

# Living Space

*A History and Heritage Vision*

*for the*

*Armagh Observatory and Planetarium*



## ***Front Cover Images***

### ***The Four Pillars of the History and Heritage Vision***

#### ***The Troughton Telescope***

*Bringing astronomy to the world for over 200 years*

The 2¾ inch equatorial telescope, built in England by John and Edward Troughton in 1795, on the recommendation of Nevil Maskelyne, the Astronomer Royal when the Observatory was first instrumented. It is now the oldest telescope in the world still essentially in its original setting. The novel design allowed it to perform the functions of a transit instrument and a quadrant, the first time that the two celestial coordinates of a star could be measured together.

#### ***The Robinson Cup Anemometer***

*Understanding the Environment*

First erected on the roof of the Observatory in 1845, this design for an anemometer by the 3<sup>rd</sup> Director, Romney Robinson, and built by Robert Munro, is now used the world over to measure the wind speed. It is known as the Robinson Cup Anemometer. Armagh has been maintaining a daily meteorological record since 1794, the longest such record in the UK and Ireland. Robinson was inspired by a great storm in 1839 to design an instrument to measure wind speed.

#### ***Armagh Observatory Building***

*A Living Heritage*

The Armagh Observatory was designed by Francis Johnston, who later became known as the 'Wren of Ireland' for the quality of his public buildings across the island. Built in 1790 it has a classical Georgian design, with several false windows providing the required symmetry. It was the home of the Director and his family for 200 years. The Troughton telescope is in the green dome, with the Robinson Memorial Dome, housing the 1885 Grubb 10-inch refractor, in the foreground.

#### ***Archbishop Richard Robinson***

*The Robinson Legacy in Armagh*

Richard Robinson, Archbishop of Armagh, also Baron Rokeby, founded and endowed Armagh Observatory after being inspired by William Herschel's discovery of the planet Uranus in 1781. The Observatory was the last of the many public buildings he had built that form the core to the City today - including the Palace, the Robinson Public Library, the Royal School and the Mall. While Robinson's dream of a University city did not eventuate, Armagh is today a thriving cultural and learning centre, as well as the ecclesiastical capital of Ireland.

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## Foreword

The Armagh Observatory and Planetarium is an institution in which not only the city of Armagh but this entire country should take legitimate pride.

Founded by a predecessor of mine, Archbishop Richard Robinson, at the end of the eighteenth century and further financed in the early nineteenth century by another munificent archbishop, Lord John George Beresford, it has maintained an association with the Church of Ireland Archbishops of Armagh and the Diocese since its foundation. It stands proudly as the oldest institution of its kind in these islands, and we have now arrived at a new and exciting point in its history, as the Observatory and the Planetarium are united as a single institution where scientific research of the highest order and educational outreach into the whole community coalesce.

But the Armagh Observatory and Planetarium is also a place of history and of cultural distinction. The Observatory is set in a wonderful building and within beautiful grounds. The Planetarium is shortly to celebrate its fifty years of existence. These are indeed institutions of which to be proud, but as living and creative organisms as they journey together into the future.

Richard Robinson's original vision for the Observatory was of a place where religious understanding and scientific knowledge would both be enhanced by the encouragement of scientific discovery. It is a vision that many of us would wish to be carried into the years and centuries ahead.

As the serving Archbishop of Armagh, I take real delight in maintaining a continuity with the foundation of the Observatory, now the Armagh Observatory and Planetarium. I wish the Director, Professor Michael Burton, and all those who work to make 'AOP' a place of learning and of outreach, every success as this great venture is carried forward with confidence and imagination.

Richard Armagh  
October 2017

Archbishop Richard Clarke  
Chairman  
Board of Governors of Armagh Observatory and Planetarium



# Living Space

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## *A History and Heritage Vision for the Armagh Observatory and Planetarium*

### Executive Summary

The Armagh Observatory and Planetarium has a rich scientific history, where the story of the development of modern astronomy can still be seen *in situ*, a place where discovery was made. AOP provides a shared space for all to enjoy, where history, science and nature can all be experienced. This document provides a vision for protecting and promoting the history and heritage of this renowned institution.

AOP itself is just a part of a much wider history that can be sampled in Armagh, linking back to the Neolithic peoples and their building the first stone calendars, through the Christian settlement marked by St Patrick and the Cathedrals, to the scientific enlightenment evident in Archbishop Robinson's founding of the Observatory, to the space age of today represented by the Planetarium.

Four concepts are integral to this vision, all intertwined with the organisation's ethos and values. These are being at the forefront of bringing astronomy to the world for over 200 years, the monitoring of the environment through the longest daily weather record, in providing a living heritage where frontline astronomy continues while connected to its historical roots, and of being a part of the Robinson legacy in Armagh – a city of learning and culture. This is *living space*. Our vision builds on these principles.

We first provide a stocktake of the history of Armagh's contribution to astronomy, alongside and paralleling world developments in the field, also including a taste of some of the human dramas and the budgetary challenges that have tested the organisation's resilience over four centuries.

In examining what needs to be done we highlight new programmes associated with displays and exhibition space, including providing bespoke tours for target interest groups such as the culturally curious. We emphasise the need to conserve and preserve the collection, as well as to catalogue and archive so it can be readily accessed,

particularly through digital means and virtual experiences. We consider the needs for informing and educating. We need to promote our environmental heritage and the necessity for dark skies to pursue astronomy, connecting to the natural environment of the grounds and Astropark, as well as to nearby dark sky reserves. To help in the delivery of programmes we propose forming a Friends of the AOP, both as a support group and as a source of volunteers, for instance for tour guides.

It is essential to open the history and heritage of AOP to a wider audience, though this also needs to be done with care as the Observatory building has limited capacity for visitors and needs to remain closely connected to the research programme as part of our living heritage. Virtual experiences offer a means of connecting to new audiences, and in bringing elements of the story into the Planetarium.

Connections need to be developed further with the wider community, at local, national and international levels. In particular, untapped potential may be released by engaging with the ABC Council in the joint marketing of events, promoting activities that emphasise depth and quality over transience and quantity, and mesh with the tourism strategy for the district.

Pursuing three enablers will allow AOP to seek new funding sources and develop tailored programmes for new and niche audiences. These are the (i) introduction of online ticketing, able to flexibly link multiple activities and providers together, (ii) obtaining museum accreditation so recognising that the collections are properly managed and curated, and (iii) developing a historic building conservation programme in conjunction with external partners so that AOP becomes eligible and competitive in applications to the Heritage and Big Lottery Funds. Finally, as a linking concept bringing all these themes together, we propose that AOP pursue, in collaboration with Council, the designation of Armagh as a Dark Sky City, and the iconic branding this would bring for promoting the City as a special place to be.



## The Four Pillars

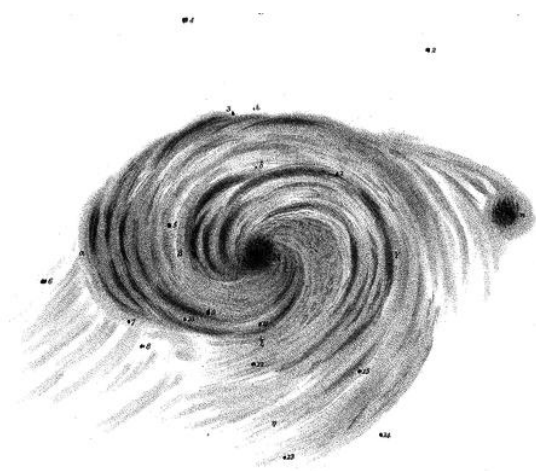
The City of Armagh contains an institution that is truly unique in the world – the Armagh Observatory and Planetarium. This contains the oldest observatory in the UK and Ireland still operating as a frontline research centre, together with a renowned centre for public education and outreach that is the Planetarium, also the oldest of its kind. They are sited within a semi-natural environment where the public can freely roam, in which a remarkable history and its accompanying heritage is evident. These are connected to a locality where the story of humanity’s yearning to understand our place in the cosmos can be readily experienced and explained.

Founded by Archbishop Richard Robinson in 1790, the last of the great public buildings he bequeathed on the City, the Armagh Observatory and Planetarium is a very special place where people can be inspired, ideas explored and nature enjoyed. This document provides a vision for protecting and promoting the history and heritage of the institution and the environment it is within, and in connecting its work and place to the wider community, be that locally, nationally or internationally.

Four concepts underlie this history and heritage, providing four pillars upon which the vision has been developed:

*i. Two hundred years at the forefront of bringing astronomy to the world*

Armagh’s first telescope – the Troughton – is the oldest telescope in the world continuously housed in its original dome, an instrument whose innovative mechanical design was ahead of its time. The *New General Catalogue of Nebulae and Clusters of Stars* was compiled by the fourth Director, JLE Dreyer in 1888. Today it is known by professional astronomers the world over, together with the NGC numbers of their favourite objects of study. Armagh has witnessed, and played a lead role in fomenting, the transformation of astronomy into astrophysics through the 19<sup>th</sup> and 20<sup>th</sup> centuries, as our understanding of the fundamental physics underlying the phenomena of planets, stars and galaxies has blossomed.



*The Whirlpool Galaxy, also known Messier 51, as sketched in 1845 by the 3<sup>rd</sup> Earl of Rosse using the Leviathan Telescope at Birr Castle in Co. Offaly. Director Romney Robinson was a frequent visitor to Birr, and drove the programme of astronomical observations using the great telescope that was designed and built by the 3<sup>rd</sup> Earl. The 6-foot diameter telescope was largest in the world for 72 years.*

*ii. Preserving the environment – maintaining the longest weather record*

The longest daily weather record in the British Isles is believed to be that kept and recorded at Armagh. Every day at 9am from 1794 the meteorological conditions have been recorded in the Observatory’s weather station. The calibrated climate record is over 220 years in length, providing a scientifically rigorous baseline that underpins many a climate study. This is especially relevant today for helping to understand the effects of global warming. The station is set within a semi-natural environment or woodland, meadows and the Astropark, where the rhythms and cycles of nature can be experienced, examined and explored.



*Historic image of the Observatory from about 1883, taken from the North Lawn with the meteorological enclosure in the foreground, with the 4<sup>th</sup> Director Dreyer beside it. On the roof can be seen the Robinson cup anemometer. To left is the East Tower with its 1827 Dome, built following a bequest from Archbishop Beresford and containing the Grubb 15-inch reflector telescope with a then novel lever support system for the mirror.*

### *iii. A living heritage*

The Observatory building today looks remarkably similar to the way it looked 200 years ago, a fine example of Georgian architecture by Francis Johnston, one among several classic buildings he designed across Ireland, such as Dublin's General Post Office and the Bank of Ireland. Yet the Observatory is not a museum. While many of its original instruments remain in situ, such as the telescopes and the clocks – the great scientific instruments of their day whose timing provided the basis for Armagh's accurate measurement of the positions of the stars – frontline astronomy still continues to be carried out inside. Only now the astronomers may be remotely accessing over the Internet telescopes that are located on the tops of desert peaks or volcanic islands where the conditions are dry and exceptionally clear, rather different to the weather that their predecessors battled with to pursue their observations of the cosmos. While stories of the discoveries that they made are being told in a modern Planetarium.

### *iv. The Robinson legacy in Armagh*

The Observatory was the last of Archbishop Robinson's great works in Armagh. These still mark and form the core to the City today, the Palace, the Robinson Public Library, the Royal School and the Mall. Yet in fact this is just part of a greater legacy that can be seen across Armagh, one that tells the story of humanity's quest to better understand our place in the cosmos. This stretches from the Neolithic era and Navan Fort, through the Christian foundation and the influence of St Patrick, to the Victorian renaissance and Archbishop Beresford, to the modern city of today, with the beacon of the space age that is the Planetarium.



*The transit clock built by Thomas Earnshaw for the Observatory on the recommendation of Astronomer Royal Nevil Maskelyne in 1790. Romney Robinson believed it to be the most accurate clock in the world at the time, running to an accuracy of ¼ second per day.*

## Why are we Here?

The four pillars described above underpin and connect to four questions that are often asked by visitors to the Observatory and Planetarium. We pose them below. Addressing the questions provides leads into activities that can developed to open and showcase the remarkable history and heritage that is within.

*i. What discoveries have been made at Armagh Observatory?*

Research is alive and well at Armagh today, as it has been across the institution's 220+ year history, now the oldest astronomical research institution in the British Isles. Whether it may be the beginnings of comprehension of about our place in a galaxy, or of the exotic state of matter that is represented by the existence of white dwarf stars, or insight into the nature of the dynamical motions and interactions of asteroids, comets and planets in our Solar System, research into fundamental questions about the cosmos remains active in Armagh. Yet this scientific history is little known outside academic circles.

*ii. What was the weather like during the famine era in Ireland?*

Knowledge of the daily weather conditions in Armagh, such as the temperature and the amount of rainfall, allows many simple yet fundamental questions to be asked regarding what the weather conditions were in the past and how that compares to today. For instance, how different was the weather during the Irish famine of the mid 19<sup>th</sup> century to that today? Quantitative data is the key to scientific inquiry, and the Armagh weather record provides such a data set. Moreover, weather is a concept that is readily understood by all, unlike many an area of scientific enquiry. Yet the basics of such enquiry remain the same, irrespective of the discipline area. The Armagh weather record can serve an exemplar of the methods of science that can be readily communicated to the public, as well as in providing a backdrop to discussions about the importance of monitoring and understanding the environment around us.

*iii. Can I look through the telescopes?*

The original telescopes remain in their place in Armagh, and though in principle they can indeed still be used, the need to conserve them

restricts our ability to do so. The heritage is, however, readily apparent, and their story can be told in-situ. A tale can be woven between the various instruments that can be seen in Armagh, one that tells the story of science in action. Much of the heritage that exists cannot be seen, however, with historic instruments and books lying in boxes and shelves in locked archive rooms, only accessible to a few scholars. Opening up the heritage and using it to tell tales of the history of science presents a challenge that needs to be solved.

*iv. What did Archbishop Robinson do in Armagh?*

Robinson's vision was for a university in Armagh, and though this has not been achieved, Armagh certainly has a reputation as a centre for learning. This is not just represented by the research carried out in the Observatory, but also by the Public Library Robinson founded and in the development of the Royal School. These, in turn, are parts of a wider story that runs from Neolithic times through the Christian settlement marked today by the two cathedrals and the many churches, to the technology-dominated society of today, represented by the Planetarium and humanity's embracing of the space age. The Observatory is thus part of a much wider story, but one that may be readily told across the City. A visit to the Observatory and Planetarium can be just one part of a wider and deeper Armagh experience. It may be used as a drawcard to attract the culturally curious, to provide a depth to the visitor experience that is lacking in many a public attraction.



## A Stocktake on the History and Heritage

Historic telescopes and their associated instruments abound within the Observatory in Armagh. They are found at, or nearby to, their original locations and in the original buildings where they were the prime research tools of their day. Together with great texts of their time, books of science that explained the cosmos, as it was then understood, as well as the papers and research notes of the astronomers who used them to pursue their investigations. Simultaneously, these heritage items are also found alongside their modern counterparts, today's researchers using the latest telescopes that are now spread around the globe, yet bringing their data back to Armagh for analysis and interpretation. A synergy of the old and the new in one site, all witness to the march of science, its progress and its pitfalls.

The accompanying *Timeline* to this document presents a snapshot of some of the multifarious activities that have taken place in Armagh as part of humanities search for understanding of the cosmos, as well as significant events in the history of astronomy that have taken place elsewhere in the world. Parallel, yet closely connected histories, involving not only the insights and new understanding, but also the human challenges, and all too often the fiscal pressures that have limited the march of progress.



*The 60-inch Armagh-Dunsink-Harvard telescope at Boyden Observatory in South Africa, with the 7<sup>th</sup> Director Eric Lindsay standing underneath. The agreement by the two governments of Ireland to jointly fund the telescope was their first cooperative joint venture.*

The state of the scientific heritage in Armagh is remarkably good, perhaps surprisingly so given the scant resources, both human and financial, that have been available to preserve them over the decades. Some luck and much foresight should be acknowledged as having made this the case, the realisation by successive Directors and their staff that the heritage really is worth protecting. However, this has come at a cost, for to conserve has meant locking many of the treasures away, in crates inside archive rooms deep in the basements, where few can go. Even those instruments visible in the Observatory building, the telescopes and the prized catalogues, are seen by relatively few, for this is a working building with limited space and accessibility. It is not suited for large numbers of visitors.

This then is the challenge, how to open up this heritage and make it accessible, yet still to maintain the vibrancy and vitality of the institution as a research centre, while also attending to the needs of education and outreach? The Observatory building needs to remain a place where science is done, the telescopes and instruments need to remain at their original locations so their place and context can be properly appreciated and explained. Yet their story not only needs to be told. The experience of seeing and feeling the history can be made tangible and real at Armagh. It is not just a story to be read about or lectured on.

There are opportunities in front of us to make much of this possible. While it might always be necessary to limit numbers in the Observatory building, the Planetarium can provide a visitor experience where the history can be visualised. The exhibition space can be used to tell the story of astronomy in Armagh. Technology now makes a virtual experience possible too, one where the reality can virtually be felt through 3D renderings of the pieces of heritage. We take these ideas forward in the next section.

### What Should We Do?

There are many ways that AOP's history and heritage can be experienced and made more accessible. It needs to be available both in person and virtually, and perhaps brought together through augmented reality. The experience might be had as a stand-alone activity or as part of a wider visit to the City of Armagh and beyond.



*The 10-inch refractor telescope, built in 1885 by Grubb of Dublin, inside the Robinson Memorial Dome. The telescope was used extensively for confirming details of nebulae for Dreyer's New General Catalogue (NGC).*

### Displays and Exhibition Space

The telescopes in the Observatory can still be seen in-situ. The clocks – the precision tools of their day – provide an impressive sight in the entrance hallway. The astronomer-at-work model of Romney Robinson and the displays in the Meridian Room helps a guide to tell the story how astronomy was conducted in Victorian times. These experiences, however, are only available for the fortunate few able to visit the Observatory on personalised tours. The logistics and constraints of the building will always limit the numbers who can visit, in addition to the impediments of being a working environment. Opening up the Observatory experience needs to be managed by multiple means and methods.

There are some limited opportunities to facilitate increased access to the Observatory, particularly in the eastern section of the Observatory building, in the Transit and Meridian Rooms, with lost office space being relocated elsewhere on the site. This would

provide space to display further items from the archives in-situ, such as telescopes, instruments and plates. However, the space is unsuitable for open access; visits would still need to be guided.

A better solution would be to tell the history of the Observatory in the Planetarium, dedicating exhibition space to showing items from the collection alongside displays that relate their story, at the same time linking these to the current research that is being carried out. It would also be desirable to regularly renew the displays from the archives so there is fresh content available for return visitors to see. This in turn needs human resources for curating their content.

Nevertheless, there is relatively little space available in the Planetarium building for such displays, as the rooms are also needed for the many workshops and associated activities that form a core part of the education and outreach programme. The optimal solution is for dedicated space to be set aside in an extension or renovation of the Planetarium building. A discussion on such a “new build” goes beyond the remit of this particular document, but clearly this would provide a means for properly displaying the history and heritage, as well as for promoting other initiatives, alongside developing and expanding AOP's core activities of education, outreach and research.

Not all the heritage needs to remain on site all the time, however. Materials can be loaned to other centres, and indeed requests to display items from the collection are regularly received and often acted upon. Small, but permanent displays could be loaned to other visitor attractions, particularly those in the Armagh area. Such “tasters” would also encourage further visitors to come to learn more, and indeed exchanges could be mutual, with small displays in the Planetarium of items from elsewhere in Armagh. This would promote linkages between the visitor attractions in the area and facilitate the joint promotions of events.

### Bespoke Tours for the Culturally Curious

Guided tours of the Observatory building and grounds do frequently occur, but these are one-off events, specifically organised in advance and run on an ad hoc basis. There is no formal programme available for the casual visitor to

join into. Advertised guided tours could readily be provided, however, promoted and bookable online and in advance, at set times that are also convenient for AOP staff (to ensure their work is not unduly interrupted). Indeed, several different types of tours could be run, examining different aspects of the history, the outreach (such as the Astropark and Human Orrery) and the environment of AOP.

Logistics limits the numbers possible, but this in turn allows a deepening of the visitor experience as small numbers mean better interaction with the guides. The guides will need training too, not just in the knowledge of the organisation and its history, but in the skills of guiding and in engaging with an audience. While the graduate students frequently volunteer as guides, and could indeed continue to do so, it would be necessary to have some dedicated guides to ensure a professional service is provided. As with many other heritage organisations such as the National Trust, volunteers might also be prepared to serve as tour guides in return for engagement with the organisation.

Tours would start from the Planetarium, which provides a suitable starting point for visitors to congregate at and receive instructions pre-tour, unlike the Observatory building. Importantly, it also provides shelter in case of inclement weather, a coffee shop and the means with which to collect money in case this is necessary. Tours might also form an additional part of a visitor package which involves a Planetarium show and/or workshop activities. We suggest that an initial offering for public tours be limited, perhaps one mid-week and one at weekends, only available by pre-booking online. As experience is gained, and the market better understood, these can be developed further.

Guided tours could also be readily packaged as a part of a wider visitor experience to Armagh, linked to similar activities at the Museum, the Library or the Cathedrals, for instance. Online booking provides a ready means to bring these together as a single package, for instance a tour of the Observatory in the morning with a Theatre show, and then another Armagh attraction in the afternoon. Once successfully established the range of visitor experience could be broadened through themed offerings, for instance focussing on the Robinson or

Beresford eras in Armagh, the architecture of the City, or the perhaps the environment, including both nature and geology. It should be readily possible to promote Armagh as a destination for the *culturally curious*, offering a deep and unique visitor experience, through the appropriate packaging of the areas attractions and such overarching themes.



*The 3-inch transit instrument built by Thomas Jones in 1827 for timing the transits of stars as they crossed the meridian. Robinson used the instrument extensively for his treatise "Places of 5,345 Stars".*

### Conserving and Preserving

The Observatory has a long history. With that comes numerous artefacts and extensive archives, accumulated over the decades. These materials have been housed within the Observatory for many years and in the past cared for by dedicated staff. The Planetarium has also collected numerous items over the past fifty years. There are no staff within AOP able to maintain this extensive collection. Current staff have other duties and cannot devote an adequate amount of time needed for their care. A dedicated archivist and librarian is needed, familiar with the methods of conservation and preservation. In conjunction, suitable display cases and storage environments need to be maintained to care for and enable monitoring of the objects on display, as well as those in storage. The same person could not only be responsible for the care of the collection, but also for the conservation and care of the Grade A heritage-listed Observatory building.

The storage of items in the Observatory is an ongoing issue. The rooms currently used are too small, and access is limited and restricted. Finding objects is hard and removing them for



inspection difficult. New premises for storage are needed, either in a new build, or in a redesign of an existing building. The old Administration Building provides space that could be made available. Currently, it is largely being used as storage space, much of it for items of little value. With modest investment, this could provide a suitable area for the housing of heritage items. Space within could also be utilised for a conservation room as well.

### Cataloguing and Archiving

In order to adequately preserve the archival material that the Observatory has accumulated over the years, a proper cataloguing / archiving system needs to be put into place. This would help to organise the material and make it more readily available to staff members and to people outside of the organisation, in particular for visiting scholars.

A collections management system is required to implement and then maintain the record. A management system will help to identify each area of the collection, what is in it, the conservation needs and more. This will save time when looking up specific items, as well as be able provide in-depth information about them. It also allows for easier lending, and aids in digitisation of the collection. This further will assist in making the archives available online, allowing many more people to access to them.



*The Robinson Memorial Dome on a winter's day. It was built by Dreyer in memory of the great Director of the Observatory, who had been at the helm for an astounding 59 years. The Armagh Robotic Telescope (ART) and the meteorological enclosure can be seen to rear.*

### Understanding the Environment

The grounds of the AOP provide a semi-natural environment of deciduous woodlands and meadows, with parkland, gardens and the Astropark itself – the scale models for the Solar System and for the Universe. These are set around the most distinctive features of the AOP, the Observatory and the Planetarium, together with the telescope domes and the meteorological enclosure.

The primary users of the Astropark are local residents out for a stroll, invariably accompanied by their dogs. They appreciate that AOP has made the grounds open, even if they don't always realise that it is not public land they are walking upon.

There is untapped potential here. Better use can be made of the grounds to incorporate them into the visitor experience. They can be used to show off the history and the heritage, to inform about the environment and its inherent interconnectedness, as well as simply providing a passive and relaxing realm that can be enjoyed.



*The lever support system for the mirror cell designed by the Dublin telescope manufacturer Thomas Grubb in 1835 for the 15-inch reflector he built, and installed in the 1827 Dome. This compound triangular system is believed to be the first ever to support a mirror this way, and a pre-cursor to the support systems that are now standard for all large optical telescopes.*

All guided tours will automatically incorporate the grounds in them as they pass from the Planetarium to the Observatory. However, there is the opportunity to travel between the buildings on multiple routes, so bringing in knowledge and understanding with the displays

in the Astropark and/or a taste of nature in the woodland and meadows.

There is a deeper environmental experience that can be incorporated here, however, relating directly the AOP's core scientific mission. Armagh's climate record provides a direct window over the past two centuries of the changing local conditions. The meteorological enclosure is a prominent feature seen in any visit. A natural environment is also a must for any Observatory, dark and unpolluted skies where the stars can be seen. While Armagh, of course, is not blessed with large numbers of perfectly clear days as now demanded by astronomers for their latest telescopes, the conditions were perfectly adequate for the needs in the Georgian and Victorian eras, when serious study of the night sky was still in its infancy. Armagh is still blessed with dark skies, at least by the standard of city dwellers elsewhere. Stars are in fact clearly visible in the sky for one third of the time, on average, when it is dark.

An objective could be to work to make Armagh a "Dark Sky City", incorporating best practice in unobtrusive street lighting. This illuminates the ground where needed but minimises the wastage of spilling light into the sky, where it is not needed and also destroys our view of the stars. This links closely to concerns about the environment, and in minimising our footprint on the planet, at the same time providing direct economic benefits through reducing use of electricity. It would also serve to brand Armagh as a special place for attracting tourists interested in a deeper visitor experience, and resonating with the other cultural attractions of Armagh. As a small city, relatively isolated from major population centres, and still surrounded by open countryside, as well as home to an historic Armagh, is exceptionally well positioned to pursue as an objective the creation of a Dark Sky City, a distinctive and iconic brand that positions it on the world stage.

Furthermore, relatively close by to Armagh are two of the darkest sky sites in Europe, in the Sperrin Mountains of County Tyrone and on Slieve Beagh on the border with County Monaghan. Dark skies, of necessity, mean little human presence, and so such sites invariably have retained a native environment for nature. Dark skies are a heritage of all humanity, a link back to the times of our ancestors for whom

they were a daily occurrence. As a consequence, they had a much greater familiarity with the stars in the heavens than we do today. Their intimate connection to the cycles of the heavens can still be seen today in the astronomical alignments associated with many Neolithic monuments. A tale can be woven linking all these aspects together during a walk around the grounds of the AOP.



*The meridian markers at Tullyards, 3 km to the north of the Observatory, used for aligning the transit instrument and mural circle prior to observations at the beginning of each night. Rings and disks to the top of each are used for the most precise alignment. Three meridian makers still exist at Armagh, two to the north and one to the south of the Observatory.*

An exhibit linking these environmental themes together would also be a suitable display for the Planetarium, based on the scientific heritage of the Armagh climate record and the need for dark skies for frontline astronomical research, and then linking to current issues such as the preservation of ecosystems and measuring the impacts of climate change. As with the earlier discussion on using the exhibition area in the Planetarium to tell the story of Armagh's scientific history, space is limited to do so with the current set-up. Such an initiative would be greatly facilitated through a new build to the Planetarium, with environment being one focus for the accompanying exhibition areas. With direct connections provided to the daily readings from the weather station, as well as to skycams at observatories worldwide that Armagh astronomers now use, the displays can be active and immediate, placing our local environment within a global context for the visitor to see and understand.



### Informing and Educating

History and heritage needs not just to be experienced and explained, there needs to be information available for those who would like to know more, whether being guided or self-guided around the site, or an arm chair viewer, browsing via the Internet.

AOP needs to produce a guidebook for visitors. Currently there are a number of leaflets available for visitors. This information is also replicated on the organisation's websites. However, a more formal offering is required, an illustrated booklet that can be purchased in the Planetarium shop by visitors which provides more detail and, importantly, images of the key items and characters in the chronology of the organisation. In fact, following preparation of a visitor guide a series of booklets could be produced covering different aspects of the organisation, such as the astronomy, the history, the Astropark and the environment, perhaps paralleling themes for tours that are also provided.

New display boards are needed around the grounds. Excellent information about the cosmos is available in the in the Astropark, however the boards they are suffering from exposure to the environment, impacting on their legibility. Further display boards are needed, however, relating to the environment and providing the visitor information regarding the natural phenomena they can experience on a journey around the grounds.

The experience can also be virtual, or indeed one that is augmented by virtual displays. It would be relatively straightforward to provide an App, whereby, as the visitor walks around the grounds they can watch short video commentaries given by the staff that become active when they reach a particular feature, telling stories of their history, the science they were used for and the environment around them.

### Friends of the Armagh Observatory and Planetarium

Many visitor attractions have their own Friends groups associated with them, notably the National Trust. Tours of their buildings are invariably given by volunteer guides who have freely given their time because they believe in the organisation, its ethos and values, and want

to feel a part of it. AOP has all the right attributes in place to foment such a Friends group as well, with its rich history, heritage buildings and attractive environment. The kind of place a committed volunteer would want to spend time at, where they can see the fruits of their labour and feel their contributions are worthwhile and appreciated.

Leading tours is just one area volunteers could assist with. Helping maintain the grounds and heritage is another. A particular possibility is assisting with the maintenance of the formal gardens, for which AOP has limited staff resource available. Another is assisting with the cataloguing and digitisation of the heritage items so that their story can be made accessible on line.

Setting up a Friends of the Armagh Observatory and Planetarium needs to be done with care, to ensure that a synergistic relationship is maintained with the parent organisation, and that AOP's responsibilities for volunteers is duly recognised and applied. AOP will also need to provide appropriate resources to support a Friends organisation. The experience of other organisations needs to be studied before any such venture should be initiated.



*An 18-inch celestial globe by Bardin obtained by the Observatory c1800. Originally presented to Nevil Maskelyne, the Astronomer Royal, it shows the positions of nearly 6000 stars and nebulae, based on observations and made by Maskelyne, Herschel and Wollaston.*

## Tasks for the AOP

Here we outline key tasks needed to implement a history and heritage strategy for the AOP. These are divided into three interrelated activities: looking after the collection, opening it to audiences, and engaging with others.

### Managing, Conserving and Preserving the Collection

The collection needs to be placed into a safe environment where it can be conserved. Preservation is needed to alleviate deterioration. Cataloguing is needed to record what is there. These require the following:

- Providing an accessible and maintainable cataloguing system. The current archive (<http://arpc65.arm.ac.uk/search-collections/search-collections.html>) needs to be translated into an open access data base accessible and searchable through the Internet. The catalogue needs to describe what is available and where it is located (when accessed locally), provide images of objects in the collection, and scans of documents (with text provided through optical character recognition). It needs to be easily editable so that content can be readily added or modified. A variety of Collection Management Systems are available for this purpose, such as MuseumPlus Classic and Modes Complete.
  - The collection needs to be placed into a safe environment where it can be conserved. It needs to be accessible so that objects can be taken out for display or returned. Workspace needs to be available for undertaking in-house preservation and recording, and to provide access for scholarly research.
  - Resources are needed for preservation and conservation of the Grade A-listed Observatory Building, including the telescopes and clocks. A preventative, instead of a reactive, maintenance programme needs to be implemented.
  - Staff resource is needed to look after the collection, including maintaining the catalogue and curating exhibitions and displays. Resource is also needed to look after the AOP library, keeping track of the stock of books and journals.
- Progress on all the above are necessary before application for formal Museum Accreditation can be made. This would provide official recognition that the collection is being properly maintained and managed, with a loans procedure in place. Museum accreditation opens opportunities for grant funding to undertake new projects relating to the preservation and the presentation of the history and heritage.



*The Jones Mural Circle. Originally used for just measurements of the declinations of stars as they crossed the meridian, using marks engraved on the brass divided circle around it. Later, timing was introduced using a clockwork chronograph to also provide the right ascension. The model is of 3<sup>rd</sup> Director Romney Robinson in a typical pose while at work!*

### Opening the History and Heritage to a Wider Audience

A fundamental principle for AOP's heritage and environs is that it is a shared space, available to all without impediment, and only limited by the resource available to show and present it. The collection needs to be made more accessible, and its stories told in multiple ways, opening them to a much wider range of audiences to

hear and to experience. Given the constraints provided by a working environment, the strategy needs to emphasise digital access as well as using the Planetarium to tell the story of the Observatory. The tasks involved include the following:

- Developing an Estates strategy for the maintenance and use of AOP's buildings and grounds to support the delivery of this programme.
- Providing displays in the Planetarium that expound on history, heritage and environmental themes.
- Producing display boards for the grounds and Astropark on these same three themes.
- Introducing a regular guided tours programme for the Observatory and Astropark.
- Providing virtual tours through developing digital architecture products involving historic building modelling that can be accessed online. These might also be experienced through the immersive environment of the Planetarium theatre.
- Developing Apps for mobile devices enabling augmented reality, with video, imagery and audio content linked to location, as identified via GPS.
- Developing a series of guide books for sale in the Planetarium shop and online, emphasising high quality imagery of the heritage and the astronomical research undertaken at Armagh.
- Developing branded products for sale in the Planetarium shop and online.

#### Engaging with other Organisations and Agencies

The strategy for encouraging visitors to the Observatory and Planetarium emphasises depth and quality over transience and quantity. It needs to link to outside organisations, so that a visit to the AOP can be part of a wider cultural experience. This involves:

- Engaging with the ABC Council to ensure that AOP's programme is linked to the wider Armagh tourism strategy based

around the Georgian City, as an element in the tourism master plan. Further, to ensure that AOP is included within ABC tourism and other promotional materials.

- Engaging with the ABC Council, as well as other visitor attractions, to develop opportunities for joint programmes and promotions. These target specific audiences; e.g. the "culturally curious". In Armagh, such joint promotions can readily be envisaged with the Robinson Public Library, the County Museum, the Palace, the Cathedrals and Navan Fort, at regional level through links to nearby environmental and dark sky reserves, and at national level through Ireland's great astronomy heritage linking Armagh with Birr Castle and Dunsink Observatory.
- Forming a Friends of Armagh Observatory and Planetarium, a support group able, on occasion, to serve as volunteers, for instance in maintaining the formal gardens or being tour guides.
- Engaging with PRONI (Public Records Office, Northern Ireland), to ensure that AOP management records are properly stored and archived, and made available for scholars, for instance researching social history.



*The Observatory Medal struck by the Dublin medallist William Mossop to commemorate the foundation of the building of the Observatory in 1789. The front shows the Observatory, together with its motto "The Heavens Declare the Glory of God" (Psalm 19), while the obverse shows Archbishop Richard Robinson.*



### Concepts for Engagement

To implement this strategy of developing and promoting the history and heritage of AOP we suggest promoting four key concepts. These provide handles which will guide AOP when developing the activities described earlier. Three of these are enablers, facilitating programme development. The fourth provides a driving goal that can bring together the programmes and the partners under a common umbrella.

### Online Ticketing

Introducing online ticketing in the Planetarium will transform our ability to promote events. It will allow a database to be built to enable direct marketing to niche target audiences attracted to our offerings. It will facilitate the ready promotion of joint events with other visitor attractions through single ticketing, including discounting for attending multiple events etc. Further, it will free up valuable staff time to concentrate on their core duties of delivering education and outreach activities.

### Museum Accreditation

AOP needs to prepare itself first before it is ready to seek accreditation as a recognized museum, managing our heritage assets so that they are preserved, catalogued and made accessible.

### Lottery Funding

There are two lottery funds that AOP could position itself towards in order to seek funding. The Heritage Lottery Fund (HLF) supports heritage significance which is at risk, needs conservation and/or needs bringing to the public's attention, in turn delivering social and community good. The Big Lottery Fund (BLF) has a more open-ended focus, centred on communities and people most in need. While the HLF is clearly applicable for AOP, many of our proposed activities could meet the BLF criteria.

An essential element prior to any application to the HLF is to develop a Conservation

Management Plan, to guide the decisions needed to support conservation objectives. This is a two-stage process, with the first phase being to obtain funding to develop the plan, and the second to then implement it. The plan needs to be supported by a clarity of vision for AOP – such as that espoused through our Four Pillars – together with a strong business plan. It must aim to further AOP's role at the heart of a community. Engaging with key local and national-level partners (such as the ABC Council and the Department for Communities) is essential here, as well as for ensuring that balanced and coordinated requests are received by the funders. It will also be necessary to provide evidence that there is a demand for any proposed projects too, through conducting appropriate surveys, undertaking trial events etc.

### Dark Sky City

AOP should explore with the ABC Council the concept of a Dark Sky City for Armagh, an iconic branding that would provide a special sense of place for the city and enhance its reputation as a centre for culture and learning, where *living space* remains a daily experience.



*The Armagh Planetarium, the vision of the 7<sup>th</sup> Director Eric Lindsay, and opened in 1968 in order to explain to the public the discoveries being made by the Observatory and the importance of science. Now the oldest planetarium operating in the UK and Ireland.*

## A Timeline for the Armagh Observatory and Planetarium

### Pre-AOP History

Time Period	Significant Events
~5,000BC	<p>Neolithic peoples come to Armagh. Settlement first on the Hill of Armagh (Ard Macha) then nearby at the Hill of Navan (Emain Macha). Became the capital of Ulster, and a focus of mythology, such as the home of the legendary warrior Cúchulainn.</p> <p>Construction of burial monuments and stone circles across Ireland, several with alignments associated with the dates of the equinoxes and solstices – the first calendars.</p>
4 <sup>th</sup> to 8 <sup>th</sup> Centuries AD	<p>Centre of influence moves back to Armagh. St Patrick founds the first church in Armagh in 444 AD and becomes the first Bishop of Armagh. Over the next four centuries Armagh becomes renowned throughout Europe as an ecclesiastical centre. Some astronomical apparitions, such as eclipses and comets, recorded in the Annals of Ulster, the first recorded astronomical observations to be made from Armagh.</p>
8 <sup>th</sup> to 16 <sup>th</sup> Centuries AD	<p>Viking and Norman invasions of Ireland, with power shifting to coastal towns such as Dublin and Drogheda. Towards end of this period the Armagh district becomes a battlefield for between opposing forces of the Earl of Tyrone and the English Crown.</p>
17 <sup>th</sup> Century	<p>Archbishops of Armagh only visit their Primatial capital occasionally. In 1654 Archbishop James Ussher produces his calculation of the date of creation, determining that Genesis occurred on the 22<sup>nd</sup> of October 4004 BC, based on his interpretation of the dates of biblical events.</p> <p>Newton publishes the <i>Principia in 1687</i>, establishing theory of gravitation and the laws of motion, and explaining Kepler's laws of planetary motion.</p>
18 <sup>th</sup> Century	<p>The <i>age of enlightenment</i>, and the growing appreciation of the methods of science, leads to advances in knowledge such as:</p> <ul style="list-style-type: none"> <li>• Realisation of the importance of astronomy for navigation, facilitating the discovery of new lands and trade with distant countries.</li> <li>• The success of Newton's theory in predicting the movements of the planets and comets in the Solar System.</li> <li>• Captain Cook's voyages of discovery and the Transit of Venus.</li> <li>• The discovery of the planet Uranus by Herschel, 8 years before Armagh Observatory starts to be built.</li> </ul>



## AOP History

Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
<p data-bbox="150 304 352 338"><b>1. 1790 – 1815</b></p> <p data-bbox="150 371 373 472"><b>The Rev. Dr James Archibald Hamilton</b></p>	<p data-bbox="410 304 1053 611">1789: Observatory founded by Primate Richard Robinson, Baron Rokeby and the Archbishop of Armagh. Architect was Francis Johnston, later known as the "<i>Wren of Ireland</i>". The connection between Church and Observatory remains to this day, with the Archbishop of Armagh being the Chair of the Board of Governors of the Armagh Observatory and Planetarium, with the current incumbent being Archbishop Richard Clarke.</p> <p data-bbox="410 645 1034 745">1791: Act of Parliament "<i>Settling and Preserving a Public Observatory and Museum in the City of Armagh, for ever</i>".</p> <p data-bbox="410 779 1031 1021">Neville Maskelyne, the Astronomer Royal and Director of the Royal Greenwich Observatory, prescribes the scientific needs for a modern observatory: "The principal requirements for serious work on the position of stars are a transit instrument, a meridian circle and an accurate clock."</p> <p data-bbox="410 1055 1027 1256">1794: Daily readings of the weather conditions begin at Armagh, recording the temperature and pressure. Armagh continues to measure the meteorological conditions at 9am every day, the longest calibrated daily weather record in the UK and Ireland.</p> <p data-bbox="410 1290 1046 1570">1794: Thomas Earnshaw clock purchased for £100 + £100 for travel to Armagh to set-up in the Observatory. Believed to be the most accurate clock in the world at the time. Partly as a result of the excellent performance of this clock Earnshaw was awarded a prize of £3,000 by the Government and became known as the <i>father of the chronometer</i>.</p> <p data-bbox="410 1603 1031 1939">1795: Troughton Equatorial telescope installed, now the oldest telescope in the world continuously housed in its original dome. Able to measure positions of stars in both celestial declination and longitude. Massive stone pillars used for support and rigidity, however the mechanical design was too far ahead of the available technology of the day. It could not match the accuracy of the simple transit and meridian circle.</p>	<p data-bbox="1074 304 1366 405">1781: Discovery of a new planet, Uranus, by Herschel.</p> <p data-bbox="1074 439 1382 539">1784: Messier publishes his catalogue of star clusters and nebulae.</p> <p data-bbox="1074 573 1382 786">1800: Herschel splits sunlight through a prism and discovers infrared radiation. Lays the foundations for spectroscopy.</p> <p data-bbox="1074 819 1374 987">1801: Piazzi discovers the first asteroid, Ceres, orbiting the Sun between Mars and Jupiter.</p> <p data-bbox="1074 1021 1382 1223">1814: Fraunhofer builds the first spectrometer and studies the Sun. Discovers absorption lines, later linked to chemical elements.</p>

Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
<p><b>2. 1815 – 1823</b></p> <p><b>The Rev. Dr William Davenport</b></p>	<p>A Senior Fellow of Trinity College, Dublin, and formerly Professor of Natural Philosophy. Contribution to astronomy virtually nil. Committed suicide in his study, now the Director’s office.</p>	
<p><b>3. 1823 – 1882</b></p> <p><b>The Rev. Dr Thomas Romney Robinson.</b></p> <p><b>Child Prodigy, BA at 16 and a Fellow of Trinity College at 21.</b></p> <p><b>Director for 59 years – a world record for an Observatory Director.</b></p>	<p>Archbishop John George Beresford contributed several thousand pounds of his own money to refurbish the Observatory with the best instruments available.</p> <p>1827: Construction alongside the Transit Room of the Meridian Room and the East Dome, fitted with a 9-inch reflecting telescope by Sir William Herschel.</p> <p>1827: 3.75-inch Transit Instrument mounted in the Transit Room.</p> <p>1831: 3.8-inch aperture Mural Circle mounted on the wall of the Meridian Room.</p> <p>Both telescopes built by Thomas Jones of London. Though similar pairs were set up in UK and Commonwealth countries during the nineteenth century, those at Armagh are the only pair known to survive to this day on their original site.</p> <p>1835: 15 inch Grubb equatorial reflector installed in the East Dome, built by Dublin instrument maker Thomas Grubb. Incorporated several revolutionary innovations which subsequently become widely accepted in telescope design: (i) the Cassegrain design, never previously used in a large telescope, (ii) the first large reflecting telescope to be mounted on a polar axis with a clock drive and with (iii) a novel lever support system for the primary mirror.</p> <p>1839: Measurement of the longitude difference between Dublin and Armagh, involving accurate timing of the explosions of rockets fired from the top of Slieve Gullion, the highest point between the two cities.</p> <p>1841: Sector Tower added above the Transit Room to house instruments from King George III’s observatory in Kew Gardens, London. Observatory also receives from Queen Victoria the Shelton and Recordon clocks, used to time the Transit of Venus in 1769.</p> <p>1846: Invention of method for measuring the wind</p>	<p>1838: Bessel measures stellar parallax, providing the first accurate distance to the stars.</p> <p>1845: William Parsons, the 3<sup>rd</sup> Earl of Rosse, completes the Leviathan telescope at Birr, the largest telescope in the world for 72 years. With advice from Robinson, uses it to discover spiral structure in M51, later understood to be another galaxy – the Whirlpool Galaxy. The birth of what is now called extra-galactic astronomy.</p> <p>1846: Neptune discovered by Galle, following calculations using Newton’s theory of gravity by Le Verrier and Adams.</p> <p>1868: A new element, Helium, discovered in the Sun, 30 years before found on the Earth.</p> <p>1872: Draper measures absorption lines in Vega, revealing chemical make-up and opening the tool of spectroscopy for studying the stars.</p>

Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
	<p>speed, now known as the Robinson cup anemometer, and used the world over. A version is on top of the Sector Tower.</p> <p>1859: Publication of the first Armagh catalogue of stars (<i>“Places of 5,345 Stars”</i>). Established the position of Armagh Observatory as a scientific institution of national and international importance. The stellar positions recorded in this book were ultimately combined with those from other observatories around the world to form a fundamental catalogue of stars which defines the reference frame of the Universe against which the movements of the planets are measured. Awarded the Gold Medal of the Royal Society.</p> <p>1867: Armagh, along with 6 other stations through the UK, established as the first self-recording meteorological weather stations.</p> <p>1869: Disestablishment of the Church of Ireland and the subsequent loss of income to the Observatory due to the removal of tithes on endowed church land results in first financial crisis. Annual income reduced from £216 to £60.</p> <p>1874: Appeal made to British Prime Minister Benjamin Disraeli regarding the financial situation, to no affect.</p>	
<p><b>4. 1882 – 1916</b></p> <p><b>Dr John Louis Emil Dreyer</b></p> <p><b>Previously Assistant Astronomer at Dunsink and Astronomer to Lord Rosse at Birr.</b></p>	<p>1883: Government grant of £2,000 alleviates the immediate dire financial position of the Observatory.</p> <p>1885: Funds used to purchase a new telescope, the 10 inch Howard Grubb Refractor, installed in the new Robinson Dome.</p> <p>1886: <i>Second Armagh Catalogue of 3,300 Stars</i> published.</p> <p>1888: Publication of the <i>“New General Catalogue of Nebulae and Clusters of Stars”</i>, now known the world over by professional astronomers for the NGC numbers of the favourite sources of study.</p> <p>1890: Published first account of the life and works of Tycho Brahe.</p> <p>1895: Publication of Dreyer’s first Index Catalogue.</p> <p>1897: Second financial crisis resulting from land reform and the loss of its estates and the rents they</p>	<p>1901: Draper star catalogue published, together with spectral classification system proposed by Annie Jump Cannon.</p> <p>1906+13: Hertzsprung-Russell diagram deduced revealing relationship between colour and brightness of stars.</p> <p>1915: Einstein’s theory of General Relativity.</p>

Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
	<p>provided; leads to 30% reduction in income.</p> <p>1908: Publication of Dreyer's second Index Catalogue.</p> <p>1906: Publication of 'A History of Planetary Theories from Thales to Kepler'.</p> <p>1916: Dreyer resigns and moves to Oxford to continue his research on Tycho Brahe.</p>	
<p>5. 1917</p> <p>Joseph Alfred Hardcastle</p>	<p>Noted for his photographic studies of the Moon, Hardcastle appointed as Director but died as he was preparing to take up office. His family continued with the move to Armagh and lived in the Director's house until the arrival of Ellison. Mrs Therese Hardcastle looked after the house and carried on with taking the meteorological records.</p>	
<p>6. 1918 – 1936</p> <p>The Rev. William Frederick Archdall Ellison</p>	<p>1919: 18 inch Calver equatorial reflector installed, presented by Ellison to the Observatory. Ellison became noted for his observations of binary stars.</p> <p>1920: Publishes "The Amateur's Telescope", describing the methods by which telescopes could be made by any dedicated person, opening the field to amateurs.</p> <p>1928: The new Northern Ireland Government at Stormont recognises the important work of the Observatory and provides an annual grant of £100, providing, for the first time, the Observatory with a foothold in an official recurrent budget.</p>	<p>1929: Hubble discovers the universe is expanding, with Lemaître later suggesting this can be traced to an initial "Big Bang".</p> <p>1930: Prediction by Chandrasekhar of collapse of a white dwarf to a neutron star. Later association with supernova explosions.</p> <p>1930: Discovery of Pluto by Tombaugh.</p> <p>1932: Jansky discovers radio waves from space.</p>
<p>7. 1937 – 1974</p> <p>Dr Eric Mervyn Lindsay</p> <p>Renowned for being the person who rebuilt the Observatory to its present position of eminence in the scientific world,</p>	<p>Lindsay realised that a small institution such as Armagh Observatory could not hope to prosper without modern equipment and that this could best be provided by collaboration with other institutes. Proposed that the two Irish observatories, Armagh and Dunsink, should combine with Harvard University, to build a telescope that would chart the skies of the southern hemisphere. The agreement by the two governments of Ireland to then jointly fund the Armagh-Dunsink-Harvard (ADH) telescope to be built in South Africa was the first North-South agreement between them to cooperate on a joint venture. It later provided a</p>	<p>1938: Bethe explains how stars generate energy through nuclear fusion.</p> <p>1948: Palomar 200-inch telescope built, opening a new era in exploration of the cosmos.</p> <p>1958: Discovery of the solar wind by Parker.</p>

Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
<p>and for building the Planetarium in order to explain to the public its discoveries and the importance of science.</p>	<p>model for the foundation of the European Southern Observatory (ESO), now the world's premier optical astronomical observatory.</p> <p>Visitor number to the Observatory also increased 3,000–4,000 people per year, with regular open nights held. Led to pursuit of the development of a planetarium.</p>	<p>1962: Foundation of the European Southern Observatory (ESO).</p> <p>1965: Penzias &amp; Wilson detect the cosmic microwave radiation, the echo from the Big Bang.</p>
<p>Acting Director 1959 Dr Harlow Shapley (visiting from Harvard, USA)</p>	<p>1938: Succeeds in increasing the yearly Government grant to £300.</p> <p>1940: Transit room and Meridian room converted into display rooms.</p>	<p>1967: Jocelyn Bell-Burnell &amp; Hewish detect the first pulsar using radio waves.</p>
<p>Planetarium Directors: 1967 – 1968 Dr Patrick Moore</p>	<p>1947: Agreement reached on the project for the Armagh-Dunsink-Harvard (ADH) telescope at Boyden in South Africa. The first signed agreement between the governments of Northern Ireland and the Republic of Ireland. Annual government grant increased to £720 to £3,320!</p>	<p>1970: Sky mapped in X-rays by Uhuru satellite.</p> <p>1970: Molecular clouds in interstellar space discovered and first mapped using radio waves.</p>
<p>1968 Terry Moseley (interim)</p>	<p>1948: Ernst Öpik arrives in Armagh, arguably the leading astronomer of his age.</p>	<p>Increasing realisation and quantification of the significant quantities of “missing” mass that exists in our Galaxy and others, needed to account for gravitational pull observed in the motions of gas and stars – now known as “dark matter”.</p>
<p>1968 – 1971 Dr Tom Rackham</p>	<p>1950: The 18 inch Calver converted into a Schmidt telescope and set up in a new dome.</p>	
<p>1971 – 1989 Terence Murtagh</p>	<p>1950: First meeting of the Board of the Planetarium Fund, jointly chaired by the Primates of the Church of Ireland and the Catholic Church.</p>	
<p>1990 Martin Ratcliffe Acting Director</p>	<p>1950: The ADH opened telescope in Boyden. This international agreement is considered by some to be a pre-runner for later ESO international agreements.</p>	
	<p>1964: New Library Wing completed, first addition to buildings since 1841, through a £3,000 grant from the Nuffield Foundation, and £5,000 from the Ministry. Funding of £50,000 for Planetarium largely secured with contributions from the Ministry and the Armagh City and County Councils.</p>	
	<p>1965: Appointment of Patrick Moore as first Director of the Planetarium.</p>	
	<p>1967: Completion of Planetarium with a Mars Projector from Goto Optical Works in Japan.</p>	
	<p>1 May 1968: Official opening of the Planetarium by Prime Minister Terence O’Neil.</p>	



Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
	<p>1974: Exhibition hall added to the Planetarium – the Lindsay Hall of Astronomy.</p>	
<p><b>Acting Director</b> 1974 – 1976</p> <p><b>Professor</b> <b>Ernst Julius Öpik</b></p> <p><b>A refugee from</b> <b>Estonia</b></p>	<p>Contributions to science include the:</p> <ul style="list-style-type: none"> <li>• discovery of degenerate stars, e.g. white dwarfs;</li> <li>• first ‘proof’ of the extragalactic nature of M31, the Andromeda galaxy;</li> <li>• prediction of a cloud of cometary material orbiting the Sun (now known as the “Oort Cloud”);</li> <li>• first computation of evolutionary models showing how main-sequence stars turn into giants;</li> <li>• prediction of the surface density of craters on Mars, eventually confirmed by planetary probes;</li> <li>• development of leading theories for the origin of the ice-ages.</li> </ul>	
<p><b>8. 1976 – 1994</b></p> <p><b>Observatory</b> <b>Director:</b> <b>Dr Mart de Groot</b></p> <p><b>Planetarium</b> <b>Director</b> 1990 – 1995 <b>Dr Ian Griffin</b></p> <p><b>Acting</b> <b>Observatory</b> <b>Director</b> <b>Dr Fred Byrne</b> 1994 – 1995</p>	<p>Noted for his contributions to stellar astrophysics.</p> <p>Last Director to live in the Observatory, as the building is converted in office space. Expansion of astronomical staff after Observatory deemed eligible to apply for research council funding. Became a node in the UK Starlink astronomical data network.</p> <p>Development of gardens and grounds relating to the 200<sup>th</sup> anniversary. Astropark opened in 1994.</p> <p>Digistar Projection system for the Planetarium. Expanded its facilities in 1994 to include Earth sciences. Emphasis on hands-on science for visitors.</p> <p>1995: The Armagh Observatory and Planetarium (Northern Ireland) Order 1995.</p>	<p>1977: Voyager probes launched to explore the outer Solar System.</p> <p>1980: 3.9m Anglo Australian Telescope opened.</p> <p>1983: Sky mapped in the infrared by IRAS satellite.</p> <p>1987: Supernova 1987A and first cosmic source of neutrinos.</p> <p>1990: Hubble Space Telescope launched.</p> <p>1992: Cosmic background radiation mapped by the COBE satellite.</p> <p>1992: Keck 10m diameter telescope built in Hawaii.</p> <p>1992: First exoplanet discovered around a pulsar.</p>

Director	Significant Events and Memorable Stories	Astronomical History Elsewhere
<p data-bbox="150 237 352 264"><b>9. 1995 – 2016</b></p> <p data-bbox="150 304 320 434"><b>Observatory Director: Professor Mark Bailey</b></p> <p data-bbox="150 474 360 604"><b>Acting Director 1998 Professor Gerry Doyle</b></p> <p data-bbox="150 645 352 775"><b>Planetarium Director 1996 – 2015 Dr Tom Mason</b></p>	<p data-bbox="413 237 1023 434">Noted for his contributions to Solar System astronomy and the dynamics of cometary bodies and asteroids. Established the Human Orrery. With the help of external funding, research staff doubled. Calibration of the climate record undertaken.</p> <p data-bbox="413 474 1054 949">Armagh astronomers engage with international Observatories at the finest locations on the Earth and in space to conduct their science. The five most commonly used are in Hawaii in the USA, La Palma in the Canary Islands, the Anglo-Australian Observatory in New South Wales, the European Southern Observatory in Chile and the South African Astronomical Observatory. Space observatories used include the Hubble, the European EXOSAT and Japanese GINGA to measure X-rays from stars, and NASA’s SMM satellite to observe the Sun. Armagh also engages as a partner in the South African Large Telescope (SALT), the world’s largest optical telescope.</p> <p data-bbox="413 990 1050 1088">Armagh begin participation in international projects: I-LOFAR (Birr; radio) and DKIST (Hawaii; solar).</p> <p data-bbox="413 1128 1015 1227">The Planetarium expands its outreach program, plus a major refurbishment including a new Digistar and exhibition material from ESA.</p>	<p data-bbox="1075 237 1382 367">1995: Discovery of the first exoplanet around a main sequence star, 51 Pegasi.</p> <p data-bbox="1075 407 1385 537">1996: First Hubble Deep Field revealing the building blocks of galaxies.</p> <p data-bbox="1075 577 1356 676">1998: Inauguration of the ESO VLT 8.4m telescopes in Chile.</p> <p data-bbox="1075 716 1385 913">1998: Acceleration of the rate of expansion of the universe discovered, with the inference of the existence of “dark energy”.</p> <p data-bbox="1075 954 1372 1263">2006: International Astronomical Union redefines the definition of a planet, including adding a category of “dwarf planet” as discoveries of objects beyond Pluto are now regularly made.</p> <p data-bbox="1075 1303 1385 1464">2016: First gravitational waves detected by the LIGO interferometer. Opens a new window on to the cosmos.</p>
<p data-bbox="150 1507 288 1534"><b>10. 2016 –</b></p> <p data-bbox="150 1574 376 1807"><b>First Director of the Armagh Observatory and Planetarium (AOP): Professor Michael Burton</b></p>	<p data-bbox="413 1507 1054 1637">Infrared and millimetre-wave astronomer, and leader in the development of astronomy in Antarctica. Research expertise in molecular clouds and star formation.</p> <p data-bbox="413 1677 1054 1874">Observatory and Planetarium combined into a single institution, the Armagh Observatory and Planetarium, with a senior management team to be appointed, consisting of a Head of Research, a Head of Education and Community Outreach and a Head of Corporate Services.</p> <p data-bbox="413 1915 1054 2045">Armagh furthers participation in international collaborations for the GOTO telescope (La Palma; optical transients), the Cherenkov Telescope Array (La Palma and Chile; gamma-rays).</p>	<p data-bbox="1075 1507 1382 1637">2016: Discovery of Proxima b, a planet orbiting the nearest star to the Sun.</p> <p data-bbox="1075 1677 1369 1807">2017: Discovery of the Trappist 1 system with 7 terrestrial-sized, temperate exoplanets.</p>

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Page 6	M51 – Whirlpool Galaxy	From Parsons, 1926, “The Scientific Papers of 3 <sup>rd</sup> Earl of Rosse 1800–1867”
Page 7	Observatory and 1827 Dome, c1883	Armagh Observatory and Planetarium
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Page 16	Observatory Medal by Mossop	Armagh Observatory and Planetarium
Page 17	Armagh Planetarium	Armagh Observatory and Planetarium
Page 26	Observatory and 1827 Dome today	Professor Mark Bailey



*The front of the Observatory today, with the original 1790 Georgian building to right, and the later editions (going to left) of the Sector Tower (to house King George III's instruments from his Kew Observatory gifted by Queen Victoria), built over the Transit Room containing the Transit Instrument, then the Meridian Room with the Mural Circle, and finally the 1827 Tower.*