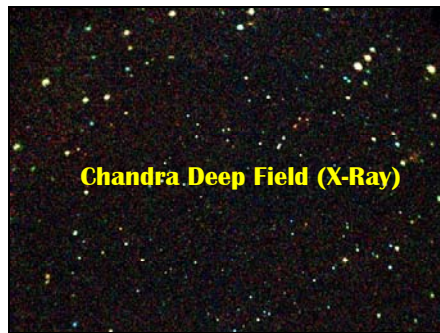
Slide 9



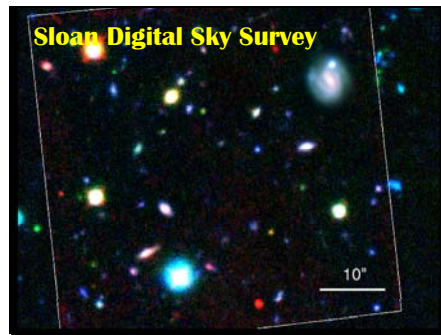
Slide 10



Slide 11



Slide 12



Slide 13



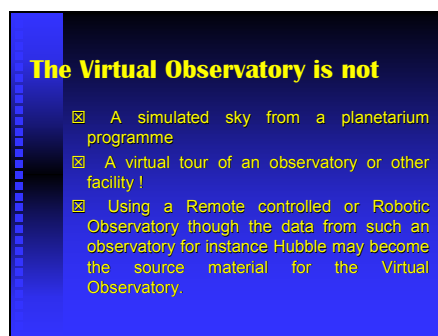
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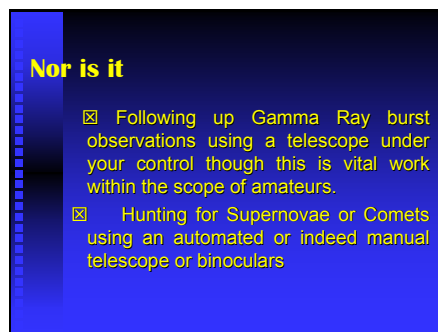
Slide 15



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Slide 17



Slide 18

**So What is a Virtual Observatory?**

Seamless access to Astronomical Data which is held on a number of servers worldwide.

Data processing run on multiple remote servers similar to an Internet search  
Only the selected data transmitted

Currently in the planning & construction stage  
Many different ideas being developed and tested.

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**Objective of the VO**

To make the vast amount of data from lots of sources available with one common consistent interface !

Data location & format invisible to the user.

'data queries' run on multiple servers across the world

Slide 20

**What will be held in the Virtual Observatory ?**

Original instrument data - usually calibrated with instrumental artefacts removed.

May be images, catalogues, spectra or any other form of data related to sky positions

Slide 21

**Why are is this being done - A  
surfeit of Data**

The amount of data is so large and growing so quickly that it is outgrowing the ability of data networks to transmit it world wide.

The database queries will be run at the data store and only the results transmitted to the user

Slide 22

**How much data is there ?**

• **The data explosion is on the way** •

Existing archives contain a few PetaBytes.  
However a lot of data for instance from radio telescopes is thrown away ! The archives are expected to double every 1½ to 2 years !

VISTA (Visible & Infrared Survey Telescope for Astronomy) Will produce 1.5PB by 2010 – 400,000 DVD's !!!  
( Searching 1.5PB will take several months ! )  
( 2.3 Million CD's – Stack 2.8 km High ! )

WFCAM on UKIRT will produce 50TB per year  
These are just two UK projects !

Slide 23

**Lots of data in lots of formats**

While current projects normally save their data in digital formats there are lots of archives of photographic plates (The RGO archive weighed over 18 tons).

Lots of old digital data in formats which can no longer be read or the skills to interpret them have disappeared.

• If I gave you an 8" floppy with data saved by an obsolete word processor could you decode it without mistakes into a document with the original format ?

Note:

20,380 plates of the Sun 1918 to 1976 from the RGO archives have recently been digitised at MSSL to add to the VO

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**What can we find in the VO ?**

Having a large number of data sets taken in a multitude of wavelengths accessible from one common interface allows novel cross wavelength investigations.

The enormous amount of consistent data together with historic data allows lots of possibilities for identification of rare or novel phenomena.

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**What it will contain**

Initial data will be from the current generation of digital surveys and observations.

Desire to digitise the older plates but the knowledge, skills & associated materials such as observing logs are rapidly disappearing. This also applies to the hardware to read some of the older computer media

Slide 26

**Who is building the VO ?**

A mixture of Astronomers, Database Experts, Hardware & Software designers

Representatives from Microsoft & Sun Microsystems. They are interested as this project requires cutting edge hardware & software in the data centres.

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**How advanced is construction of the V.O?**

- ✧ Plans are being drawn
- ✧ Some foundations have been laid
- ✧ Some Building blocks exist
- ✧ Computer & software technology needs to develop to allow the VO to develop it's full potential
- ✧ Even Microsoft is involved – their first attempt at science ?

There is a long way to go until completion but what exists can already be used.

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**Current VO Initiatives**

There are two major projects under way – America has a project called 'National Virtual Observatory (NVO). Europe has an initiative called 'Astrophysical Virtual Observatory (AVO)' this is supported by the UK proposal to form the Astro-Grid that is currently being evaluated by PPARC.

Slide 29

**What has been built ?**

Two principal applications that integrate data from multiple sources already available:

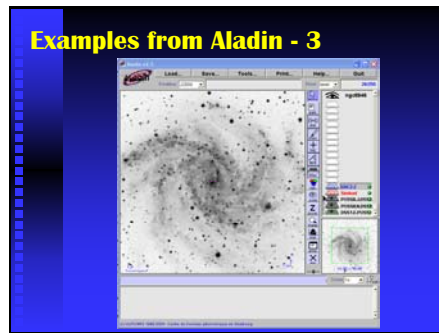
Aladin - at CDS (*Centre de Données astronomiques de Strasbourg*)

NASA's Skyview

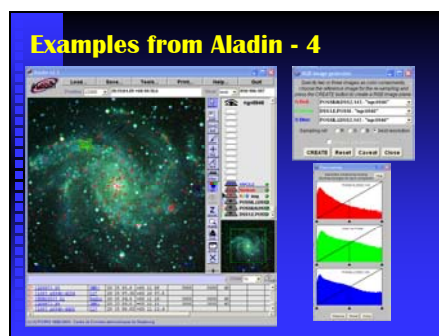




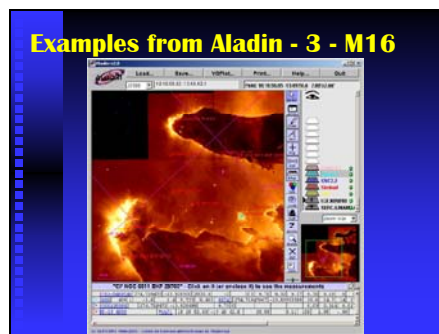
Slide 36



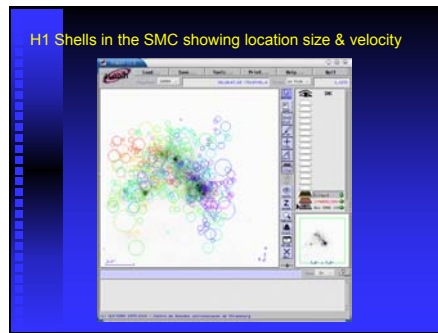
Slide 37



Slide 38



Slide 39

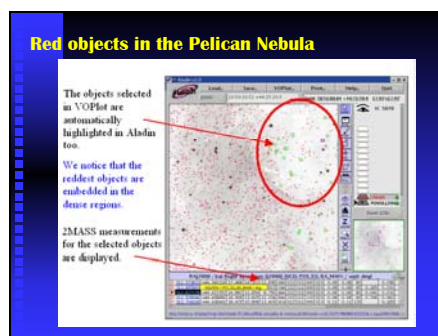


Write the following expression in the **filter definition** box:

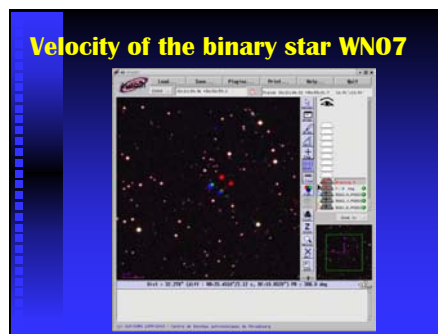
This filter draws a circle which radius is proportionnal to the extension radius of the shell (EXTENSION\_RAD) and wich colour scales with the heliocentric velocity of the bubble (VELOC\_HC) (between 120 and 200 km/s) with a rainbow palette.

We can now observe the distribution of the H I shells with their position, size and velocities. Note the colour view of the velocity gradient of the Small Magellanic Cloud.

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## Alternative access to Aladin

**NVO Core Applications**

Tool	Developer	Description
Aladin	Andréanne Beaulieu	Full feature software, astronomical data, image archives, and other astronomical resources accessible with the NVO.
Aladin Lite	Thomas McFlynn	Desktop and Online Data in the Virtual Observatory.
Aladin Web	William O'Meara	Cloud hosted user data with numerous catalogs.
Aladin Desktop	Thomas McFlynn	Search, plot, and retrieve SDSS, 2MA, and other surveys.
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<http://www.us-vo.org/apps/>

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## NVO Datascope - 1

**NVO National Virtual Observatory Datascope**

What do we know about a region of the sky?  
Use the Virtual Observatory Datascope to gather and organize information from astronomy archives and data centers around the world.

Enter a position (name) and the maximum size of the region of sky you are interested in.

Position:

Radius:

**Ignore cache.** Datascope will issue a fresh request even if an identical request is in the cache.

**Recent searched objects and responses:** (Click on maps to see cached results)

Object	RA (J2000)	DEC (J2000)	RA (J2000)	DEC (J2000)
NGC 273	187.270000	3.133333	187.270000	3.133333
NGC 273	187.270000	3.133333	187.270000	3.133333
NGC 273	187.270000	3.133333	187.270000	3.133333
NGC 273	187.270000	3.133333	187.270000	3.133333

<http://heasarc.gsfc.nasa.gov/cgi-bin/vo/datascope/init.pl>

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## NVO Datascope - 2

**Display**

Basic Services  Aladin  Aladin Lite  Aladin Web  Aladin Desktop

Images  Images  Images  Images  Images  Images  Images  Images

Tables  Tables  Tables  Tables  Tables  Tables  Tables  Tables

Observations  Observations  Observations  Observations  Observations  Observations  Observations  Observations

Maps  Maps  Maps  Maps  Maps  Maps  Maps  Maps

Catalogs  Catalogs  Catalogs  Catalogs  Catalogs  Catalogs  Catalogs  Catalogs

References  References  References  References  References  References  References  References

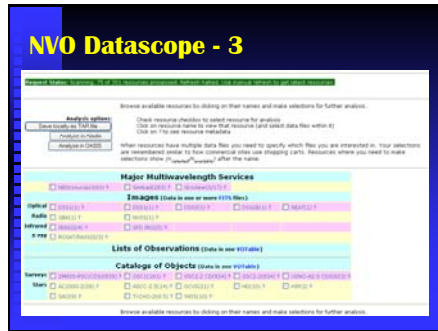
Links  Links  Links  Links  Links  Links  Links  Links

News  News  News  News  News  News  News  News

Other  Other  Other  Other  Other  Other  Other  Other

You can control the categories of results displayed by using these checkboxes. Some checkboxes, e.g., Objects serve as toggles that control a whole set of categories.

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### No need to apply for Telescope Time !

Amateur Astronomers have been at a serious disadvantage in the use of large telescopes since any proposals that they made for the use of large telescopes were extremely unlikely to be accepted. With the VO the data should be accessible to amateur astronomers if we are let in.

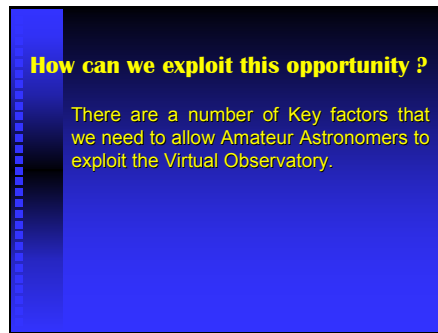
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### Opportunities for Amateurs in the VO

**If we get a key to the door The Sky's the Limit !**

There will be so much data available that there are not enough Professional Astronomers to analyse it all. This gives a big opportunity for amateur astronomers to contribute to the Astronomy in the 21<sup>st</sup> Century.

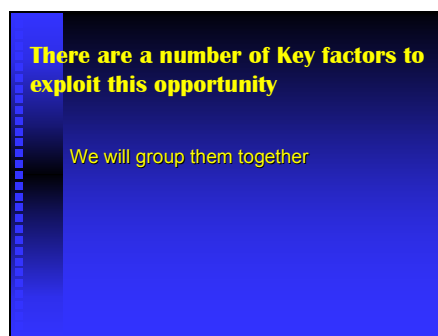
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**How can we exploit this opportunity ?**

There are a number of Key factors that we need to allow Amateur Astronomers to exploit the Virtual Observatory.


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**There are a number of Key factors to exploit this opportunity**

We will group them together

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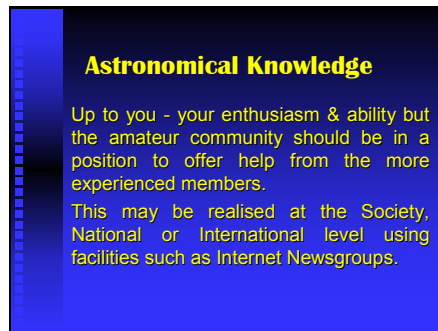


**Enthusiasm & Commitment**  
**Time**  
**Tenacity**

All these are really down to your motivation – results will not fall into your lap ( unless you are extremely lucky ! ).

Members of societies can help each other by forming groups to discuss problems or have joint investigations.

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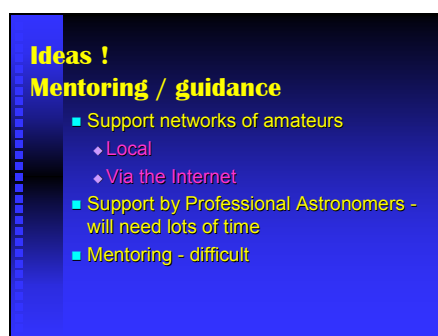


**Astronomical Knowledge**

Up to you - your enthusiasm & ability but the amateur community should be in a position to offer help from the more experienced members.

This may be realised at the Society, National or International level using facilities such as Internet Newsgroups.

Slide 52

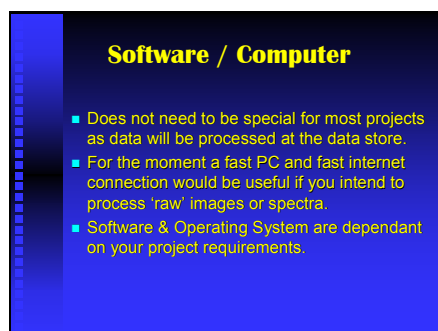


**Ideas !**

**Mentoring / guidance**

- Support networks of amateurs
  - ◆ Local
  - ◆ Via the Internet
- Support by Professional Astronomers - will need lots of time
- Mentoring - difficult

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**Software / Computer**

- Does not need to be special for most projects as data will be processed at the data store.
- For the moment a fast PC and fast internet connection would be useful if you intend to process 'raw' images or spectra.
- Software & Operating System are dependant on your project requirements.

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### **Opportunity to publish results**

Unlikely that the 'Professional' journals will publish the results unless there is extensive Professional input.

Some journals such as the Journal of The ASP are (slightly) more accessible.

This will be one of the biggest hurdles to overcome.

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### **Access to The Virtual Observatory**

Data Queries will run on large (& therefore expensive) machines at the data centres.

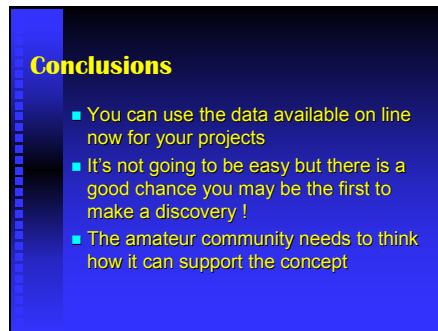
Will the VO be open to all or will it only be open to subscribing institutions ?

Slide 56

### **What we need to achieve our objective**

- Support / Mentoring Networks with professional assistance
- Routes to publish reports that will be accepted by Professional Astronomers
- Ensuring that amateurs get access to data & to 'search' engines via the VO.

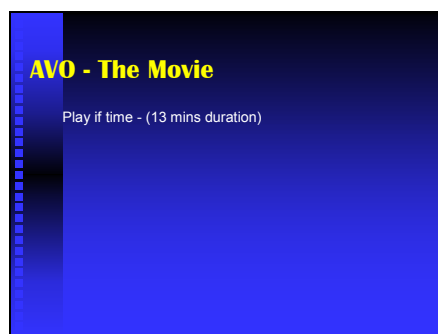
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**Conclusions**

- You can use the data available on line now for your projects
- It's not going to be easy but there is a good chance you may be the first to make a discovery !
- The amateur community needs to think how it can support the concept

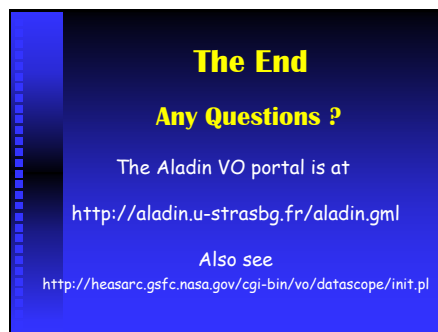
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**AVO - The Movie**

Play if time - (13 mins duration)

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**The End**

**Any Questions ?**

The Aladin VO portal is at  
<http://aladin.u-strasbg.fr/aladin.gml>

Also see  
<http://heasarc.gsfc.nasa.gov/cgi-bin/vo/datascope/init.pl>

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