“Captured by Curiosity: the historical development of astronomy in South Africa, from the pre-colonial past to c.1970.”

By: Paige Smith

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Supervisor: Professor Sandra Swart

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Declaration

As this thesis is submitted electronically, I hereby declare the work contained herein is entirely my own, original work. I declare that I am the sole author of this dissertation (unless otherwise explicitly stated) and that I have not previously submitted this dissertation, or any portion thereof, in order to obtain any qualification. I also declare that the reproduction and publication of this dissertation by the University of Stellenbosch will not infringe on any third-party rights.

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Abstract

The historical development of astronomy in South Africa did not occur along linear lines, nor was it sustained by only one group of people or one intellectual tradition. This thesis offers a fresh history of the development of astronomy by synthesising the contribution of various individuals, groups and institutions that contributed to its development from what may be defined as the pre-colonial period up until 1970, when it was first introduced as a subject to study at South African tertiary institutions. It argues that the development of astronomy in South Africa over time, as an intellectual and cultural body of knowledge as well as a scientific and professional discipline, was derived from diverse sources. In doing so, this thesis traces the trajectory of the development of astronomical inquiry by investigating the astronomical practices and cosmological beliefs of various indigenous groups of southern Africa, as well as the individuals, organisations, and institutions of European colonialists from the mid-seventeenth century. This thesis contributes to the existing body of literature by discussing both the precolonial and colonial histories, while also addressing how the role of indigenous peoples and their astronomical activities is often excluded from the broader narrative and that it belongs in our broader understanding of the history of astronomical thinking.

Keywords: South Africa, history, astronomy, intellectual, cultural, discipline, indigenous, colonial.

Opsomming

Die historiese ontwikkeling van sterrekunde in Suid-Afrika het nie op ‘n lineêre wyse plaasgevind nie, en dit is ook nie deur slegs een groep mense of een intellektuele tradisie onderhou nie. Hierdie tesis bied ‘n nuwe geskiedenis aan wat van die ontwikkeling van sterrekunde deur die bydrae van verskillende individue, groepe en instellings wat bygedra het tot die ontwikkeling daarvan, te sintetiseer vanaf die voorkoloniale tydperk tot 1970, wanneer dit eers as ‘n onderwerp bekendgestel in Suid-Afrikaanse tersiêre instellings te studeer. Hierdie tesis voer aan dat die ontwikkeling van sterrekunde in Suid-Afrika oor tyd, as ‘n intellektuele en kulturele kennis, sowel as ‘n wetenskaplike en professionele dissipline, uit verskillende bronne verkry is. Hierdie tesis volg die trajek van die ontwikkeling van astronomiese ondersoek deur die astronomiese praktyke en kosmologiese oortuigings van verskillende inheemse groepe in Suider-Afrika, sowel as die individue, organisasies en instellings van Europese kolonialiste uit die middel van die sewentiende eeu te ondersoek. Hierdie tesis bydra tot die bestaande literatuur deur beide die voorkoloniale en koloniale geskiedenis te bespreek, en bespreek ook hoe die rol van inheemse mense en hul astronomiese aktiwiteite dikwels uitgesluit word van die breër verhaal en dat dit hoort in ons breër begrip van die geskiedenis van astronomiese denke.

Sleutelwoorde: Suid-Afrika, geskiedenis, sterrekunde, intellektueel, kultuur, dissipline, inheems, koloniaal,

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List of Abbreviations

ASSO – The Astronomical Society of Southern Africa

BIS – British Interplanetary Society

CSIR – Council for Scientific and Industrial Research

DACST – Department of Arts, Culture, Science and Technology

MNASSA – Monthly Notes of the Astronomical Society of Southern Africa

NASA – National Aeronautics and Space Administration

SAAO – South African Astronomical Observatory

SAARG – South African Rocket Research Group

SAIS – South African Interplanetary Society

SALT – Southern African Large Telescope

SKA – Square Kilometre Array

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Chapter One: Introduction to Astronomical Development in South Africa

Historically, the various peoples of what has come to be 'South Africa'[1] have had a deep interest in the cosmos. For example, indigenous cosmology of the Khoisan in pre-colonial southern Africa, the Igbo people of Nigeria and the Southern Nguni are just a few examples of this. Each of these above-mentioned case studies shed light on the historical roots of cosmology, which only later developed into a more formalised astronomical practice. The arrival of a handful of astronomers in South Africa (most of whom travelled from the Northern hemisphere) was influential in this process as they had been contemplating what came to be known as astronomy since the late 1600s.[2] As a result, a number of influential astronomers, scientists, and scholars each contributed knowledge, skills, and resources to the advancement of astronomy under southern skies.

The practice of studying and observing the night sky has a long history, one which has been traced back to the stellar and lunar observations of the Babylonians and ancient Egyptians. There is an ongoing discussion amongst scholars regarding who the first people were to develop the practice of astronomy. For example, academics such as Charles Gates, Robert Wilson, John M. Steele and Hermann Hunger suggest that the ancient Babylonians, who inhabited the first cities around the East-Mediterranean basin of Southern Mesopotamia from the 4th to the 2nd millennia B.C[3], were the first to make a significant contribution to the practice of stellar observation through their development of early mathematics.[4] Steele and Hunger consider the development of early mathematics to be a significant factor in the development of astronomical practices because the application of mathematical formulas and calculations was necessary to measure and predict the movements of celestial bodies. Historical evidence suggests that people of ancient Mesopotamia developed a complex and

[1] Present day 'South Africa' only became officially known as such from 1910 onwards, and thus it must be noted here that when making reference to 'South Africa', particularly in the context of 16th and 17th century development in the field of astronomy, one is referring to the various occurrences that took place within the region of southern Africa then divided into various systems of government.
[2] G. G. Cillie, "Brief Survey of the Development of Astronomy in South Africa," *Monthly Notes of the Astronomical Society of Southern Africa,* 32, 8, 1973, p. 59.
[3] C. Gates, *Ancient Cities: The archaeology of urban life in the Ancient Near East and Egypt, Greece, and Rome,* (United States of America, Routledge, 2011), p. 30 – 31.
[4] R. Wilson, *Astronomy through the Ages,* (United States of America, CRC Press, 1996), p. 11.

multi-faceted system of astronomical observation, which involved the observation and recording of astronomical phenomena, the use of practical methods to predict future astronomical events, as well as the development of mathematical theories that were used to explain various motions of the sun, moon and the five planets.[5] Hermann Hunger supports this by claiming that from as early as 500 BCE, Babylonian astronomers were calculating movements of the moon and the planets, "using mathematical methods based on relatively simple arithmetic."[6] Another important aspect of Babylonian astronomy was their use of lunar observations and long series of lunar eclipses to determine the length of seasons. Owen Gingerich postulates the Babylonians discovered that lunar eclipses repeated in patterns and that it was possible to work backwards in determining when seasons began and ended.[7] This advancement was significant in the sense that they were some of the first people to do so.

On the other side of this discussion are scholars such as Joanne Conman, Joachim F. Quack, R.A. Parker, who are of the opinion that the ancient Egyptians can be linked to the early development of astronomy, through their perception of the sky and the passing of time. Conman contends that, for the Egyptians, the sky was seen as an active force that was continuously turning, a notion which can thus be likened to a modern-day clock. This notion translates into the belief that one's "direction was a consequence of time, [thus] dependent on the sun's location."[8] This meant that their concept of time was based on their concept of direction and thus those two concepts could not be separated. For the ancient Egyptians, West and East are dependent on *when* – i.e., what time it is. Rather than seeing West and East as regions of the sky, directions were understood as time connected to those particular regions of the sky. In other words, the right, or the west, side of the sky is associated with day, while the left, or the east, side is night.[9] In addition to this, some of the oldest astronomical monuments found in Egypt are star clocks, which date back to the period between 2050 and 1900 BCE.[10]

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[5] J. M. Steele, "Celestial Measurement in Babylonian Astronomy," *Annals of Science,* 64, 3, 2007, p. 294.
[6] H. Hunger, "The relation of Babylonian astronomy to its culture and society," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 65.
[7] O. Gingerich, *The Eye of Heaven: Ptolemy, Copernicus, Kepler,* (American Institute of Physics, New York, 1993), p. 12.
[8] J. Conman, "It's about Time: Ancient Egyptian Cosmology," *Studien zur Altägyptischen Kultur,* 2003, 31, 2003, p. 36.
[9] *Ibid,* p. 37.
[10] J. F. Quack, "Astronomy in Ancient Egypt," *Oxford Handbook of Science and Medicine in the Classic World,* p. 2.

What this discussion shows is that there is a divide between scholars seeking to settle the debate about who were the 'first people' to formally practice astronomy and record the movement of celestial bodies and other astronomical phenomena they witnessed.

With this in mind, one should also consider the etymology of the word "astronomy", in order to get a better sense of where and how the practice came to be. The word "astronomy" has many linguistic origins, including "*astrenomie"* in Old French, and *"Astronomia"* in Latin and Greek. The word first emerged amongst the Ancient Greeks in the 13th century, and it denoted the scholarly or supernatural study of heavenly bodies.[11] The English term "astronomy" was derived from the Greek word "*astronomia*", and generally refers to the practice of mapping constellations or movements of the planets. In English, the word "astronomy" actually pre-dates the word "astrology" and each has its own meaning and application within the broader study of the cosmos. Astrology is explained as the "the study of the heavens", which relates to the study of how the Sun, Moon, and planets (other than Earth) influence terrestrial events, human psychology, and destiny.[12]

While these contrasting discussions show a clear distinction between the two in terms of defining them, the on-going debate surrounding the origin of astronomy continues. After all, if one uses the etymology of the word "astronomy" to attempt to trace its origins, the ancient Greeks emerge as another group of people who made significant strides in the field as well. Francesca Rochberg argues that the history of astronomy underwent a significant change with the discovery of ancient civilisation in the Near East, which ultimately resulted in scholars and historians to revise their view that Greek astronomical science was the first of its kind. In fact, her argument is that "Greek astronomy came to be seen to depend… [on] technical details borrowed from a Babylonian tradition."[13] Her argument is that ancient Babylonian records continue to have a lasting effect on astronomical understanding and the history of the subject itself, even long after they were a prominent population group. Nicholas Campion agrees that "astral theology of the Mesopotamians (and Egyptians) was systematised by the

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[11] Online Etymology Dictionary, *Astronomy (n.),* URL: https://www.etymonline.com/word/astronomy. Accessed on: 4 September 2021.
[12] P. Zarka: "Astronomy and astrology," *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 420.
[13] F. Rochberg, "A consideration of Babylonian astronomy within the historiography of science," *Studies in History and Philosophy of Science,* 33, 2002, p. 662.

Greek philosopher Plato c. 428 – 348."[14] So, although the Greeks are often portrayed to be the pioneers in astronomy and astrology and are often regarded as the first ancient people to develop the concept of the zodiac, the reality is that there were other groups paving the way in astronomy in other parts of the world a long time before them.

It is very likely that Babylonian astronomical practices later informed the Greeks, however such practices were only characterised as 'astronomical' much later on when scholars and historians started studying it. This discussion has shown that the definition of 'astronomy', and its practical application is different for various population groups, and thus categorising it under one term has proven problematic. One could argue that the English term 'astronomy' is a social construct that is used to conceptualise a complex and ever-changing practice, one that in reality is very difficult to define. With that in mind, each of the above-mentioned case studies should be studied within their own right, because ultimately each one was practicing some sort of astronomy, they just might not have called it as such. Historically, a lot of academic focus has been placed on these population groups, while others have been neglected. Therefore, this thesis seeks to address, and contribute to, the ongoing discussion around historical astronomical development by contributing an alternative interpretation and considering the differences in practice and understanding of cosmological studies and astronomical practices amongst the indigenous populations of South Africa as well as the imported populations from the West. This is done in order to offer an alternative perspective on the historical development of astronomy in South Africa by taking both indigenous and foreign astronomical practices into account.

Up until now the historiography of the development of astronomy in South Africa has focused largely on key developments within economic, scientific, and technological spheres, with almost no attention paid to the cultural and professional aspect of astronomy. In the South African context, cultural aspects of astronomy relate to the various indigenous traditions and practices that subsequently inform the study of astronomy amongst indigenous peoples in South Africa. On the other hand, the professional aspect of astronomy refers to the way in which the study of astronomy became institutionalised and was offered as a subject at

[14] N. Campion, "Astronomy and political theory," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 597.

tertiary institutions, as well as how the practice of astronomy drew attention of both amateur and professional astronomers respectively. Interestingly, only a handful of scholars, including Kevindran Govender[15], Peter Martinez[16], Lerothodi L. Leeuw and Jarita Holbrook[17], critically discuss the role played by professionals, academics, scientists, and even some amateur astronomers, in the historical development of astronomy in South Africa.

Therefore, in order to address this gap in the literature, this dissertation performs two functions: firstly, it offers a study over the *longue durée*, uniting several intellectual traditions of various groups such as the indigenous |Xam and San peoples of southern Africa, the Southern Nguni of the Eastern Cape, Dutch and English settlers. This is affected in order to show how each of these groups' (and of some individuals' among them) beliefs, practices and ideologies played a role in the historical development of astronomy in South Africa, focusing attention specifically on the pre-colonial period up until 1970, when it was first introduced as a subject to study at South African tertiary institutions. This first function aims to reclaim what has been neglected in the current discourse and in many instances ascribed them to the categories of mere myth and folklore. In addition, while some scholars have done some investigations into the historiographical development of science and astronomy over the *longue durée*, there are very few who consider indigenous knowledge as forming a part of it. William Beinart and Saul Dubow have made a mention of this aspect in their most recent book, "The Scientific Imagination in South Africa; 1700 to the present," but there still remains more to be said on this topic, which this dissertation focuses on. The second function of this thesis is that it explores the intellectual and academic history of astronomy as a discipline in South Africa, while at the same time uniting amateur and professional astronomers in the overall discussion.

This study begins in the hard to date pre-colonial past and looks closely at the astronomical cosmology of indigenous groups. It then moves from the early 1600s, investigating how the

[15] K. Govender, "Astronomy for African development," the Role of Astronomy in Society and Culture Proceedings IAU Symposium no. 260, 2009, p. 577 – 586.
[16] P. Martinez, "Building capacity for astronomy research and education in Africa," *Astronomy for the developing world IAU Special Session,* 5, 2006, p. 89 – 98.
[17] L. L. Leeuw. & J. Holbrook, "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," *Under One Sky: The IAU Centenary Symposium Proceedings IAU Symposium*, 349, 2019, p. 240 – 247.

initial establishment of astronomical institutions by European travellers gave rise to other developments in the field later on and ultimately contributed to the academic development of the discipline over time. In order to establish when, how and why the study of astronomy was established in South Africa and investigate how the practice developed into an intellectual and academic discipline, this study first explores the key developments and shifts that took place up until the early 19th century. Therefore, by placing this study within this time period, the aim is to contextualise how astronomical practice was introduced into southern Africa, who was involved in its early development and how this facilitated further developments in science, technology, and academia over time. It is hoped that by doing so, a clearer understanding of the development of astronomical practice over time can be gained, as well as a discussion surrounding its emergence at a tertiary education level as an academic discipline in South Africa in 1970 can be had. This thesis contextualises and analyses the development of astronomy amongst both indigenous and settler groups in the country over this period, to demonstrate how certain key developments in the past ultimately contributed to our understanding of astronomy.

Methodology

This study explored the large body of literature that discusses South Africa's involvement in and contribution to astronomy and outer space exploration over time, categorising it into four historiographical schools.

The first historiographical school focuses on the notion of "Great Man" History, particularly that which characterised the colonial period. The notion "Great Man" History was first coined by Thomas Carlyle in the 19th century, and essentially relates to the idea that history is driven by 'great men', who do so through their innate superiority.[18] In a sense, this historiographical school can be applied to the colonial influences on astronomical practices in South Africa. This is because with the arrival of Western individuals and groups, the practice of astronomy in the region shifted to become self-consciously scientific and ostensibly not contoured by religious and cultural beliefs and practices, although it still operated within a societal context. However, it is important to reflect on the fact that European, or Western, astronomy was previously based heavily on religious beliefs, and not purely science. Discussions presented by Thomas J. McLaughlin[19], Paul Murdin[20], Alberto Righini[21], and Daniel Śpelda[22], to name a few, will be discussed in greater detail in the literature review, in order to present and substantiate the argument that the historiographical school of "Great Man" history tends to emerge when discussing topics of social and intellectual prestige, such as astronomy and scientific inquiry. Each of these scholars' arguments have been incorporated into the literature review in order to show how each one contributes to this first historiographical school of thought.

The second historiographical school discusses key indigenous and cultural practices in southern Africa, many of whom were practicing cosmology and astronomy prior to the arrival and influence of colonial populations. This historiographical school serves as a contestation

[18] K. Culkin, "Doing Historian Business: Local History, Student Historians, and the Hall of Fame for Great Americans," *Transformations: The Journal of Inclusive Scholarship and Pedagogy,* 26, 2, 2016, p. 247.
[19] T. J. McLaughlin, "Astronomy: Queen of the Specific Sciences," *Angelicum,* 87, 4, 2010, p. 1015 – 1041.
[20] P. Murdin, "Introduction: the development of astronomy in Europe," *European Review,* 10, 2, 2002, p. 159 – 169.
[21] A. Righini, "The telescope in the making, the Galileo first telescoping observations," p. 27 – 32.
[22] D. Śpelda, "The history of science as the progress of the human spirit: The historiography of astronomy in the eighteenth century," *Studies in History and Philosophy of Science,* 63, 2017, p. 48 – 57.

and challenge to the "Great Man" history school of thought because it considers other aspects of astronomical development, from a non-Eurocentric perspective. Scholars who focus on investigating various indigenous groups of southern Africa within this historiographical school provide sufficient evidence to support the claim that cosmological practices once held (and sometimes still hold) spiritual connotations for these indigenous groups, while at the same time functioning as a tool of resilience. Michael Wessels and Helen Tilley are two prominent scholars who argue that some southern African indigenous narratives, and practices, have become lost in the wave of emerging Western narratives that dominate the current discourse. Wessels argues that it is important to study such indigenous narratives, particularly those of the San/Bushmen, as they provide scholars with "insights into early phases of human history" and would ultimately contribute to a greater understanding of primitive modes of thought.[23] This thesis rejects such a view of indigenous cosmology – arguing that it is neither primitive nor somehow from an earlier age of human past, but a sophisticated living history with strong socio-cultural and intellectual threads into our contemporary period. Nevertheless, taking their beliefs seriously fits in well with this second historiographical school as it challenges the "Great Man" historiographical school of thought, by focusing on the lesser told stories of those who came long before the spread of Westernised ideas and practices and countering the argument that Western influences and knowledge were predominant over indigenous practices.

Other scholars who address this issue include Elizabeth Green Musselman[24], Kevindran Govender and Peter G. Alcock[25], each of whom promote the idea that the inclusion of indigenous practices and narratives is crucial to gaining a broader understanding of how those people lived and experienced the cosmos, prior to colonial influence coming into effect. What is also important to mention here is that William Beinart & Saul Dubow's book, *The Scientific Imagination in South Africa; 1700 to the present*[26], also speaks to this discussion

[23] M. Wessels, "New Directions in |Xam studies: some of the implications of Andrew Bank's Bushmen in a Victorian world: the remarkable story of the Bleek-Lloyd Collection of Bushman folklore," *Critical Arts: A Journal of South-North Cultural Studies,* 22, 1, 2008, p. 71 – 72.
[24] E. G. Musselman, "Worlds displaced: projecting the celestial environment from the Cape Colony," *Kronos: Journal of Cape History,* 28, 1, 2002, p. 64 – 85.
[25] P. G. Alcock, *Venus Rising: South African Astronomical Beliefs, Customs and Observations,* (South Africa, 2014).
[26] W. Beinart, & S. Dubow, *The Scientific Imagination in South Africa: 1700 to the Present, (*United Kingdom, Cambridge University Press, 2021).

and does direct some of its attention in this direction. A quote from the book shows this as it is explained that "This book… is largely a history of individuals associations, and institutions that were at the fulcrum of important scientific developments."[27] However, with that being said, this thesis aims to contribute to this discussion in greater detail by drawing on other discussions from alternative perspectives.

The third historiographical school relates to the way in which technological advances and infrastructural developments in South Africa in the early 20th century contributed to the overall development of the field of astronomy, from a scientific and professionalised perspective. In this discussion, many scholars such as Peter Martinez, Kevindran Govender, Cherryl Walker and George Miley are of the opinion that infrastructure and technology are major driving factors behind the development of astronomy, both within South Africa and internationally. For example, Walker has written extensively on the role of large-scale developments in astronomy, particularly the Square Kilometre Array (SKA) in the Northern Cape. South Africa and Australia were announced as the co-hosts for the SKA in 2012[28], and while the development of this particular project does not fall within the time-period of this thesis, it is still important to mention as it is seen to be one of the largest astronomical projects in southern Africa, and possibly the world. In addition to this, Walker and Chinigò use the SKA to argue that the "relationship between big astronomy projects and their local, national and global development impacts"[29] needs to be considered, as such projects undoubtedly have a lasting impact on the development of astronomy in the country over time.

On the contrary, scholars like David Baneke suggest that over time "big science" projects have gradually become part of normal science. In other words, what was once seen to be a major development and technological triumph, has now become the norm in terms of astronomical inquiry and outer space research.[30] For example, the construction of the first permanent observatory at the Cape in 1820 was a monumental achievement in science and astronomy during its time. However, over time, the construction of observatories became the

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[27] *Ibid,* p. 3.
[28] C. Walker & D. Chinigò, "Disassembling the Square Kilometre Array: astronomy and development in South Africa" *Third World Quarterly,* 39, 10, 2018, p. 1981.
[29] *Ibid*, p. 1979.
[30] D. Baneke, "Let's Not Talk About Science: The Normalization of Big Science and the Moral Economy of Modern Astronomy," *Science, Technology and Human Values,* 45, 1, 2019, p. 165 – 194.

norm, and in addition, observatories have become larger and more impressive. Consider the construction of the South African Large Telescope (SALT) in Sutherland, South Africa in 2005 as an example. Drawing from a paper published by Buckley, Charles and O'Donoghue, SALT was constructed with the intention of contributing to a variety of research fields in astronomy, astrophysics, and cosmology.[31] Through the support of the South African government's Department of Arts, Culture, Science and Technology (DACST) and South Africa's cooperation with Poland and America, SALT was constructed and was set to "be the largest of its kind in the southern hemisphere, and the second largest in the world."[32]

This contrasting perception explains how certain big projects, such as the SKA and SALT, are classified into a broader theme of "big science", which in turn fits into the overall historiography of science. The concept is based on the idea that "big science" can only be successfully achieved by large international consortiums, with support from government private organisations as well as the input of large teams of scientists, engineers, and managers.[33] While in some instances this is certainly the case, with the Square Kilometre Array being a primary example, however there were other institutions, private observatories and organisations that contributed in other ways to the formalisation and institutionalisation of science and astronomical inquiry, particularly in South Africa. For example, the construction of the first official astronomical observatory at the Cape of Good Hope in 1820, run by only one Royal Astronomer and a small group of technicians is one such institution. One could argue that, viewed within the context of the time in which they occurred, both developments should be considered "big projects" of science because without the establishment of southern Africa's first permanent observatory, the country would not be where it is today within the global astronomical field.

Therefore, one of the main aims of this third historiographical school is to draw attention to both the big, and small, projects of development in the field, which in turn, play a critical role in opening up the astronomical field to a wider variety of participants. The above-mentioned

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[31] D. A. H. Buckley, P. A. Charles, and D. O'Donoghue, "Science with the Southern African Large Telescope," *South African Journal of Science,* 101, 2005, p. 531 – 536.
[32] M. J. Kahn and B. D. Reddy, "Science and Technology in South Africa: Regional Innovation Hub or Passive Consumer?" *Daedalus,* 130, 1, 2001, p. 225.
[33] Baneke, "Let's Not Talk About Science," p. 166.

scholars have written comprehensively on how astronomy and its infrastructural development as integral to the overall promotion and success of the field, in terms of both political and socio-economic development, which the literature review will elaborate on. This thesis seeks to use the discussions featured within this third historiographical school to further the conversation on how the arrival and establishment of colonial influence in southern Africa during the 17th century (particularly in terms of science and astronomy), later resulted in further astronomical developments in the country.

The fourth and final historiographical school this thesis discusses is that which considers how academics, scientists and astronomers are trained in the field of astronomy, particularly from the perspective of it being a professionalised field. This school of thought can be, in some ways, connected to the third school as the development of key observatories, institutions and equipment in the earlier part of the 19th and 20th centuries would have had a profound impact on the level of training received by scholars as well as the overall success of scientific and academic projects in the field later. Peter Martinez features rather prominently in this historiographical school because his paper on building capacity for astronomy research and education in Africa[34] mentions a number of key points that pertain to this school of thought. The first is that astronomy as a scientific discipline requires a high level of professional and political commitment from the country in which it occurs, rather than only relying on the popularisation of astronomy.[35] The second point, which is supported by similar discussions from George Miley and Kevindran Govender, is that the International Astronomical Union (IAU) plays a crucial role in the popularisation of astronomy as well as fosters the mutual communication and cooperation between countries involved in astronomical research programmes. Essentially, this historiographical school supports the notion that the advancement of education and training for professionals in this field is integral to making full use of astronomy as a tool for development.[36]

[34] P. Martinez, "Building capacity for astronomy research and education in Africa," *Astronomy for the developing world IAU Special Session,* 5, 2006.
[35] *Ibid,* p. 89.
[36] G. Miley, "Astronomy for international development," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 539 – 546.

With the above-mentioned historiographical schools in mind, the second phase of research for this thesis focused on investigating a wide range of archival sources including newspaper articles published in the Rand Daily Mail, the archival documents of several local astronomical societies and 'outer space' organisations, as well as other primary historical records obtained at the Western Cape National Archives. This phase of the research process was undertaken to gain a better understanding of how astronomy has developed over time in the country and also to gain insight into the role of astronomical societies, individuals, and other academic groups in the national development of astronomy as a discipline. One of the most informative primary sources is the Astronomical Society of Southern African online archive. The archive contains digital scanned copies of the astronomical handbooks that were published in volumes, called the Monthly Notes of the Astronomical Society of Southern Africa between 1948 to 2003. An investigation of these handbooks is very useful when unpacking the history of the society as these publications provide key insight into who was contributing to the society through the publication of scientific papers, the society's involvement in the transfer of astronomical research, data, and information about celestial discoveries, as well as the progression and advancement of the society's activities.

Finally, the third research phase was carried out by reconstructing the past from oral history. Interviews were conducted with key individuals who have played a significant role in the development of astronomy in South Africa. These individuals include academics in various fields of astronomy, science, and history, both professional and amateur astronomers, as well as some members of local astronomical organisations. The aim of this phase of research was to gather first-hand information from such individuals relating to the nature of astronomical inquiry and how it took shape over time and how individuals contributed to the field, particularly within the academic sphere.

Literature Review

The historiography of astronomy is replete with statements as sweeping as Kevin Donnelley's observation: "Astronomy is a subject so capable in its results… that there is scarcely any age or period of the world in which men [sic] have not… been drawn to it with a strong feeling of interest and awe."[37] This thesis is an effort to move away from such generalities to the specificities of how a discipline develops over time and the various groups that contribute to its development. This literature review aims to gain a clearer understanding of the current schools of thought on the historical development of astronomy in South Africa and how it has come to be recognised as an academic discipline within an internationally connected system. A study of the existing body of literature revealed, unsurprisingly, that the bulk of the literature relates to scientific and technological advances that have occurred in the field over time.

This thesis seeks to locate itself within the broader discussion of historical astronomy development in South Africa. In order to do so, the four above-mentioned historiographical schools need to be investigated further. The first school of thought presents the idea that astronomy developed along 'linear' lines of upward progress, and in some cases, uncritically celebrates the notion of 'Great Man' history. This notion can be explained as an 'old-fashioned' way of writing a particular history – in other words, writing a history from the perspective of a small group of influential individuals who are said, or at least believed to be, those who dominate that particular history and who set the tone for the rest of the world to follow. This kind of history is considered to be 'old-fashioned' because it neglects to reflect on the other groups and individuals who also played a key role in the development of said history. In this case, for example, the first academic and scientific theories about the structure of the universe and the motions of celestial bodies, the chartering of stars and comets, the subsequent development and improvement of the telescope, as well as the gradual reshaping of society's perception of the cosmos are all developments that are largely located within the Western territory of the historiography and are often discussed from a predominantly Eurocentric perspective.

[37] K. Donnelly, "On the boredom of science: positional astronomy in the nineteenth century," *The British Journal for the History of Science,* 47, 3, 2014, p. 484.

Tracing back to the 4th century BCE, the Greek philosopher Aristotle hypothesised that the universe was divided into two realms, namely the sublunar and the celestial.[38] Aristotle's hypothesis was the most predominant idea at the time**,** because many believed that Earth was the centre of the universe, and the universe could only be understood in terms of what it was comprised of. This notion was the foundation for what became popularly referred to as 'Aristotelian cosmology'. As explained by Paul Murdin, Aristotlean cosmology was the most widely believed notion for many people because it described the cosmos, or universe, to be centred around the Earth, which was orbited by the Sun, Moon, other planets, and stars.[39] For many centuries, the belief that God had created the universe and the idea that Earth was the centre of it was the predominant ideology, backed by faith and religion.

Furthermore, Aristotle's explanation of the universe characterised it as finite, something that existed with a beginning and an end, and everything else beyond that was inconceivable.[40] For the first two centuries of European settlement in North America, the teachings of ancient philosophers like Aristotle, who postulated that the Earth was located at the centre of a finite universe, were believed, and followed. Around 500 years later, a Roman-Egyptian mathematician and astronomer Ptolemy, presented a similar theory to Aristotle's theory. It was similar in the sense that Ptolemy attempted to give a "purely mathematical explanation of the motion of heavenly bodies," while Aristotle aimed to explain the world from a physical point of view.[41] According to Fantoli, the development of Ptolemy's theory can be attributed to the earlier "advancements of Greek astronomy [which was] fostered by its relationship to Babylonian astronomy."[42] What these two above-mentioned theories show is that from 384 BC until around 130 AD, Greek astronomers were focused on providing both physical and mathematical explanations for the motions of celestial bodies and Earth's position within the universe. However, there is another aspect of astronomy that pertains to the spiritual connections that people ascribed to it.

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[38] McLaughlin, "Astronomy: Queen of the Specific Sciences," p. 1015.
[39] Murdin. "Introduction: the development of astronomy in Europe," p. 160.
[40] A. Romer, "The Welcoming of Copernicus's *De revolutionibus:* The *Commentariolus* and its Reception," *Physics in Perspective,* 1, 1999, p. 157.
[41] A. Fantoli, *Galileo for Copernicanism and for the Church,* (Italy, Vatican Observatory Publications, 1994), p. 1.
[42] *Ibid,* p. 6.

According to Ronald L. Numbers, the religious connection to cosmological belief for these people was that "God lived not very far away and often reminded the colonists of his power and presence … by sending lightning and earthquakes, comets and meteors, famine and disease."[43] Often frightened by such occurrences, these early groups prayed to and obeyed the teachings of the Bible, which they saw as "the repository of spiritual and temporal truth."[44] For contemporary scholars in this field, it can sometimes be difficult to imagine what the night sky might have meant and symbolised for prehistoric peoples. One possible way to conceptualise it is to acknowledge that it was necessary for these prehistoric groups to understand the changing appearance and movements of the sun, moon, stars, and planets, because having a greater understanding of such phenomena would have given these people "a sense of control and predictability of the physical and supernatural realms [they believed in]." [45] This sort of control and predictability becomes crucial when religion and astronomy are directly linked, because in many instances seasonal changes and times of the year were being accurately recorded for the planning of rituals or religious ceremonies.[46]

Connections between religion and astronomy were of course not limited to the prehistoric period. This can be said as religion and astronomy appear to have worked simultaneously in many ways and with somewhat limited friction, until 1543, when Nicholas Copernicus published his heliocentric theory of the universe. While the heliocentric theory of Copernicus was not the first of its kind, the mathematical explanation he provided with the theory made it a novelty from a scientific standpoint.[47] Copernicus's theory was also controversial in the sense that it was an obvious contradiction of the fundamental principles presented by Aristotelian cosmology. Copernicus based his theory on the notion that Earth is not the centre of the universe, which was contrary to the prior hypotheses of earlier scholars. This caused quite a stir amongst certain groups at the time due to its perceived mockery of Greek learning and philosophical errors that went against the current discourse of the time, as well its incompatibility with certain Biblical texts.[48] Even prior to the emergence of Copernicus'

[43] R. L. Numbers. "Science and Religion," *Osiris Historical Writing on American Science,* 1, 1985, p. 61 – 62.
[44] Numbers. "Science and Religion," p. 61 – 62.
[45] E. Hadingham: *Early Man and the Cosmos,* (United States of America, University of Oklahoma, 1984), p. 5.
[46] D. Leverington, *Babylon to Voyager and Beyond: A History of Planetary Astronomy*, (United Kingdom, Cambridge University Press, 2003), p. 3
[47] Fantoli, *Galileo for Copernicanism and for the Church,* p. 18.
[48] Romer, "The Welcoming of Copernicus's *De revolutionibus:* The *Commentariolus* and its Reception," p. 158.

theory, the relationship between the biblical image of the world and the philosophical and astronomical concepts of the Greeks had been a prominent problem for Christianity.[49] This is because Ptolemy's attempt to present mathematical theories for the movements of stars and planets went against the teachings of Christianity, which postulated that a higher being was in control of these phenomena. For example, one of the greatest Latin church fathers of the 4th century A.D was St. Augustine, who was critical of Greek philosophy and astronomy and believed that scientific research was not a necessary field to pursue for a believer who could rather dedicate his intellectual capacity to matters of faith and Christianity.[50] The relationship between reason and revelation was embodied in Greek philosophical thinking and Christianity, and thus as Edward Grant suggests, a discrepancy between the philosophical disciplines of logical and natural philosophy emerged.[51] The argument here is that there are some truths that are known through reason, while there are others that are not. Saint Augustine was one of many who insisted that revelation was superior to reason and therefore, in this sense, many Christians believed that Greek philosophy and natural philosophy could be used to aid understanding of scripture.[52]

Copernicus's theory of the 16th century contributed to the ongoing dispute between science and religion because "heliocentrism displaced the earth from the centre of the cosmos, transformed the earth into a planet and the planets into earths, and furthermore transformed the stars into suns, which as suns may be orbited by planets."[53] What this notion suggests is that previously held beliefs about Earth being the centre of the universe were thrown into question and the debate surrounding the validity of these ideas was challenged from both sides. When Copernicus made his theory public, there were other scholars and authors who applied various scientific, philosophical, and religious counter arguments against his theory. One such individual was Johannes Kepler, who published his *Astronomia Nova* (which translates to 'New Astronomy') in 1609.[54] This book presented two of three laws on planetary

[49] Fantoli, *Galileo for Copernicanism and for the Church,* p. 12.
[50] Fantoli, *Galileo for Copernicanism and for the Church,* p. 14.
[51] E. Grant, *Science and Religion, 400 B.C. to A. D. 1550,* (United States of America, Greenwood Press, 2004), p. 13.
[52] *Ibid.*
[53] M. J. Crowe, "Astronomy and Religion (1780 – 1915): Four Case Studies Involving Ideas of Extraterrestrial Life," *Osiris,* 16, 2001, p. 210.
[54] Righini, "The telescope in the making, the Galileo first telescoping observations," p. 27.

motions, which are today referred to as *Kepler's Laws*. Kepler had always been perplexed by Copernicus' postulations relating to the heliocentric theory and thus "Kepler was determined to link physical causes to the planetary motions."[55] Over time, revolutionaries like Copernicus and Newton had essentially remodelled the prevailing religious discourse by presenting contrasting ideas about Earth's position in the universe and presenting undisputable natural laws that provided scientific explanations of astronomical and meteorological events.[56] This shift in perspective and understanding of the cosmos is important to mention from the outset because it established the precedent for later academic research in this field.

Fast forward over half a century, and another figure that emerged in (and offered a challenge to) the discussion around the relationship between science and religion was Galileo Galilei. His use and improvement of the newly invented telescope brought about a significant shift in people's understanding and perceptions of the cosmos. While religion had been the predominant driving force behind the study of the universe for centuries prior, it was Galileo's revelations of the solar system in 1609 that reinforced the solar system model that was previously presented by Copernicus in 1543.[57] Galileo's use of the telescope enabled him to formulate a strong opinion that the system of Copernicus was "much more probable" than that of Aristotle and Ptolemy.[58] This once again caused conflict between science and religion because the refinement of telescopes and the subsequent spread of observatories enabled astronomers to discover new celestial objects,[59] and thus brought about significant change to the on-going debate. What is most interesting about this shift in understanding is that European astronomers began to perceive and understand the structure and meaning of the universe differently to how they had interpreted it before. It can be said that the shift in understanding came about when some scholars, theorists and scientists attempted to debunk or reframe the pre-existing narratives of the time, such as Copernicus and Galileo.

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[55] Gingerich, "Kepler, Galileo and the birth of modern astronomy," p. 173.
[56] Numbers. "Science and Religion," p. 62.
[57] Murdin, "Introduction: the development of astronomy in Europe," p. 162.
[58] Fantoli, *Galileo for Copernicanism and for the Church,* (Italy, Vatican Observatory Publications, 1994), p. 59.
[59] W. E. Burns, *Science in Enlightenment: An Encyclopaedia,* (United States of America, ABC – CLIO, 2003), p. 11.

As previously mentioned, popular astronomical practices were largely informed by religious beliefs for many years, and science had not yet become the primary focus of such practices. However, with the onset of the Enlightenment Period in Europe, which took place during the 17th and 18th centuries, astronomy and people's understanding of the sky shifted once again. Over time, astronomy had developed into a thriving discipline and the painstaking observations that were made over long periods of time gave rise to key discoveries and scientific breakthroughs. During this period, many Enlightenment philosophers and scholars were of the opinion that knowledge itself must be constantly improving. Thus, in the case of astronomy, the Enlightenment period gave rise to many significant developments over a long period. As stated by Lorraine Daston, the Enlightenment period scientific observation had reached a turning point, in some senses a climax, because it came to be so significantly integral to most refined scientific practices.[60]

According to Daniel Śpelda, during the age of Enlightenment, "it was already clear that European astronomy was on a higher level."[61] This statement reinforces what the "Great Man" historiographical school argues because it suggests that these above-mentioned 'men of science', as well as some others, were seen to be the ones who made the largest contributions to astronomy and scientific inquiry during this time. While this thesis does not discredit these individuals and their contribution to the field of science, physics, and astronomy, it rather focuses on challenging this school of thought by showing that there were in fact other groups who played a critical role in the overall development of astronomy and those groups need to be considered. Where the development of astronomy in southern Africa fits into this particular discussion is the way in which a form of "Great Man" history was transplanted into southern African society during the colonial period, particularly at the Cape of Good Hope, with the arrival of European settlers. From the early 1600s, astronomy in the Cape region slowly developed to become based on European notions of observation and enquiry, which ultimately resulted in those European astronomical practices and knowledge taking a large majority of the spotlight and praise in the overall discourse of historical astronomical development.

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[60] L. Datson, "Observation and Enlightenment: Introduction: The Age of Observation," *Scholars in Action,* 2, 2013, p. 658.
[61] Śpelda, "The history of science as the progress of the human spirit", p. 56.

A Commonwealth of Knowledge by Saul Dubow discusses the way in which European or Western 'knowledge' was disseminated and institutionalised through the imperial project in South Africa, beginning in the 1820s. A key issue mentioned by Dubow in the fifth chapter of the book relates to how notions of patriotism and pride is communicated to the population by promoting the understanding of science as a 'universal project', one which is endorsed by a shared commitment to the principles of European 'civilisation'.[62] By considering this school of thought, this thesis aims to refute the notion of "Great Man" history and bring about a paradigm shift by introducing another lens of discussion to the ongoing debate. It must be noted that this thesis is certainly not the first to attempt such change. Saul Dubow and William Beinart have done so in a newly published book *The Scientific Imagination in South Africa; 1700 to the present*.[63] This thesis will draw on arguments presented by these scholars, as well as a few others, to locate itself within the developing narrative on this topic.

The second historiographical school investigates the indigenous knowledge and practices that form part of the discussion around cultural astronomy in South Africa. By considering various examples of local traditions, teachings and tales, this historiographical school argues that Westernised practices of astronomy often overshadow those of local, indigenous peoples. Chapter 6 of Helen Tilley's book *Africa as a Living Laboratory*[64] confronts this debate by focusing on the processes of ethnographic research and imperial administration and the effect it has on indigenous knowledge across Africa. Her argument is that colonial interventions are often pursued before a proper understanding of the function and meaning of different social practices is obtained,[65] and as a result, indigenous knowledge systems and practices are left to fall by the wayside or are regarded as insignificant under the looming shadow of colonial knowledge systems. Kevindran Govender also contributes to this school of thought by saying that "indigenous astronomical knowledge in Africa serves as proof of the advanced thinking and observations of our ancestors," while also showing that astronomy belongs to everyone

[62] S. Dubow, *A Commonwealth of Knowledge: Science, Sensibility and White South Africa 1820 – 2000,* (United States of America, Oxford University Press, 2006), p. 206.
[63] Beinart & Dubow, *The Scientific Imagination in South Africa: 1700 to the Present*.
[64] H. Tilley, *Africa as a Living Laboratory*, (United States of America, The University of Chicago Press, 2011).
[65] Tilley, "Chapter 6: An Anthropological Laboratory: Ethnographic research, Imperial Administration, and Magical Knowledge," in *Africa as a Living Laboratory*, p. 261.

and that "it is not something exclusive that can only be enjoyed by the wealthy or the privileged."[66]

Other scholars such as Peter G. Alcock, Elizabeth Green Musselman and Michael Wessels argue that vernacular traditions need to be considered when writing a history of astronomy because these practices and people existed long before colonial influences arrived. In addition to this, Keith Snedegar[67], Johnson Urama and Jarita Holbrook also share similar sentiments with regards to indigenous knowledge and how it is featured in the overall historical narrative in this field. For example, Urama and Holbrook published a paper in 2009, which details the African Cultural Astronomy Project and how it intends to "unearth the body of traditional knowledge of astronomy [of] people [from] different ethnic groups in Africa."[68] Another paper by Wessels[69] discusses the process of how indigenous knowledge is collected and assimilated into the historical narrative, particularly the collection of Bushman folklore compiled by Wilhelm Bleek and Lucy Lloyd in the 1870s. His paper investigates "the process of collection of materials and the relationships between the main players in the colonial context of Victorian Cape Town, the status of the materials … and their interpretation and analysis."[70] The work of Bleek and Lloyd in the late 19th century has subsequently been used by other scholars to support their claims of there being a 'forgotten' native narrative that must be taken into account when discussing indigenous knowledge practices. Bleek and Lloyd came to the Cape, in 1855 and 1849 respectively, and began compiling materials on Bushmen and |Xam language and folklore in 1870.[71] Between 1870 and 1911, Bleek collected over 3 600 pages of notes, while Lloyd successfully collected around 8 400 pages of |Xam material.[72] They achieved this by interviewing local |Xam Bushmen prisoners who had come to live with their family in order to gain insight into |Xam language, folklore and related customs.[73] As a result, Bleek and Lloyd became very well-known anthropologists and

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[66] Govender, "Astronomy for African development," p. 579.
[67] K. V. Snedegar, "Stars and Seasons in Southern Africa," *Vistas in Astronomy,* 39, 4, 1995, p. 529 – 538.
[68] J. O. Urama & J. C. Holbrook, "The African Cultural Astronomy Project," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 48.
[69] Wessels, "New Directions in |Xam studies," p. 69.
[70] Wessels, "New Directions in |Xam studies", p. 69.
[71] A. Barnard, *Anthropology and the Bushmen,* (United Kingdom, Berg, 2007), p. 24 – 26.
[72] *Ibid,* p. 26 - 27.
[73] S. Dubow, "Earth History, Natural History, and Prehistory at the Cape, 1860 – 1875," *Comparative Studies in Society and History,* 46, 1, 2004, p. 127.

linguists during their time at the Cape, a fame that continued long after their deaths. At the time, Bleek was unmatched in his field of academic research during the second half of the 19th century. The publications of Bleek and Lloyd have been digitised and are accessible on the University of Cape Town website.[74] Some of the work by Bleek and Lloyd will be discussed in Chapter 2 as their insight and application of first-hand indigenous narratives are integral to the overall discussion of this historiographical school.

By considering this second historiographical school, this thesis aims to reframe the discussion around astronomical research through an anticolonial historiographical lens, in an effort to bring local, traditional practices and knowledge to the forefront of such discussions. This thesis also seeks to fit in with the ongoing discussion by presenting a different perspective of indigenous knowledge and how it should not be discredited when considering the historiographical development of astronomy. This is because it cannot be ignored that many indigenous, precolonial populations of southern Africa were practicing astronomy and making celestial observations, based on their own spiritual and religious beliefs, prior to the arrival of colonial influences. Thus, their practices and knowledge need to be addressed and included here in order to present a holistic investigation on the historical development of astronomy in South Africa.

The third historiographical school focuses on scientific and technological advances in the field of astronomy. However, it does so from within the academy and with critical awareness of those advances, with careful contextualisation of the achievements in the broader socio-political milieu. For example, scholars such as Peter Martinez[75], Cherryl Walker, David Chinigò and Saul Dubow[76], as well as Patricia Ann Whitelock[77] tend to focus on either the impact of certain technological and infrastructural developments in the field or on the various

[74] The University of Cape Town Online Archive, "Collections, The Digital Bleek and Lloyd Collection", University of Cape Town, 1 June 2005, URL: http://lloydbleekcollection.cs.uct.ac.za.
[75] P. Martinez, "Building capacity for astronomy research and education in Africa," pp. 89 – 98.
[76] C. Walker, "Cosmopolitan Karoo: Land, Space and Place in the Shadow of the Square Kilometre Array," *Journal of Southern African Studies*, 45, 4, 2019, pp. 642 – 662., C. Walker & D. Chinigò, "Disassembling the Square Kilometre Array: astronomy and development in South Africa," *Third World Quarterly,* 39, 10, 2018, pp. 1979 – 1997., & C. Walker, D. Chinigò & S. Dubow, "Karoo Futures: Astronomy in Place and Space – Introduction," *Journal of Southern African Studies*, 45, 4, 2019, pp. 627 – 639.
[77] P. A. Whitelock, "Astronomy in post-apartheid South Africa," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium*, 260, 2009, pp. 587 – 594.

administrative laws and policies that govern local astronomical activities or key astronomical events (such as the observation of rare celestial occurrences and stellar discoveries). While each of these aspects are important to consider when investigating the historical development of astronomy in the country over time, it is also important to explore the discussions surrounding the expansion of astronomy in South Africa from an academic and institutionalised point of view. Speaking from an 'academic point of view' refers to the way in which astronomy is taught and practiced in various academic institutions and used as a tool for scientific and technological development. Such discussions have been attempted by Dubow and Beinart but very few consider how historical developments, largely brought about by colonialism as well as shifts in political power and changes in society, changed the way a discipline was practiced and taught. The way in which this thesis approaches this school of thought is by providing a broader explanation of how the expansion of astronomy, particularly from a scientific perspective, occurred because of an increase in infrastructure and development across the country.

The final historiographical school focuses on the education and training of scientists in this field, particularly at universities and other tertiary institutions, which enabled them to form part of the network of scholars that serve this field. This section of the literature review considers how academics have played a role in the overall development of astronomy in South Africa over time. According to Miley, the accessibility of the sky and the immensity of the universe is inspirational, and it encourages processes of internationalism and tolerance within the field.[78] As Peter Martinez suggests, the role of the International Astronomical Union (IAU) and other educational training facilities are integral to the overall increase in academics in this field and the success rate of their astronomical endeavours. George Miley supports Martinez's first point as he claims that the IAU is responsible for conducting a wide range of activities that are aimed at education and training, with an emphasis on universities and research facilities.[79] This shows that the professionalisation of astronomers, and other scientists related to the field, is one that has been, and continues to be, a wide-spread, globally supported initiative. Thus, the reasoning and motivations behind the investment of resources and capital to this endeavour need to be discussed. Another reason for the inclusion

[78] Miley, "Astronomy for international development," p. 540.
[79] Miley, "Astronomy for international development," p. 543.

of this historiographical school is based on the notion presented by Valls-Gabaud and Boksenberg. Their interpretation of scientific development in the field of astronomy is that it is an ongoing process, which requires a lot of time and resources to be dedicated to it, in order for it to be successful. Their argument is that astronomy should be located at the forefront of knowledge development, due to its multidisciplinary characteristics, thus enabling it to boost the advancement of science and technology simultaneously.[80]

With the above-mentioned historiographical schools in mind, this literature review is divided into various subsections, each considering the research of a handful of scholars and academics who have ventured into this largely unexplored realm of inquiry up until this point and therefore reveals a gap in the literature, which this investigation seeks to fill. Due to the aim and scope of this thesis, it is necessary to locate this investigation between the pre-colonial period up until 1970. This historical period was selected to present a holistic, historiographical dissertation which considers a wider scope of groups and individuals and their activities in this field.

Local traditions of learning

While investigating the historical development of astronomical practice in southern Africa, it was discovered that some of the earliest and most enduring astronomical practices were in fact carried out by a number of indigenous groups in the region. Chapter 2 of this thesis sheds further light on discussions within the second historiographical school, because contrary to popular belief and the conventional historical orthodoxy, various astronomical practices were being carried out many years prior to the arrival of European settlers, mostly by various indigenous southern African peoples. Local groups such as the San, the |Xam and the Khoekhoe, and other precolonial indigenous peoples such as the Nguni-speaking groups of East Africa and the Igbo people of Southern Nigeria, had a variety of practices and beliefs related to celestial phenomena they observed in the sky. This includes monitoring the changing phases of the moon and the identification of constellations, as well as the spiritual association to celestial phenomena. In most instances, the location of certain constellations in the night sky were used for navigation while hunting or for the prediction of seasonal

[80] D. Valls-Gabaud & A. Boksenberg, "The role of astronomy in society and culture," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 6.

patterns. Scholars within this particular historiographical school include Helen Tilley[81], Kevindran Govender, Elizabeth Green Musselman[82] and Michael Wessels. While each of their discussions focus on various contexts of indigenous astronomical practices, the overall argument of each is that such indigenous narratives and knowledge should be reinserted into the existing body of literature, particularly with respect to southern African astronomical practices.

While living under a variety of circumstances, these above-mentioned groups are said to be some of the first to engage in such astronomical activities across the region. One of the first reasons for this is because, for many pre-colonial people, time was perceived through the observation of "a sequence of discrete natural events…"[83] Scholars such as Snedegar, Chukwuezi and Holbrook have written articles on these sorts of practices amongst various indigenous groups. An example discussed by Snedegar refers to the way in which the Igbo people of Nigeria used the phases of the moon to create their calendar. The Igbo calendar has 12 months, and each month of their year has a certain significance and social activity ascribed to it.[84] Chukwuezi states that the third month of the Igbo calendar is the designated period for planting crops, while the fifth month marks the start of the first harvest for the New Year.[85] In a similar sense, the |Xam of the Karoo used the changing phases of the moon to predict rainfall patterns. Their belief was that the position and angle of the crescent of the moon signified whether rain would fall or not. Holbrook and de Prada-Samper conducted interviews with descendants of the |Xam on farms and in towns between 2011 and 2014, and learnt that if the crescent of the moon appeared horizontally, it was believed to be holding water within the crescent. With the changing phases of the moon over time, the moon appeared to shift into a more vertical position in the sky, and thus it was believed that the water being stored within the crescent would pour out and there would be rainfall.[86] This belief of the |Xam can be regarded as a tool for survival, because the rainy seasons would

[81] Tilley, *Africa as a Living Laboratory*.
[82] Musselman, "Worlds displaced: projecting the celestial environment from the Cape Colony," p. 64 – 85.
[83] Snedegar: "Stars and Seasons in Southern Africa," p. 529.
[84] B. Chukwuezi: "The Relationship Between Human Destiny and the Cosmic Forces – a study of the IGBO Worldview," in *African Cultural Astronomy – Current Archaeoastronomy and Ethnoastronomy Research in Africa,* p. 213.
[85] Chukwuezi: "The Relationship Between Human Destiny and the Cosmic Forces", p. 213.
[86] J. Holbrook & J. M. de Prada-Samper, "|Xam skylore of the Karoo Desert, South Africa," *Mediterranean Archaeology and Archaeometry,* 16, 4, 2016, p. 84.

have brought about a change in the indigenous flora and fauna in the areas they occupied. Thus, understanding when rains were expected to fall was crucial for these semi-nomadic groups because it enabled them to plan their movements around the change of the seasons.

In addition, some other early groups of African and South African communities formulated an understanding of the passage of time by considering "the motions of celestial bodies, the maturation of plants and the mating patterns of animals" and the sighting of certain stars and asterisms were believed to signal significant times of the year."[87] This notion can also be seen as a method of survival for these groups because certain times of the year, usually marked by the appearance (or disappearance) of certain celestial bodies, would have signified when it was time to begin preparing for cultivation or harvesting of crops. One such example of this is Orion's Belt. For Zulu people, the rising of Orion's Belt in July, referred to as *Impanbaba*, signalled the beginning of the cultivation season.[88] When Orion's Belt appeared in the sky at this time, it was a common practice for these people to begin their cultivation season, ahead of the heavy rains that were characteristic of the winter season. For some Xhosa-speaking groups, Venus (more commonly referred to as the Morning Star) was perceived as a sign that "dawn was coming" and that "those going to the fields to plough or plant, [needed] to prepare for the new day."[89] This can be regarded as a tool used for the perception of time and how much time in a day is needed to complete certain tasks, such as ploughing or planting seeds. Similarly, there were certainly some Swazi-speakers who paid close attention to two stars, namely the Morning and Evening Stars as the definitive beginning or ending of a day.[90] What these examples suggest is that, without access to any form of modern-day technology, such as a clock or sundial, these indigenous peoples applied celestial observations to the perception of time and for survival purposes. Further discussion on each of these groups and their astronomical practices is located in dedicated sub-sections of Chapter 2 as the main purpose of this chapter is to give a sense of how different groups used the night sky and their interpretation of the cosmos to survive.

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[87] Snedegar: "Stars and Seasons in Southern Africa," p. 529.
[88] *Ibid,* p. 534.
[89] P. Alcock: "The Stellar Knowledge of Indigenous South Africans," a chapter in *African Indigenous Knowledge and the Sciences,* G. Emeagwali and E. Shizha (eds.), p. 126.
[90] *Ibid,* p. 124.

These sorts of beliefs and practices are often characterised under the term 'Cultural astronomy' - which can be defined as "the use of astronomical knowledge, beliefs or theories to inspire, inform or influence social forms or ideologies…"[91] or alternatively as ethnoastronomy, which is defined as "the branch of astronomy [that is] concerned with the astronomical beliefs and practices of specific cultures."[92] Therefore, many African cultural astronomy studies have revealed a wide variety of mythic figures and cosmological ideas, each of which are based on the observation of celestial bodies.[93] Such observations include the rising and setting of the sun, the appearance or disappearance of certain stars at particular times of the year or the periodic appearance of planets, usually seen in the morning or evening.[94] Scholarly studies also suggest that for the |Xam of southern Africa, the sun, moon and stars were interpreted differently. Their belief was that these celestial bodies were in fact brought into being by the actions of their ancestors who once lived on Earth. For example, it was said that "… the sun was [once] a man, while the moon … had been a feather or a leather shoe, both once alive, [that was] thrown aloft," perhaps by an ancestor of the past.[95]

The on-going debate amongst scholars in this historiographical school is also important to mention as there are some cases where scholars believe that the astronomical knowledge and practices of indigenous peoples are not being effectively discussed. For example, Peter Alcock's 2014 *Venus Rising* focused on how various African groups ascribe different meanings to celestial bodies and events. While the book is considered to be a useful contribution to the ongoing debate on this topic, there are some scholars who think that more should be said to broaden contemporary scholars' understanding of these indigenous notions. One of the most outspoken on this issue is Keith Snedegar. Snedegar who reviewed *Venus Rising*[96], praising Alcock for presenting a "thorough compilation of what has been, to present, a fragmented and incoherent body of material", but also simultaneously criticising him for

[91] Urama & Holbrook, "The African Cultural Astronomy Project," p. 48.
[92] J. Holbrook, "Astronomy, Indigenous Knowledge, and Interpretation: Advancing studies of Cultural Astronomy in South Africa," *Journal of Astronomy in Culture,* 1, 1, 2016, p. 1.
[93] Urama & Holbrook: "The African Cultural Astronomy Project,", p. 48.
[94] S. C. McCluskey, "Traditional Astronomical Concepts: Linking Space, Time, and Culture," *Archaeoastronomy,* 23, 2010, p. 11.
[95] J. Parkington, D. Morris & J. M. de Prada-Samper, "Elusive Identities, Karoo |Xam Descendants and the Square Kilometre Array," *Journal of Southern African Studies,* 45, 4, 2019, p. 732 – 733.
[96] Alcock, *Venus Rising.*

not offering sufficient discussion on the "value or meaning of indigenous astronomy."[97] This thesis hopes to address this lacuna.

Snedegar's work in this field is somewhat different to Alcock's in the sense that Snedegar's aim is not only to inform others about indigenous knowledge and practices in astronomy and cosmology, but also to shed further light on the importance and value of including indigenous astronomical narratives in the overall historiographical discussion. While Snedegar is not the only scholar to share this view, the contrasting argument he makes cannot be ignored because it plays a crucial role in the promotion of indigenous narratives as integral parts of the history of astronomy, particularly in southern Africa. This thesis therefore seeks to contribute to this ongoing debate by discussing the activities of certain African groups in later chapters.

Colonial influences

While some indigenous groups are considered to be the pioneers of astronomical practices in southern Africa during the pre-colonial period, there were a number of significant changes that occurred in terms of approaches to astronomy during the mid-1600s. Drawing on notions presented in the first historiographical school, chapter 3 of this thesis focuses on the arrival of Dutch East India Company (VOC) settlers in 1652, under the command of Jan van Riebeeck, and the effect that their arrival had on astronomical development in the region. In doing so, chapter 3 discusses the various individuals and developments that took root at the Cape and within the broader regions of southern Africa, each bringing their own contribution to the overall development of 'westernised astronomy' in southern Africa. Chapter 3 seeks to address, as well as argue against, some of the discussions within the first historiographical school, which pertains to the notion of "Great Man" history. The reason for this is because there are a number of linkages that one can draw between the teachings of Aristotle, the subsequent challenges to popular opinion by Galileo and Copernicus, and the arrival of European astronomers at the Cape in 1652.

After its foundation in 1602, the Dutch East India Company (VOC) had grown to control much of the trade in the East Indies. This area of control included parts of Africa, South

[97] K. Snedegar, "Comment and Review: Venus Rising: Cultural Astronomy in Southern Africa," *Monthly Notes of the Astronomical Society of Southern Africa,* 73, 9 & 10, 2014, p. 250 – 252.

America, and the Caribbean, extended into parts of Asia such as China and Japan, as well as established control centres in India and Indonesia. With this increasing scope of dominance, it soon became necessary for the Company's ships to make regular stops to restock their ships with food and other supplies. While Dutch East India Company ships had been stopping in Table Bay at the Cape from as early as the 1590s, settlers only formally settled down in the mid 1600s. The main purpose of these early stops was "to take on fresh water and … barter [for] livestock with the local Khoikhoi" before sailing on.[98] As the power and influence of the VOC continued to increase so did the number of ships that were passing the most southern tip of Africa. For example, "during the latter half of the seventeenth century, [approximately] 33 Dutch ships stopped over in Table Bay per year," which ultimately led to VOC officials deciding that there was a need for a more permanent settlement at the Cape of Good Hope.[99] On 7 April 1652, Van Riebeeck arrived at the Cape, armed with the task of carrying out his "role of founder of the first permanent European settlement at the Cape."[100] The Dutch settlement at the Cape of Good Hope developed fairly quickly after their arrival as "…a castle was built, a town [was] established, and a great hedge of wild almonds … was planted to mark off the settled area."[101] After the initial objective of the VOC was achieved, other aspects of social, cultural, and intellectual life slowly started developing. One such example is science and astronomy. Under the first Dutch influence, astronomy was not the primary business of the settlers, however "…when something striking like a comet was observed it was usually noted in the official journal."[102]

However, the Dutch were not the only foreign influences on astronomy in southern Africa during the 16th and 17th centuries. The first British occupation of the Cape, between 1795 and 1803, saw astronomy slowly begin to rise in the ranks of imperial influence. This is because the historiography of astronomy, particularly during this period, reveals that there was a significant change in people's perception and understanding of science, specifically in relation to astronomy. According to Daniel Śpelda, the astronomical and scientific successes

[98] S. Pooley, "Jan van Riebeeck as Pioneering Explorer and Conservator of Natural Resources at the Cape of Good Hope (1652 – 62)," *Environment and History,* 15, 1, 2009, p. 8.
[99] *Ibid,* p. 10.
[100] Pooley, "Jan van Riebeeck as Pioneering Explorer and Conservator of Natural Resources at the Cape of Good Hope (1652 – 62)," p. 10.
[101] D. S. Evans, "Historical Notes on Astronomy in South Africa," *Vistas in Astronomy,* 9, 1967, p. 268.
[102] Evans, "Historical Notes on Astronomy in South Africa," p. 268.

during the 16th and 17th centuries set the tone for the future progress of astronomy, because it progressed into a more "contemporary science."[103] This is explained by Śpelda as "astronomy was no longer considered to be the revelation of the hidden mathematical order of the world authorise by God,"[104] it was rather a gradual reshaping of perspectives and opinions in terms of human reason. In the case of the Cape Colony, the influence of British occupation at the Cape is said to have only become more evident in the years after the British reconquered the Cape colony from the Batavian Republic in 1806.[105] Astronomical studies became formally institutionalised with the establishment of the Royal British Observatory in the Cape Colony in late October 1820.[106] As Elisabeth Musselman noted: "Astronomy has [since] been recognized as a tool of empire. Its service to navigation and geography have made it indispensable to European expansion."[107]

The establishment of the Royal Observatory at the Cape was the first major scientific endeavour in this field in southern Africa. This is because the Royal Observatory came to be seen as a symbol of the Cape's increasing presence in the global system of empire and the exchange of knowledge. An investigation into archival sources at the Western Cape Archives, provide evidence of the first correspondence letter sent from the Secretary of State of London, dated the 31st of July 1820. The letter requests that "a piece of ground, of the expense of the Colonial Government, be allotted for the erection of an Observatory, at the Cape of Good Hope"[108] The letter states that where an Observatory is to be established is one which "the Astronomer whom the Lords of the Admiralty propose[s] to send out may deem fit and eligible."[109] This therefore indicates that plans to construct an observatory at the Cape were already in motion in mid-1820. Later correspondence, sent from Downing Street on the 20th of September 1839 by Major General George Napier, gives further insight into the

[103] Śpelda, "The history of science as the progress of the human spirit: the historiography of astronomy in the eighteenth century," p. 49.
[104] Śpelda, "The history of science as the progress of the human spirit: the historiography of astronomy in the eighteenth century," p. 49.
[105] M. Godby, "'To do the Cape': Samuel Daniell's representation of African peoples during the first British occupation of the Cape," *Journal of Historical Geography,* 43, 2014, p. 29.
[106] L. L. Leeuw & J. Holbrook, "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," p. 241.
[107] E. G. Musselman, "Swords into Ploughshares: John Herschel's Progressive View of Astronomical and Imperial Governance," *The British Journal for the History of Science,* 31, 4, 1998, p. 419.
[108] KAB GH 1/26, 322 Erection of an Observatory at the Cape of Good Hope 1820.
[109] KAB GH 1/26, 322 Erection of an Observatory at the Cape of Good Hope 1820.

discussion around the establishment of a magnetic observatory at the Cape. The letter states "Her Majesty's Government having resolved to take measurements for the erection of a Magnetic Observatory at the Cape of Good Hope, I have to instruct you to appropriate a piece of ground in a suitable location as the site of such observatory."[110]

Archival sources show that a letter of correspondence was sent from the Governor of the High Commissioner, Hercules Robinson, to Joseph Chamberlain on the 13th of July 1895, which acknowledges discussions around the "establishment of a meteorological and magnetical observatory."[111] This letter indicates that conversations had been taking place between state departments in Britain and South Africa and once a suitable site was selected, the construction of the Observatory was completed in 1828. The first astronomical activities carried out at the Observatory were mostly practical and focused on "…navigation, meteorology, time-keeping, tidal observations, hydrography and boundary mapping…"[112] This gradually changed over time as knowledge and technology improved, however at that time the Observatory was seen to be intricately linked to the formalisation and institutionalisation of astronomy in the Southern Hemisphere, the success of which was maintained through a close link with similar establishments in the Northern hemisphere. The Royal Observatory at the Cape drew a variety of separate places into the European sphere of influence, particularly through developments in science and empirical observation.[113] Walker et al suggest "the roots of the modern science of astronomy… lie in South Africa's much more recent colonial past."[114] This can be further substantiated by the fact that the development of astronomy in the 19th century was "…deeply implicated in the project of British imperialism regionally and globally, with a primary function of … [advancing] applied science related to maritime navigation, time-keeping and terrestrial surveying and mapping."[115] This theme will be discussed in greater detail in Chapter 3, as this chapter draws

[110] KAB GH 1/131 2056 Papers Received from Secretary of State London: General Despatches. Requiring assistance to be given to the officer proceeding to the Cape for the Erection of a Magnetic Observatory 1839.
[111] KAB GH 23/40, 95 General Despatches. Regarding Establishment of a Meteorological and Magnetical Observatory 1895.
[112] S. Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," *Journal of Southern African Studies,* 45, 4, 2019, p. 664.
[113] J. McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," *The British Journal for the History of Science,* 46, 3, 2013, p. 391.
[114] C. Walker, D. Chinigò. & S. Dubow, "Karoo Futures: Astronomy in Place and Space – Introduction," *Journal of Southern African Studies,* 45, 4, 2019, p. 629.
[115] *Ibid.*

on discussions made by scholars such as Saul Dubow and William Beinart who all share a similar model regarding the development of astronomy at the Cape, and while it is not one to be ignored or discredited, the study aims to extend this model by furthering the investigation into the way in which colonial astronomy contributed to the later development of astronomical studies in universities and tertiary institutions, ultimately resulting in the professional development of the discipline over time.

Astronomical societies of the early 20th century

While Dubow contends that the establishment of the Royal British Observatory at the Cape of Good Hope should be considered as a defining moment in the development of astronomy in South Africa, other scholars claim that the early formation of local astronomical societies and research groups, particularly those formed during the early 20th century, were also influential in this process. There were a number of influential local astronomical societies that emerged during the early 20th century, some of which have survived up until the present. One of the earliest localised astronomical societies was the Astronomical Society of Southern Africa, which was formed in 1922.[116] Over time, this particular society contributed greatly to the promotion of astronomical studies within the country and abroad. Members of the society were involved in the publication of astronomy handbooks, some of which are preserved in the Astronomical Society of Southern Africa's online archive. These publications were usually released annually and covered a wide variety of topics relating to astronomy. Fields of interest include the charting of stars, observation of meteors and the delineation of planetary and celestial body movements. The online archive features digital copies of these handbooks, beginning in 1946 up until 2003. As the online archive is limited, it is not yet known whether or not any further publications were released after 2003, however the handbooks that are available provide some key insight into the activities carried out by the society and its involvement in the transfer of astronomical research, data, and information about celestial discoveries.[117] The Journal of the Astronomical Society of South Africa is another good example of how information was disseminated amongst members of the society. In a journal

[116] The Astronomical Society of South Africa, *Constitution and Bye-Laws*. Cape Town: Townsend, Taylor, and Snashall Printers, 1922, p. 1.
[117] Handbook for 1948 of the Astronomical Society of South Africa, 1948, p. 1 – 19. Available from: http://assa.saao.ac.za/sections/history/assa-archive/publications-of-the-astronomical-society-of-southern-africa/#handbook.

published in April 1924,[118] there is an article published by Mr. W. M. Worssell, which discusses the observation of variable stars and the various methods that can be used.[119] Therefore, it can be said that the publication of journals and handbooks played a significant role in the sharing of astronomical knowledge and expertise amongst both professional and amateur astronomers.

Some years after the establishment of the Astronomical Society of Southern Africa, other local space-related organisations began to emerge. Two examples include the South African Interplanetary Society, established in 1953, and the South African Rocket Research Group, established in 1959.[120] While almost no information exists on the South African Interplanetary Society, a few scholars have written on the South African Rocket Research Group (SARRG.) Since the SARRG was established, the group was involved in the construction and testing of various aerospace rockets, which could potentially have been used in astronautic expeditions. Gottschalk also states that during its time in operation, the group launched '528 rockets and conducted 102 static firing tests.'[121] While these developments did not specifically influence astronomy in South Africa in particular, they do however show that local amateur groups were influential in the explanation and exploration of outer space. At the time, this was an impressive achievement for a group of amateur rocket scientists, and it emphasises the need to further investigate how the activities of such organisations contributed to the overall development of astronomy and outer space-related activities in South Africa, as well as the facilities and collaborations that were associated with those activities.

In addition to the innovations and scientific advances made by the South African Rocket Research Group, this group of amateur rocket scientists also gave South Africa an opportunity to secure connections with other science and outer space-related organisations. This is due to the fact that the level of interest expressed by its members did not go unnoticed, especially amongst international space exploration organisations. One example

[118] The Journal of the Astronomical Society of South Africa, 1, 3, 1924, p.73 – 99. URL: https://assa.saao.ac.za/wp-content/uploads/sites/23/2015/01/assaj_v1_n3_1924-Apr.pdf.
[119] W. M. Worssell, "The Observation of Variable Stars," *The Journal of the Astronomical Society of South Africa*, 1, 3, 1924, p. 75 – 77.
[120] T. Waetjen, "Sputnik From Below: Space Age Science and Public Culture in Cold War Southern Africa," *Interventions,* 18, 5, 2016, p. 692.
[121] K. Gottschalk, "South Africa's space programme – Past, present, future." *Astropolitics,* 8, 1, 2010, p. 36.

was the group's involvement in various astronomical examinations at the Hartebeeshoek Testing Site throughout the 1960s, as their involvement captured the attention of the National Aeronautics and Space Administration (NASA) in the United States. In his article, Gottschalk discusses how amateur space enthusiasts and rocket scientists, who were also members of the Astronomical Society of South Africa, participated in NASA's project '*Moonwatch.*'[122] According to Gottschalk, the project was carried out over a period of ten years, from 1957 to 1967, and focused primarily on the tracking and timing of satellites that are in orbit, while also contributing to gaining a better understanding of "…solar-terrestrial physics, new satellite data, and advances in communication…"[123] This project further facilitated the sharing of research and astronomical data between local and international groups, which in turn would have enabled South Africa to move up in the ranks as a significant contributor to the global astronomical and outer space exploration industry. Peter Martinez supports this by claiming that the development of a Deep Space Station at Hartebeeshoek in the 1960s, one which was initially commissioned by NASA, should be regarded as an important development because the station "…supported a significant number of lunar and planetary exploration missions…"[124] In addition to this, the Hartebeeshoek facility was designed to "support interplanetary robotic missions..."[125], which further emphasises the importance of the facility, as it was one of the first of its kind in the country.

Therefore, the establishment of astronomical observatories and institutions will be discussed in Chapter 3, with the major themes being the influence that Western practices and institutions had on astronomical practices in southern Africa. The main theme includes the establishment of the Royal Observatory at the Cape of Good Hope in the 17th century as well as the gradual rise in independent astronomy at the Cape subsequent to that. Chapter Four focuses specifically on localised developments in astronomy, such as the establishment of national observatories and institutions, aimed at furthering South Africa's potential in the field. This section focuses on the Transvaal Observatory, and later the Union observatory.

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[122] Gottschalk, "South Africa's space programme – Past, present, future," p. 36.
[123] *Ibid.*
[124] P. Martinez, "The development and initial implementation of South African's national space policy," *Space Policy,* 37, 2016, p. 31.
[125] Waetjen, "Sputnik from Below": Space Age Science and Public Culture in Cold War Southern Africa," p. 692.

Essentially, the aim of this chapter is to show how local developments were contoured by new knowledge from abroad that was applied in a southern context. The formation of local astronomical and outer space related research groups, and the publication of astronomical journals and catalogues are discussed in Chapter 5. The main themes include the Astronomical Society of Southern Africa, the South African Astronomical Observatory, and the fostering of international collaborations in the field. The reason these groups are important to mention is because each one made its own contribution to the growing academic interest in astronomy overtime. Also, the connections between local groups and international institutions such as NASA also prove that astronomy developed into a lot more than a hobby or leisure pastime.

The link between all these various factors come together in Chapter 6, which looks into how astronomy became formally recognised as an academic discipline in South Africa. While astronomy and various complimenting subjects had been taught amongst amateurs and professionals as courses in local astronomical societies from as early as 1929, the first formal course in Astronomy taught at university level was in the late 1950s, as part of the science department at the University of Cape Town. In 1957, the director of the university was appointed as the honorary professor of astronomy at the university, and this development can be regarded as the first step in the direction of establishing a full-time astronomy department.[126] In the 1970s, a dedicated Department of Astronomy was established at the University of Cape Town. This is an important theme to mention within this thesis as it was a defining moment in astronomic and scientific circles in South Africa because it brought about an entirely new age of exploration and excitement for aspiring students. Chapter 6 argues that astronomy should be perceived as an important scientific endeavour. Drawing on the argument presented by Valls-Gabaud and Boksenberg, the practice of astronomy is at the cutting edge of knowledge and thus it should be used as a tool for development to boost the advancement of science and technology.[127]

[126] J. D. Fernie, "The Teaching of astronomy in South African universities," *MNASSA: Monthly Notes of the Astronomical Society of South Africa,* 18, 10, 1959, p.148.
[127] Valls-Gabaud & Boksenberg, "The role of astronomy in society and culture," p. 6.

In conclusion, this literature review has shown that with the interconnections between individuals, institutions and international bodies, the increasing interest in the subject and the development of astronomy in South Africa during the 18th and 19th centuries is closely linked to the introduction of astronomy as an academic discipline in the 20th century. In addition, this literature review has shown how different perspectives and interpretations by different scholars can be used to formulate the argument that indigenous, vernacular narratives are just as important to mention in the broader academic narrative. While the above mentioned scholars and their contrasting opinions on various historiographical applications are useful to draw inspiration on, there is still room for this thesis to present an alternative perspective into the historical development of astronomy in South Africa, by comparing and contrasting the arguments of others to show the discrepancies and advantages of having such a discussion in present times.

Chapter Two: "Looking to the Southern Stars" – Archaeoastronomy and indigenous astronomical practices in southern Africa.

For millennia, human beings have been captured by a curiosity to understand the cosmos. It is almost impossible to pinpoint exactly *when* human beings first turned their faces to the sky with questions about unexplained celestial phenomena and in some instances, their very existence. However, despite this, the general consensus appears to be that humans have long had the desire to better understand the world, and for some the universe, in which we exist. Historical interpretations of outer space and celestial phenomena have been generated through the observations and practices of different people from different places and spaces. This supports the notion that while spending a great deal of time pondering the peculiarities of the physical environment, to exploring various biological and ecological occurrences, there is no doubt that as a species, our fascination with the sky plays a fundamental role in how we interpret our place in the universe.

This chapter explores the existing historiography of indigenous peoples, the developing understanding of ethnoastronomy or cultural astronomy and also considers how certain indigenous astronomical practices were influenced by, and in turn also influenced, the introduction of European practices relating to astronomy. As mentioned previously, this chapter attempts to challenge the argument that astronomy developed on a linear model, one which is often portrayed to be directly linked to European influence. Through the use of case studies particular to the indigenous peoples of southern Africa, this chapter attempts to address the fact that knowledge also comes from 'nameless people' and that it is something which is accumulated over time from a variety of different peoples and locations. This chapter aims to highlight the way in which certain indigenous societies played a crucial role in laying the foundations for astronomical and cosmological practice, and yet some have been neglected in the overall historiographical narrative.

This chapter is divided into three sections, each of which discusses a different phase of development. The first sub-section begins by offering a context outside of southern Africa, in

order to introduce the study of archaeological astronomy. This section refers to some of the earliest known practices of astronomy, some of which date back to the 2nd millennium BCE. This notion is outlined from the outset as it contextualises and provides a rough starting point of the development of astronomy, from which the rest of the chapter will follow. The second sub-section discusses the notion of 'Ethnoastronomy' and takes a closer look at the specific cultural significance of astronomy, particularly from the perspective of two local African societies. The third sub-section then focuses its attention on southern Africa in particular and considers the various culturally connected cosmologies and activities of indigenous southern African societies, namely the San Bushmen of the Cape and the |Xam Bushmen of the Northern Cape. This section also introduces the idea that, to some extent, the cultural connections, and perceived cosmologies of these three groups became 'westernised' as a result of colonial influences that infiltrated the sub-continent during the mid to late 1600s. It is hoped that, by looking at these three phases in the following subsections, a clearer timeline of the development of indigenous astronomical interest in southern Africa can be constructed.

Archaeological Astronomy

The study of archaeological astronomy, also referred to as archaeoastronomy, has only recently emerged as an academic subject and has since drawn the attention of a wider audience of scholars. Archaeoastronomy can be defined as an "interdisciplinary field… [that] seeks evidence from the written as well as the unwritten record to shed light on the nature and practice of astronomy and timekeeping in ancient civilisations."[128] The process involves the investigation of traditional astronomical practices that originated from various ancient civilisations. This form of research looks at "written records, oral histories and iconography", as well as the study of the history behind the construction of specialised architecture that suggests ancient knowledge of the sky.[129] Jarita Holbrook presents the notion that archaeoastronomy can be divided into two academic camps, each of which consider the differences in the study of archaeoastronomy in two different global regions - namely the

[128] A. F. Aveni, "Archaeoastronomy in the Ancient Americas," *Journal of Archaeological Research,* 11, 2, 2003, p. 149.
[129] *Ibid*, p. 150.

"Old World" and "New World".[130] This concept was first suggested by Anthony Aveni in 1989[131], however Holbrook brings it back into more recent discussions by saying that Old World archaeoastronomy focused on the "study of astronomical alignments in ancient monuments and megaliths," particularly in Europe, and was reliant on "archaeological record and statistical analysis of sites."[132] Alternatively, "New World" archaeoastronomy focuses on living indigenous cultures and relies heavily on historical and ethnographic records, as well as anthropological studies.[133] What these two camps indicate is that there is not just one simplified way of studying ancient practices and their implications.

As impressive as this sounds, tracing the development of astronomical studies from the ancient world to the modern era is no simple task. A number of scholars have attempted to do so, however the biggest challenge they face is accessing sufficient information concerning ancient astronomical activities in various locations. Prior to the introduction of archaeoastronomy in the 1970s, the study of ancient astronomical practices was limited. This is because, in most cases, early astronomical activities were carried out by members of traditional agrarian societies, thus knowledge and experiences were seldom written down or recorded. In fact, stories of astronomical observations and practices were generally passed on via oral histories, folklore, and myths. The result of this is that researchers had very little physical evidence on which to base their assumptions. A large majority of research carried out before the turn of the 20th century relied on limited oral sources and the investigation of traditional mythology, thus there was almost no scientific proof pertaining to the practices being carried out nor any further explanation of their purpose. This all changed with the emergence of archaeoastronomy, as a number of significant studies into the development of ancient astronomy have now been done. While focusing its attention on various case studies drawn from the "New World" archaeoastronomy camp, this subsection briefly discusses the development of archaeoastronomy over time and demonstrates how this branch of research

[130] J. Holbrook, "Astronomy, Indigenous Knowledge, and Interpretation: advancing studies in Cultural Astronomy in South Africa," *Journal of Astronomy in Culture,* 1, 1, 2016, p. 2.
[131] A. F. Aveni, "Introduction: whither archeoastronomy?," *Archaeoastronomy,* 1989.
[132] Holbrook, "Astronomy, Indigenous Knowledge, and Interpretation," p. 2.
[133] *Ibid.*

has contributed to gaining a clearer understanding of the origins of astronomy in the ancient world.

Some of the earliest historical records of astronomical observations and the recording of celestial data can be traced back to early civilisations in India, Babylonia, Greece, Egypt, and the Far East.[134] The first known physical evidence of ancient astronomical practice originated in Babylonia. Babylonian clay tablets inscribed with information relating to 'phenomena in the sky' date back to the 2nd millennium BCE.[135] The discovery and excavation of these clay tablets suggests that Babylonians were one of the very first ancient civilisations that kept physical records of astronomical observations. The translation of these tablets revealed valuable evidence of the significant advancements made by the Babylonians in their study of the skies and thus encouraged further archaeological investigations to take place in other parts of the world.

The study of the astronomical practices of the ancient Babylonians in Mesopotamia is just one example that shows the high importance of archaeological astronomy. One could argue that research into these early astronomical practices began with a largely "Old World" approach to archaeoastronomy as the discovery of nearly 300 cuneiform clay tablets in Babylon at the end of the 19th century came to be one of the most valuable discoveries in the field of archaeoastronomy, however it can also be said that the later analysis and interpretation of these texts, from a historical and anthropological perspective, falls into the "New World" approach, because it has significantly increased our knowledge of ancient astronomy that took place during the late Babylonian period.[136] These clay tablets proved to be very useful to both archaeologists and historians because their contents revealed that "Babylonian astronomers made important observations in the service of religion, and carefully recorded them."[137]

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[134] P. K. Seidelmann, "A History of Western Astronomical Almanacs," *Journal of Astronomical History and Heritage,* 22, 1, 2019, p. 93.
[135] H. Hunger, "The relation of Babylonian astronomy to its culture and society," p. 62.
[136] D. Leverington, *Babylon to Voyager and Beyond: A History of Planetary Astronomy*, (United Kingdom, Cambridge University Press, 2003), p. 5.
[137] F. Rochberg, "A consideration of Babylonian astronomy within the historiography of science," *Studies in History and Philosophy of Science,* 33, 2002, p. 665.

Leverington states that these tablets were used to predict the movement of the sun and the moon, which thus enabled the Babylonians to create their own calendar.[138] The study of such artefacts, texts, and concepts in the field of archaeoastronomical research shows, particularly in the case of ancient Babylon, that these ancient artefacts are some of the last few remaining pieces of evidence relating to the astronomical practices of these people.

Other investigations into ancient astronomical practices have led archaeologists and historians to also turn their attention to the role of the ancient Egyptians in the development of astronomy. Based on a variety of physical and written sources, the ancient Egyptians had a profound interest in the sky as well as an impressive talent for observing celestial phenomena.[139] Such talents can be seen in their use of lunar calendars and star clocks. This can be said as their initial interest in celestial events was mainly for time keeping and calendar development. Research into the formulation of Egyptian calendars reveals that, between 3200 – 3000 B.C., Egyptians used a lunar calendar. The lunar calendar was formulated by aligning the beginning of their new lunar month with the day that the crescent of the moon from the previous month could no longer be seen.[140] Another indication was the orientation of Egyptian tombs and pyramids towards the north, as well as the decorations found in temples built during the Ptolemaic period (around 300 BC). Some scholars propose the idea that "temples were constructed in strict relation to stars… [and]… like the pyramids, must be taken as indicating astronomical knowledge."[141] These physical structures and their orientation might provide an indication of the advanced state of Egyptian astronomy and their knowledge of the sky being applied to everyday life.

Star clocks were used from as early as the 24th century B.C.[142] The way a star clock was used by the ancient Egyptians was by the regular recording of the rising of certain stars, or groups

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[138] Leverington, *Babylon to Voyager and Beyond: A History of Planetary Astronomy*, p. 6.
[139] R. A. Parker, "Ancient Egyptian Astronomy," *Philosophical Transactions of the Royal Society of London, Series A, Mathematical and Physical Sciences,* 276, 1257, 1974, p. 51 – 65; E. Theodossiou. & V. N. Manimanis, "The Eternal Role of Astronomy in History and Civilisation, *Advances in Hellenic Astronomy during the IYA09 ASP Conference Series,* 424, 2010, p. 475 – 476.
[140] Parker, "Ancient Egyptian Astronomy," p. 52.
[141] J. N. Lockyer, *The Dawn of Astronomy: A study of the temple-worship and mythology of the Ancient Egyptians,* p. 14.
[142] Parker, "Ancient Egyptian Astronomy," p. 53.

of stars, at 12 intervals during the night.[143] What this subsection shows is that these ancient interpretations of time were still valuable and useful to these population groups, and only shifted to being more scientific much later on. Thus, these practices became linked to more advanced scientific explanations during the late 15th and early 16th century, which provided evidence that time was a factor of the Earth's rotation and the way in which the Earth travels around the Sun. While these scientific explanations were not yet known to the ancient Egyptians, nor were they known to any other groups of people, (at least not until the emergence of influential individuals like Copernicus and Galileo during the age of Enlightenment), there were other groups who practiced astronomy in other contexts and in different regions across the globe in the pre-Enlightenment period, particularly in Africa.

African Ethnoastronomy

Having considered Babylonia and Egypt as primary examples of some of earliest, ancient traces of astronomy amongst humans, there is also a need to consider other forms of astronomy that emerged subsequent to that. This is because one cannot simply assume that Babylonia and Egypt were the only early human civilisations engaging in astronomy. Therefore, this subsection turns its attention to astronomical practices of two groups in Africa, namely the Igbo people in Nigeria and the Southern Nguni. This section aims to show how the location and culture of different groups of people, particularly those in Africa, might influence their interpretation and interaction with the stars.

Human fascination with the stars has been studied by many, in an attempt to ascertain how astronomy developed from "the ancient world as a system of theoretical knowledge,"[144] to "a unique combination of science, technology and culture."[145] A more specific branch of academic research that considers the way in which traditional communities engage with astronomy is known as ethnoastronomy. It is defined as "the branch of astronomy [that is] concerned with the astronomical beliefs and practices of specific cultures."[146] What most studies in this branch of academic inquiry suggest is that such astronomical practices were carried out for two reasons. The first is because isolated groups of people living in remote

[143] *Ibid,* p. 54.
[144] A. Pannekoek, *A History of Astronomy,* (New York, Dover Publications Inc, 1961), p. 13.
[145] G. Miley, "Astronomy for International development," *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 539.
[146] Holbrook, "Astronomy, Indigenous Knowledge, and Interpretation," p. 1.

places had access to pollution-free skies, thus making the study of the sky and stars a possibility.[147] This notion is largely informed by the assumption that the remoteness of these people was beneficial to the success of their astronomical practices, because there is no interference from artificial lights and because they usually live outside of large, expanding cities, away from the growing population. Therefore, many African groups have been able to make astronomical observations and predictions by looking up at the night sky, long before the telescope was invented.

The second reason is that astronomical practices and celestial observations were often practiced out of necessity and for the survival of these communities. Paul Baki claims that the development of indigenous astronomical knowledge is often a result of the need to understand and predict seasonal weather changes, or navigation.[148] As many early rural African communities relied on agriculture and subsistence farming for survival, as well as travelling from place to place on foot, this necessity to survive provides some explanation as to why such societies depended so heavily on the sky. To provide further contextual evidence for the expansion of ancient cultural astronomy in Southern Africa, the following sub-section briefly discusses ethnographic case studies of two indigenous African groups in order to compare and contrast cultural astronomy practices of African societies over time. The case studies in this subsection include the Igbo people of Nigeria and the Southern Nguni of southern Africa.

The Igbo

For the Igbo people of the south-eastern region of Nigeria, a West African country that borders on Niger, Chad and Cameroon, there is a heavy dependence on heavenly bodies such as the Moon, The Sun, the Heavens (sky) and the Stars.[149] This is because the Igbo people have a historical belief system, which considers the "origin and nature of the universe and life existence."[150] Like some other African cultures, Igbo cosmology is based on the belief that

[147] S. Manxoyi, "African Skies: astronomy," *Quest,* 13, 1, 2017, p. 18.
[148] P. Baki, "Astronomy in the cultural heritage of African societies," *Astronomy for the developing world IAU Special Session no. 5*, 2006, p. 99.
[149] B. Chukwuezi, "The Relationship Between Human Destiny and the Cosmic Forces – a study of the IGBO Worldview," in *African Cultural Astronomy – Current Archaeoastronomy and Ethnoastronomy Research in Africa,* p. 209.
[150] *Ibid.*

there are various beings that inhabit the universe.[151] These 'beings' include Igbo ancestors, which are believed to be the spiritual forces that exist both under the Earth and as human beings on Earth. The Igbo people ascribe a high degree of importance to these beliefs, as it is often that such beliefs form the basis of society and defines how it operates on a day-to-day basis. Igbo cosmology is often referred to as *Igwebuike,* which refers to an "indigenous philosophy of the modality of being for the realisation of being."[152] This belief system is based on the way in which Igbo people identify and consider the universe, as well as influences how they perceive their own reality and existence. In a sense, this belief system underscores their sense of belonging, identity, and social standing, and in turn it therefore informs their actions and decisions. For example, a new born child is perceived to be the return of a deceased relative or the return of an ancestor, particularly one who wishes to live amongst his people again.[153] The Igbo people also believe that the heavens are the provider of rains and that the heavens work in conjunction with the earth to provide plentiful harvests for human survival.[154] Like many other cultures, the moon is also a fascinating celestial body for the Igbo people, one that many other groups of people have historically pondered over for centuries. The moon influences various activities of the Igbo people because each phase of the moon has a different significance on society. For example, the Igbo calendar is based on the phases of the moon, and thus each month has certain activities ascribed to them. According to Chukwuezi, the third month on the Igbo calendar is the period of planting, the fifth month marks the time for the first harvest of the year and the seventh and eighth months are usually earmarked for cultural activities.[155] The stars and constellations of the night sky are also a source of great admiration as it is believed that when a shooting star is seen in the sky, it signifies that an important person has died or is about to die. These types of sightings carry a significant social and cultural connotation, which can either be considered as a good omen or a bad one.[156]

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[151] '*Cosmology'* is defined as a system of beliefs that attempts to describe or explain the origin and structure of the universe. Cosmology also integrates time, space, the planets, stars, and other celestial phenomena into its description. J. C. Holbrook: *African Cosmology,*" *Cosmology Across Cultures ASP Conference Series,* 409, 2009, p. 138.

[152] A. I. Kanu, "*Igwebuike* as an Igbo-African Philosophy for Christian-Muslim Relations in Northern Nigeria," *Igqwbuike: An African Journal of Arts and Humanities,* 2, 2, 2016, p. 6.

[153] J. O. Urama, "The Challenges of Astronomy in Nigeria," *Physica Scripta,* 97, 2002, p. 21.

[154] Chukwuezi, "The Relationship Between Human Destiny and the Cosmic Forces," p. 212.

[155] *Ibid,* p. 213.

[156] *Ibid*.

The cosmogony mythologies of many indigenous groups have very deep cultural roots.[157] Cosmogony refers to the theories and explanations that form part of cosmologies of indigenous people which focus on origin stories and creation myths.[158] In this sense, cosmogony is a form of cosmology because it seeks to explain how early human beings came to be and it is their interpretation of their place in the universe. For the Ancient Egyptians, their cosmogony myth about the origin of the cosmos and the state speaks to how the state was created by the gods in order to communicate with the living on earth.[159] Other studies into the formation of such beliefs point towards an idea that there is a close connection between nature and culture. Petrus and Bogopa explore the awareness "…of the three-dimensional nature of human beings as … biological, social, and spiritual beings."[160] As the above-mentioned examples demonstrate, this is the case with the Igbo people of Nigeria. On one hand, this cultural connection can be beneficial in creating an awareness of advanced scientific practices and knowledge. However, on the other hand there is a downside. This is because different cultures, religions, and spiritual beliefs can be misinterpreted, and it is often that these misconceptions are held by members of other groups. Furthermore, the beliefs, teachings and practices of a particular group can be perceived to be in total opposition to the views of another. For example, it can be seen as a rejection, or total disregard, of the more widely held Western views. This notion is supported by Funso Afolayan, as he claims that "In nineteenth and twentieth century South Africa, the values, norms, and practices of ancestral religions were effectively mobilised … adopted, adapted, and deployed by Africans as a strategy of resistance to European cultural and political domination…"[161] This is a similar case as with the Igbo people because their later resistance to Western ideas and practices can be somewhat understood, as it is likely that when certain societies are influenced by Western ideas, their indigenous, cultural beliefs become lost in translation.

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[157] Urama, "The Challenges of Astronomy in Nigeria," p. 21.
[158] Holbrook, *African Cosmology,*" p. 138.
[159] J. Assmann. &. D. Frankfurter, "Egypt," in *Ancient Religions* by S. I. Johnston, (United States of America, The Belknap Press of Harvard University Press, 2007), p. 157.
[160] T. S. Petrus & D. L. Bogopa, "Natural and Supernatural: Intersections Between the Spiritual and Natural Worlds in African Witchcraft and Healing with Reference to Southern Africa," *Indo-Pacific Journal of Phenomenology,* 7, 1, 2007, p. 7.
[161] F. Afolayan, *Culture and Customs of South Africa,* (United States of America, Greenwood Press, 2004), p, 66

The Southern Nguni

The term *Nguni* is used as a 'collective term' to categorise the people of Southeast Africa, specifically those who are different from other groups in the North and interior in terms of language and culture.[162] Nguni peoples constitute approximately two-thirds of the indigenous African or black population in South Africa. In order to effectively differentiate between these groups, the Nguni people can be divided into three major subgroups: The Northern Nguni, the Southern Nguni, and the Ndebele. While an in-depth investigation of these three subgroups would be beneficial to gaining a clearer understanding of their history and heritage, it will not be possible to carry this out individually. This is because these three groups are made up of many different, ethnic groups, each with their own cultural, religious, and spiritual beliefs. Therefore, for the purpose of this investigation, the focus of this section is specifically on the ethnoastronomical practices of the Southern Nguni groups.

The historical formation of the Southern Nguni subgroup took place during the early 1800s. The separation of African groups between the north and the south occurred for a variety of reasons, however one of the most widely recognized reasons was due to the expansion of Zulu factions across the continent. The formation of the Southern Nguni subgroup was influenced by the spread of Zulu-speakers into various ethnic groups across Northern and Central Africa. The history of the Zulu people traces back to the reign of Dingiswayo, who was the chief of a Nguni-speaking group called the Mthethwa from 1795 to 1818.[163] Originating from south-eastern Africa,[164] the Mthethwa people initially took control of the Zulus, who at that time were still a fairly small population group. Shaka Zulu was one of these people, and he sought refuge with the Mthethwa.[165] Although the Zulu were one of the least significant chiefdoms that were absorbed into the Mthethwa at the time, their prominence increased significantly when Shaka Zulu emerged as a prominent figure amongst them. Shaka Zulu overthrew Dingiswayo and took control of the community in 1816 and set in motion one of the most well-known historical periods of upheaval in African history. This

[162] C. Hamilton, "Political Centralisation and the Making of Social Categories East of the Drakensberg in the Late Eighteenth and Early Nineteenth Centuries," *Journal of Southern African Studies,* 38, 2, 2012, p. 294.
[163] J. Gump, "Origins of the Zulu Kingdom," *The Historian,* 50, 4, 1988, p. 523.
[164] M. Deflem, "Warfare, Political Leadership, and State Formation; The Case of the Zulu Kingdom 1808 – 1879," *Ethnology,* 38, 4, 1999, p. 371 – 391.
[165] M. Deflem, "Warfare, Political Leadership, and State Formation," p. 377.

period is known as the *Mfecane,* which has been translated to mean "crushing" in Zulu. In other words, the *Mfecane* refers to the terror and disruption caused by the Zulu's during the 820s under the reign of Shaka Zulu.[166] Under his leadership, between 1816 and 1828, the Zulu kingdom expanded significantly. This expansion was largely attributed to the widespread violent militarisation and conquest by the Zulus. During this period, Shaka Zulu developed a well-ordered system of organization within the Zulu military, and also introduced new weapons and combat tactics to be used during their period of conquest.[167] The Zulus used these new tactics and influential leader to expand their area of control.[168] As previously mentioned, this period involved the widespread conquest by Zulu groups of other African peoples and the subsequent disruption caused many of these groups to migrate southwards, coming together to become loosely-defined as the Southern Nguni.

Cultural flattening and homogenisation are to be eschewed as the Southern Nguni people have shifting and diverse spiritual, religious and cosmological ideas. This has encouraged some scholars to further investigate this aspect of their lifestyle, and research has since revealed some close similarities as well as some clear differences, to that of other indigenous groups. One of the first findings was their interpretation of the seasons and their determination of seasons over time. For many indigenous African groups, the sky is a very valuable source of information as it can enlighten early pastoralists and farmers on when they can expect rainfall or the start of the dry season. One of the most widely used stars in this regard is the Evening Star, more commonly known to the Xhosa as *Ingongoli.*[169] The observation of this star, presumably Venus, was often linked to the months of summer, thus also linking it to the presence, or absence, of rainfall. This of course depended on where certain groups were located at the time of observation, however it was still useful, nonetheless. In order to further explain this association, it is useful to trace back to the meaning of the term *Ingongoli*. The term *Ingongoli* translates to 'wildebeest' and this name for the star was specifically selected by the Xhosa because the star was generally observed during the same lunar month in which wildebeests calve.

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[166] *Ibid,* p. 388.
[167] *Ibid,* p. 377.
[168] M. Gluxman, "The Rise of a Zulu Empire," *Scientific America,* 202, 4, 1960, p. 158.
[169] K. V. Snedegar, "Stars and Seasons in Southern Africa," *Vistas in Astronomy,* 39, 1995, p. 535.

Similarly, for other Nguni groups like the Swazi and Zulu, this star was also linked to the start of calving season and corresponded with the start of November/December.[170] Another star that was widely referenced by these Nguni groups was Canopus. According to Snedegar, the Zulu and Swazi called the Canopus star *inKhwenkwezi,* which means "brilliant star."[171] A well-known Zulu poet, Mazisi Kunene, described *inKhwenkwezi* as "one of the morning stars which help people determine time," and there is also further evidence which suggests that the appearance of Canopus had calendrical significance because it was said to only become visible towards the end of May and therefore signals the start of the winter season.[172] The Milky Way is also a very prominent celestial body that is easily observable in the night sky. For the Zulu, the orientation of the Milky Way in the sky is often used to determine when rainfall is to be expected. For example, when the Milky Way is seen in a predominantly east-west orientation (particularly during the summer), then rain is to be expected. When the Milky Way is orientated in a north-south direction, usually during winter, then rain is not expected.[173]

There are also other indigenous beliefs that relate to their being some sort of higher being or deity that controls events and phenomena on Earth. For example, some Zulu-speakers acknowledged a nature goddess, named *Nomkhubulwana*. Also referred to as the Princess of Heaven, this nature goddess is believed to be a master of "…beer making, cropping, harvesting and other useful arts, which she teaches to those who please her."[174] What this suggests is that such a belief is linked to the natural, celestial occurrences that people witness and therefore adds a layer of spirituality to their perception of such occurrences. It also maintains the notion that certain gods, spirits, or goddesses contribute to the daily social and cultural activities of these groups. According to Afolayan, such deities offer answers to the questions people have regarding the origin of man, the society they inhabit as well as the largely unexplained natural occurrences that take place around them.[175] Another example is the Xhosa belief in there being a supreme creator, who is responsible for bringing life to all

[170] Snedegar, "Stars and Seasons in Southern Africa," p. 535 – 536.
[171] *Ibid,* p. 531.
[172] *Ibid.*
[173] P. Alcock, "The Stellar Knowledge of Indigenous South Africans," in *African Indigenous Knowledge and the Sciences,* G. Emeagwali and E. Shizha (eds.), p. 119.
[174] Afolayan, *Culture and Customs of South Africa,* p. 65.
[175] Afolayan, *Culture and Customs of South Africa,* p, 65.

people and animal life on Earth.[176] Therefore, by pleasing or praising these spirits, people believed they would be granted many successes or well-being throughout their lives. In order to continue the spiritual connection that these groups had with their environment and the skies above them, as well as to allow us to study these beliefs today, there must have been some system of folklore or education that was responsible for passing on these stories and beliefs.

This notion links to the central thesis statement of this investigation because, even though these beliefs originated amongst these indigenous groups there is a possibility that such beliefs could have influenced some of the ideas and notions that are being studied 'scientifically' in the present. Without knowledge of earlier indigenous astronomical knowledge and practices, the overall narrative of historical astronomy becomes less inclusive and shifts towards a more Eurocentric perspective. While many scholars have attempted to unpack these complex indigenous narratives, Snedegar's approach is the most important to mention here. This is because his main contribution to the overall discussion is his lamentation that indigenous narratives must be told as well as understood. The importance of understanding these various practices and beliefs must not be ignored in this case because ultimately, what Snedegar aims to do through his work is to bring these narratives to the forefront of the discussion and include them in their rightful place in the historiography of astronomy in southern Africa and Africa itself. Therefore, what this subsection argues is that indigenous knowledge is tantamount to understanding the overall development of astronomy in South Africa. For these experiences and beliefs to be disregarded is an injustice to these groups, because their history and cosmology is just as important as any others.

Therefore, based on the above-mentioned case studies, one could say that indigenous astronomical practices and beliefs from the pre-colonial era onwards had an influence on the development of astronomy, as an academic and scientific discipline, many centuries later. For example, the development of a lunar calendar, the measurement of time and the plotting of stars and constellations are astronomical activities that date back to the period in history when ancient Babylonians and Egyptians existed. There were also some early European population

[176] Alcock, *Venus Rising,* p. 30.

groups that existed long before the Egyptians and the Babylonians, such as the Irish Monks of the Faeroe Islands in the year 700 or the travelling Norsemen of Iceland in 870.[177] In terms of their astronomical practices, there is evidence which suggests these groups used the night sky to plot their course across the ocean using "azimuths[178] of the celestial bodies,"[179] in relation to the horizon. This shows that naval navigation and long-distance voyages were being attempted by early populations as early as the 6th century.

However, what sets these early European groups apart from the ancient Babylonians and Egyptians is that there is no record of them using any form of instrumentation, device, or written records to carry out their astronomical observations. While this makes the study of these early populations and their astronomical practices difficult, but it cannot be denied that these European groups and their astronomical practices played a role in furthering the scientific aspects of astronomical studies later on – in terms of the improvement of technology and alternative thought processes. What this subsection has shown is that despite the popular notion that European, or Western, population groups were the most advanced in terms of science and exploration in these early years, one cannot dispute that certain earlier groups, from as early on as the 2nd millennia BCE, pioneered astronomical inquiry.

Cosmology and the Cosmos

As the previous subsections suggest, "All ancient or traditional cultures have a cosmology of some kind and these cosmologies are invariably religious in nature, or constitute a reaction to, or reinterpretation of a prior religiously conceived cosmology."[180] This statement can be considered true to a certain extent, because when one considers the link between religion and astronomy (particularly as a factor of ancient history), the creation of the world is often linked to a divine being or entity. For example, in the ancient Sumerian civilization of Mesopotamia (which now forms the southern part of modern-day Iraq), the study of the

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[177] G. J. Marcus, "The Mariner's Compass: It's Influence Upon Navigation in the Later Middle Ages," *History,* 41, 1141/143, 1956, p. 17.
[178] *Azimuth is the direction of a celestial object from the perspective of the observer. This measurement is expressed as the angular distance from the north or south point of the horizon to the point at which the object intersects the horizon.*
[179] Marcus, "The Mariner's Compass: It's Influence Upon Navigation in the Later Middle Ages," p. 17.
[180] J. T. Fitzgerald, "Cosmologies of the ancient Mediterranean world," *In die Skriflig/In Luce Verbi,* 47, 2, 2013, p. 3.

heavens was encouraged because "they believed their destiny could be read in the stars."[181] Other examples include, "[t]he Maories of New Zealand [who] thought the stars to be souls of heroes … Asiatic tribes believed the stars to be the children of the sun and the moon, [and]… the Chaldeans thought the stars to be little lamps suspended by strings and managed by the angels."[182] These are just a few examples of ancient populations ascribing spiritual and cosmological connections to celestial bodies. Similarly, for many years, Western cosmological and astronomical thinking was also largely dominated by Biblical interpretations of the development of the universe. In some instances, religious thinking and the strict teachings of the church often restricted the development of more advanced, scientific thinking. Previously mentioned examples of this limitation include the emergence of the heliocentric theory of Nicholas Copernicus in 1543[183] and Galileo Galilei's use of the newly developed telescope in 1609.[184]

This subsection focuses on the links that people make between the cosmos, their religious practices, and spiritual beliefs. In order to demonstrate this, this section discusses cultural conceptions of the cosmos held by two indigenous groups of southern Africa, namely the |Xam of the Northern Cape and the southern Cape. It is hoped that by highlighting the ways in which these two people relied on the stars and celestial phenomenon to formulate and guide their religious practices, one can gain a further understanding of the link between religion and the development of astronomy.

Before any further discussion can take place, it is necessary to problematize the terms 'San' and 'Bushman'. Over time, these terms have become the most widely used terms when referring to these indigenous groups of southern Africa. This can be problematic as it is not names chosen by those people: 'Bushman' was the name used by European travellers and

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[181] R. Wilson, *Astronomy through the Ages: Ancient Astronomy,* (United States of America, CRC Press, 1996), p. 10.

[182] *Chaldeans were a group of ancient people who lived in Chaldea, around 800 B.C. They were renowned as astronomers and astrologers.* U. C. Taylor: "Astronomy Through the Eyes of the Ancients," *Journal of the Royal Astronomical Society of Canada,* 25, 1931, p. 55.

[183] N. Campion, "Astronomy and Culture in the Eighteenth Century: Isaac Newton's Influence on the Enlightenment and Politics," *Mediterranean Archaeology and Archaeometry,* 16, 4, 2016, p. 497 – 502.

[184] P. Harris, *Toward Human Emergence: A Human Resource Philosophy for the Future,* (United States of America, HRD Press Inc., 2009), p. 39.

settlers to broadly categorise various indigenous groups they encountered upon their arrival in the mid-1600s. Since the 1920s, the term "Bushmen" has been used to describe a population of people that fit into a larger constellation of ethnic groups, known as the Khoisan people.[185] While the term Khoisan was initially used by the Europeans to describe certain groups of people who had similar physical characteristics, Alan Barnard claims that it is now more commonly used as a cultural or linguistic description.[186] The word 'San' was later introduced in an attempt to replace the word 'Bushman'. In a study by Renée Sylvain, entitled "Class, Culture and Recognition: San Farm Workers and Indigenous identities," it is argued that by essentializing the identities of indigenous peoples, there is a risk of "deculturating" those indigenous peoples. Therefore, Sylvain postulates that "the category of 'Bushmen' is merely a creation of capitalism and colonisation,"[187] and her argument is that the term should not be used because it is a product of colonial history, which served as an imposed identity rather than an identity that was employed by the people themselves. However, it was soon realized that the use of 'San' was also problematic, because it was derived from a Khoe term meaning 'hunter-gatherers' or 'foragers.[188]

Nevertheless, over time, the term "Bushman" became the most generally accepted collective group name for these peoples, despite the fact that they had diverse dialectics, traditions, lifeways, and cosmologies. As a result of being grouped under one general population term, many assumed that these people were a single, homogenous group. However, various historical studies have since revealed this to be far from the truth. In fact, while the Khoisan people are said to be the first inhabitants of southern Africa, it has now been proven that they in fact formed part of a larger assemblage of different ethnic groups, [189] which include the indigenous "Bushmen" hunter-gatherers and Khoekhoe pastoralists. The divide between them was porous and was not based on ethnicity but rather on social mobility.[190] While this investigation does not seek to discuss the ongoing debate around this term, it must still

[185] A. Barnard, *Anthropology and the Bushmen,* (United Kingdom, Berg, 2007), p. 5.
[186] *Ibid.*
[187] R. Sylvain, "Class, Culture and Recognition: San Farm Workers and Indigenous Identities," *Anthropologica,* 45, 1, 2003, p.114.
[188] Barnard, *Anthropology and the Bushmen,* p. 5.
[189] *Ibid,* p. 5.
[190] K. Sadr, "The Neolithic of Southern Africa," *The Journal of African History,* 44, 2, 2003, p. 200.

acknowledge the use of the term and remind readers of its hurtful history. Therefore, as a large majority of the literature on this topic refers to different "Bushmen" groups, this section will do the same in order to refer to certain ethnic groups throughout the discussion, but it also does so by acknowledging specific groups within this term – like the |Xam and the San.

The |Xam

Historically, the |Xam of the Northern Cape have had a close cultural connection with the cosmos. This connection has been revealed through a handful of investigations into the early cultural beliefs, traditional narratives, and religious traditions of these people. While these studies provide some evidence of the various practices of these people, the execution of such studies has also proven tricky. This is because the vast majority of evidence is found in oral tradition. Not only is there a stark contrast in cultural beliefs between those carrying out the study and those being studied, but there is also the issue of language and translation. It has taken a handful of scholars a number of years to work through a wide variety of folklore tales and traditional narratives, passed down from generation to generation.

One of the most significant collections and comprehensive studies of |Xam language and culture was carried out by two scholars, Wilhelm Bleek and Lucy Lloyd, in the mid-1800s. Bleek and Lloyd were the first scholars to "[transcend] the narrow racial prejudices of their era … and [recognise] the value of the |Xam tradition…"[191] Beginning in the late 1850s, up until Bleek's death in 1875, the pair began a project to "record the |Xam language, which was spoken by hunter-gatherer populations of the …Karoo regions of the Cape Colony."[192] The reason for selecting these populations was due to Bleek's primary interest in human origins. Bleek sought to understand the "asymmetrical linguistic and cultural evolution of different groups of people,[193] and this interest motivated him to study the development of southern African languages and to draw comparisons with the development of Indo-European languages. Over the period of their research, thousands of pages of personal history,

[191] M. Wessels, "New directions in |Xam studies: some of the implications of Andrew Bank's *Bushmen in a Victorian world: the remarkable story of the Bleek-Llyod collection of Bushman folklore," Critical Arts: A Journal of South-North Cultural Studies,* 22, 1, 2008, p. 70.
[192] M. McGranaghan, "'Hunters-With-Sheep': The |Xam Bushmen of South Africa between Pastoralism and Foraging," *Africa,* 85, 3, 2015, p. 523.
[193] Wessels, "New directions in |Xam studies", p. 71.

traditional tales and ethnographic data were recorded in |Xam and English translations were provided along with them. According to McGranaghan, the publication of their findings was due to Lucy Lloyd's continued effort to finish the project, even after Bleek died in 1875.[194] The project remains particularly significant and relevant presently because it gave such detailed accounts of indigenous narratives, as well as preserved the original |Xam language.

Roger Hewitt's analysis of the materials collected by Bleek and Lloyd was published in 1986 with the title *Structure, Meaning and Ritual in the Narratives of the Southern San.*[195] According to Wessels, Hewitt's book "…resulted in a great deal of writing on the |Xam archive, most of which [was] of historical or biographical nature."[196] This indicates that the Bleek and Lloyd collection has been responsible for fostering a great deal of interest in the study and interpretation of |Xam histories and traditions. For example, an article by J. C. Hollmann emphasises the significance of the Bleek and Lloyd manuscripts. Hollmann clams that these manuscripts have provided crucial insight into |Xam knowledge and beliefs about the origins of celestial bodies and how these understandings and beliefs fit in with the |Xam worldview.[197] There are numerous narratives and tales shared by the |Xam that pertained to their understanding of the cosmos and the phenomenon they observed when looking up at the night sky. Not only do these stories tell how the |Xam associated different celestial bodies and occurrences to spiritual beliefs, but they also drew close social and cultural connections to the cosmos. In addition, J. D. Lewis-Williams contributes to this discussion by stating that the academic analysis of the Bleek and Lloyd collection suggests that the southern San cosmology was not conceived and understood in the same way by every member of the community, therefore the Bleek and Lloyd collection must be regarded as one researcher's interpretation of the reading of the texts.[198]

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[194] McGranaghan, "'Hunters-With-Sheep': The |Xam Bushmen of South Africa between Pastoralism and Foraging," p. 523.
[195] R. Hewitt, *Structure, Meaning and Ritual in the Narratives of the Southern San,* (Germany, Helmut Buske Verlag, 1986).
[196] M. Wessels, "The Discursive Character of the |Xam Texts: A Consideration of the |Xam "Story of the Girl of the Early Race, Who Made Stars," *Folklore,* 118, 3, 2007, p. 307.
[197] J. C. Hollmann, "'The Sky's Things:' |Xam Bushman '*Astrological Mythology*' as recorded in the Bleek and Lloyd Manuscripts," *African Skies,* 11, 2007, p. 8 – 12.
[198] J. D. Lewis- Williams, *A Cosmos in Stone: Interpreting Religion and Society through Rock Art,* (AltaMira Press, United States of America, 2002), p. 78.

One interesting example of the |Xam connection to the cosmos is "The Story of the Girl of the Early Race, Who Made Stars."[199] This story illustrates a connection between observed celestial objects or phenomena and the lived realities of the |Xam people. "The Story of the Girl of the Early Race, Who Made Stars" describes how and why the Milky Way was created. It tells of how a young girl, in the process of becoming a woman, creates the Milky Way. According to historical interpretations, this story speaks about the anguish and frustration of a young girl who feels trapped under her mother's watchful eye. It has been found that in |Xam culture, it is customary practice for girls going through puberty to be separated from society, particularly while they are menstruating. The belief is that grown men in the community might prey on these young girls, particularly those undergoing physical and emotional changes of puberty, thus these girls should be kept away from harm. Thus, as the girl is going through puberty, she is not allowed to socialise with other members of society and has to remain under the supervision of her mother. Her isolation and the restrictive practices of society frustrate her, and she becomes angry with her mother and the social norms of |Xam society.

A notebook from the Bleek and Lloyd archival collection, which has been digitised by the University of Cape Town, gives a first-hand account this story from an |Xam informant named Jantjie Tooren, who remembers this story being told to him by his mother.[200] Jantjie was interviewed in January 1873, and his story was translated by Bleek and Lloyd, the informant explains the story in detail. The story tells that in her anguish and frustration, the girl grabs a handful of roots and ashes from the fire and tosses them into the sky during an angry outburst. Jantjie explains that "… the girl arose, she thrust her hands into the wood ashes, she threw up the wood ashes into the sky; she said to the wood ashes 'The wood ashes [are] here, they shall all together become the Milky Way."[201] Traditional |Xam therefore believe that the ashes and burning roots thrown into the sky created the glowing mass of stars and light they see each night. According to the Bleek and Lloyd translation, the stars and the

[199] Wessels, "The Discursive Character of the |Xam Texts," p. 307.
[200] Bleek and Lloyd Collection, BC 151 A2 1 034, 1873, p. 2505.
[201] Bleek and Lloyd Collection, BC 151 A2 1 034, 1873, p. 2505.

Milky Way are seen to be very closely linked and the way that they appear and disappear in the night sky is interpreted differently. For example, the changing positions and disappearing of the stars in the night sky are seen to be caused by the start of a new day. "The stars turn back, while they go to fetch the dawn, they may lay down nicely while the Milky Way does lie down."[202] This interpretation can be explained in the sense that the coming of a new day means that the Milky Way and the stars can no longer be seen, and it seems as if they disappear, or turn back, as the sun rises and brings a new day. It can also be interpreted as the stars and Milky Way lying down to rest as the day begins, and then returning when the sun sets again.

Another interpretation of this story is that the stars and the events that resulted in their formation are closely linked to notions of 'supernatural potency.'[203] According to Hollmann, the stars were seen to be filled with supernatural potency that causes death and misfortune, and in a similar sense, many Khoe-San societies believe that girls experiencing their first menstruation cycle has an effect on the supernatural potency of the universe.[204] Michael Wessels provides further insight into this story and his interpretation is that the young girl's ill-feeling towards her isolation, in both a physical and emotional sense, causes her to act out in frustration as well as desperation. Wessels supports this claim by saying that the girl "…wishes to provide light for people at night, especially for young men going hunting."[205] An analysis of this could be that her isolation from other members of society, young men in particular, makes her yearn for their attention as well as their safekeeping. Another interpretation is that the roots the young girl throws into the sky serve as a symbol of power, nourishment, and healing. This is because, for the communities of the region, the roots of some plants in the Northern Cape are believed to hold great power because they are a source of food and nutrients, as well as a tool for healing in the form of medicine. Thus, when these roots are thrown into the sky, they became celestial lights with deep spiritual and cosmological symbolism.

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[202] Bleek and Lloyd Collection, BC 151 A2 1 034, 1873, p. 2509.
[203] Hollmann, "'The Sky's Things:' |Xam Bushman '*Astrological Mythology*,'", p. 11.
[204] *Ibid.*
[205] Wessels, "The Discursive Character of the |Xam Texts," p. 311.

What is most interesting about this particular story is its exclusion from other publications and articles which speak to the historiographical school of indigenous knowledge. As shown above, there are only a few scholars in the field who have attempted to unpack this narrative and as a result the story has been largely excluded from the overall historiography. This is likely due to the fact that such stories and beliefs are not linked to any scientific justifications; thus, their importance is often overshadowed by more advanced, westernised scientific explanations. Therefore, one of the overarching issues that this chapter seeks to address is that indigenous knowledge and astronomical practices have become lost and, in some cases, almost forgotten within the broader discussion of the development of astronomy in southern Africa.

San/Bushmen of Southern Africa

The San or Bushmen, the first population groups to occupy various regions of southern Africa, were a complex and culturally diverse group of people. The San occupied many regions of southern African, particularly the Karoo, and later became known as the "Khoisan", as discussed earlier. Similar to the earlier problematization and explanation of the term "Bushman", before any further discussion occurs, the term "Khoisan" must also be problematised. The term "Khoisan" can also be defined as somewhat of an umbrella term that was created by early Europeans who encountered various indigenous ethnic groups during their expeditions in and around southern Africa during the 18th century. Alan Barnard explains that the term "Khoisan" is actually an amalgamation of two words, 'Khoi' and 'San.' In this case, the word "Khoi" (alternatively spelt 'Khoe') means person or individual, while "San" means bushman, hunter-gatherers, or foragers.[206] The labels that are used to describe indigenous groups need to be used sensitively. This is because the term 'Khoikhoi' was initially used to refer to pastoralists and San or 'Bushmen' was used to refer to hunter-gatherers. However, historians later realised that there was a porous boundary between the two groups. Some prefer the term Khoisan as a collective name for these groups, while 'Bushman' is sometimes perceived as both derogatory and empowering, depending on the context in which it is used. 'San' is sometimes used, but it can also prove to be problematic because it means 'men without cattle' and was essentially pejorative.

[206] Barnard, *Anthropology and the Bushmen,* p. 5.

For example, following their brief encounters with these individuals, the term "Bushmen" was adopted by the Europeans as a way of referring to certain individuals of 'a supposed physical type' or shared appearance. For example, in 1655, a group of Dutch explorers reported they had come into contact with a group of African ethnic individuals. The Dutch described these people as "... a certain people of very small stature, subsisting very meagrely, quite wild, without huts, cattle or anything in the world, clad in small skins like these Hottentots[sic] and speaking almost as they do."[207] Taking the context of the time into consideration, this is a fair description, especially since the Dutch had no real way of differentiating between the two groups. Therefore, this chapter will respectfully make use of the terms "Bushmen" and "San" interchangeably when investigating the existing historiographical narratives pertaining to these people.

Prior to the 18th century, before contact with white settlers first took place, there is very little written documentation or source material pertaining to the beliefs of various indigenous groups, particularly about the way they perceived the world they lived in and the cosmos they depended on for survival. However, since the discovery of caves and ancient burial sites across the southern African region in the late 19th century, many of which are decorated with rock art from centuries ago, there has been an increase in the number of inquiries into San Bushman rock art. This is because the rock art illustrates stories of ancient folklore, and provides insight into Bushman perceptions of spiritual connections, trances, and other worldly experiences. These discoveries sparked great interest amongst archaeologists, historians, anthropologists, and other scholars. One of the first examples of South African rock art being studied was the work of George William Stow in the late 1860s.[208] His research into rock art was driven by the need to understand "the history … and customs of the Bushmen, as depicted by themselves."[209] In his book, *The Native Races of South Africa,*[210] Stow claims that he was driven by "the simple desire of acquiring historical knowledge… to work out the primitive history of a country which never possessed a history of its own…"[211]

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[207] A. Smith, C. Malherbe, M. Guenther, and P. Berens, *The Bushmen of Southern Africa: A foraging society in transition,* (New Africa Books, South Africa, 2000), p. 26.
[208] Barnard, *Anthropology and the Bushmen,* (United Kingdom, Berg, 2007), p. 34.
[209] *Ibid.*
[210] W. G. Stow, *The Native Races of South Africa,* (London, S. Sonneschein & Company limited, 1905).
[211] A. E. Voss, "The Image of the Bushman in South African English Writing of the Nineteenth and Twentieth Centuries," *English in Africa,* 14, 1, 1987, p. 34.

Part of this statement is particularly problematic, and somewhat biased, in terms of its interpretation of southern African ethnographic studies. This is because it implies that the indigenous people of southern Africa had no history before the arrival of Western scholars. This assumption has since been deemed inaccurate by other scholars, but still requires some further discussion. With this in mind, this chapter aims to draw on studies by Stow, Lewis-Williams, Barnard, and Voss in order to show that southern African rock art and cosmological narratives are intrinsically linked and cannot be perceived as only having context and meaning ascribed to them after their discovery by Western researchers.

Early attempts to decipher the rock art paintings of San Bushmen were no simple task, and contemporary attempts remain so. This is mostly due to the fact that the creators of these paintings had died long before their discovery, and thus no context for the paintings could be provided. Scholars such as J. D. Lewis-Williams, Anne Soloman[212] and Felix A. Chami[213] have attempted to gain a clearer understanding of religion and society of these groups through their rock art. For example, Anne Soloman states that Lewis-Williams acknowledges a relationship between myth and art[214], which is a notion further supported by Chami, who claims that there is evidence in rock paintings and engravings that star symbols serve as references to celestial bodies.[215]

Another influential scholar, Patricia Vinnicombe, who carried out her research in the Drakensberg mountains of KwaZulu-Natal in the 1960s, focused on the significance of paintings of animals and their link to indigenous cosmological beliefs. Since then, the painting of animals and their significance to astronomical practices of indigenous has been identified as a reoccurring motif by other scholars, who have come across similar images across many different rock paintings and excavated sites. Vinnicombe was one of the first scholars to determine that certain animals they hunted, such as the Eland, were central to Bushman rituals. She concluded that the Eland was seen as "a rain animal", signifying

[212] A. Soloman, "The Myth of Ritual Origins? Ethnography, Mythology and Interpretation of San Rock Art," *The South African Archaeological Bulletin,* 52, 165, 1997, p. 3 – 13.
[213] F. A. Chami, "Evidence of Ancient African Beliefs in Celestial Bodies," in *African Cultural Astronomy*, p. 121 – 130.
[214] Soloman, "The Myth of Ritual Origins? Ethnography, Mythology and Interpretation of San Rock Art," p. 3.
[215] Chami, "Evidence of Ancient African Beliefs in Celestial Bodies," p. 127.

fertility.[216] Barnard claims that Vinnicombe's investigations showed that certain animals held ritual significance and her interpretation of these animals in art provided "a new understanding of rock art as religious art."[217] Vinnicombe published her findings in a book called *People of the Eland* in 1976, and it was one of the first to give insight into the lives of San people and their understandings of the world. The book includes references to San beliefs and symbols which served as a buttress to contemporary understanding of these people. David Lewis-Williams drew on Vinnicombe's work in the 1970s as he introduced processes of statistical analysis to the study of rock art and was thus the first to develop semiotic understandings of rock art.[218]

What these above-mentioned scholars have done is use archaeological evidence to show that the San people had a very long history of cultural sophistication and diversity, one which was initially unseen by the European settlers. The excavation of ancient sites during the 1970s and 1980s has since provided historians, anthropologists, archaeologists, and other academics with valuable information on the origin and development of these ethnic groups over time. Alan Barnard mentions that around the 1970s, archaeological practices had shifted, and "new 'scientific' approaches paved the way for intensive quantitative techniques."[219] Thus, the discovery of archaeological objects provides an additional lens into the cultures and cosmological beliefs of these people.[220] One important benefit of such archaeological research is the discovery of ancient artefacts, tools, and rock paintings. Not only do these artefacts provide a lens into the cultural and social lifestyles of these ethnic groups, but they also reveal San/Bushmen spirituality and cosmology.[221]

Nomadic and pastoral people had a close connection with the cosmos because of their interaction with the sky on a regular basis. As outlined by Claire Oxby, there is a prevailing

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[216] Smith, Malherbe, Guenther, and Berens, *The Bushmen of Southern Africa: A foraging society in transition*, p. 18.
[217] Barnard, *Anthropology and the Bushmen,* p. 89.
[218] *Ibid,* p. 90.
[219] A. Barnard, *Hunters and Herders of Southern Africa: A comparative ethnography of the Khoisan peoples,"* p. 92.
[220] J. Parkington, D. Morris & J. M. de Prada-Samper, "Elusive Identities: Karoo |Xam Descendants and the Square Kilometre Array," *Journal of South African Studies,* 45, 4, 2019, p. 730.
[221] J. C. Holbrook, "African Cosmology," *Cosmology Across Cultures: ASP Conference Series,* 409, 2009, p. 138 – 144.

stereotype amongst those living in crowded, urban areas, which claims that nomadic herders and pastoralists had no boundaries and were directly exposed to the sky, thus giving them an advantage in the practice of cosmology.[222] One cannot simply accept it as a given. In fact, there are a number of case studies that point towards an opposite theory, one that indicates these people developed a close relationship with the cosmos out of necessity and for survival, not purely because they had unrestricted access to it.

To explain this notion further, one also needs to consider the socio-cultural circumstances of the San/Bushmen and how this determined their connection with the cosmos. This connection was characterised by a number of factors, three of which will be briefly discussed below. The first factor relates to the San being a hunter-gatherer community and their primary source of food and raw materials being the environment that surrounded them. Depending on where they roamed, their access to food and supplies could be limited. Their total dependence on mother nature meant that, on a spiritual level, the San had a deep sense of appreciation for what the Earth provided for them. One way in which they idolised and gave thanks to mother nature was to "name the stars they observed after the animals they hunted, [such as] steinbok [sic], hartebeest, eland, anteater, lion, tortoise…"[223] The second important factor was the use of the night sky for navigation while hunting. The San Bushmen used the location and appearance of certain constellations to guide them on hunting trips, as well as to keep track of any weather changes. Variations in the observation of certain stars and constellations were very significant to the San as they used this knowledge of celestial motion to "correlate the changing positions of heavenly bodies with seasonal changes on Earth."[224]

The final factor relates to the spiritual practices of the San and their perception of celestial occurrences. Archaeological research and rock painting analysis reveals that the San had a very significant connection with the Moon in particular. Their interpretation of lunar cycles and the significance of the changing phases of the moon was based on the idea that "the moon, along with the sun and the sky, [are] visible manifestations of God."[225] Furthermore,

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[222] C. Oxby, "A Review of African Ethno-Astronomy: With Particular Reference to Saharan Livestock-Keepers," *La Ricerca Folklorica,* 40, 1999, p. 56.
[223] Oxby, "A Review of African Ethno-Astronomy," p. 56-57.
[224] Snedegar, "Stars and Seasons in Southern Africa," *Vistas in Astronomy,* 39, 1995, p. 530.
[225] Oxby, "A Review of African Ethno-Astronomy," p. 60.

rock paintings and ancient folktales suggest that the San bushman ascribed a deep significance to the Moon, as if it is a heavenly being. One of the most widely held beliefs amongst the San Bushmen was that the moon had some sort of power or authority over the ordering of social life. This can be linked to the previously mentioned belief that divine beings or spiritual entities inhabit the sky, and that they are constantly watching over. While these are only a handful of examples, what is most striking about these above-mentioned factors is that while the night sky was used mostly for navigation and the prediction of weather patterns, there was also a deep sense of spirituality attached to it, which is often overlooked.

A more contemporary approach to gaining a greater understanding of the lived experiences of indigenous groups can be found at the !Khwa ttu San Heritage Centre[226], situated approximately 70m outside of Cape Town. This facility is one of the most comprehensive centres for discussions of Southern African cultural history because it offers a wide variety of exhibitions and educational facilities that is aimed at informing the general public of the lived experiences of San people. It can be said that this heritage centre plays a crucial role in furthering the understanding and interpretations of indigenous peoples of Southern Africa, particularly the San Bushmen. Drawing on the argument by Snedegar, this centre is important to mention here because it is actively involved in sharing the indigenous knowledge practices and lived experience with people in present times and can be seen as making a vital contribution to the overall contemporary understanding of precolonial peoples. In addition to the existing cultural site and learning centre, !Khwa ttu Heritage Site is also currently embarking on creating a digital archive, which will serve as a repository for a collection of information from "libraries, archives, museums and private collections across the globe… about the San."[227] The creation of such a digital archive will also assist in furthering people's understanding and interpretation of particularly San heritage.

What this chapter has attempted to argue is that indigenous, cultural practices amongst local people play a vital role in our understanding of cosmology and astronomy in a South African

[226] "!Khwa ttu: San Spirit Shared," URL: https://www.khwattu.org/heritage-centre-museum/. [Accessed on: 15 September 2021].
[227] "!Khwa ttu: San Spirit Shared," https://www.khwattu.org/heritage-centre-museum/digital-archive/. [Accessed on: 15 September 2021].

context, however in many cases, such narratives and practices are not discussed on any broader level within this historiographical school. Some scholars have attempted to interpret and analyse these stories on a number of intellectual levels, but it appears the lack of supplementary sources have limited those discussions. Drawing on a notion presented by Evan Hadingham, the study of ancient astronomical practices should not be limited to simply explaining how and why certain groups carried out astronomical activities and attributed religious beliefs to what they saw. In fact, this argument suggests that the study of ancient indigenous practices should also consider how these groups connected their observations and knowledge to both everyday practices and their spiritual inclinations.[228] While these practices may not have had formal scientific validation, they still form a significant part of explaining how human intellectual and cultural relationships with the stars have changed over time, depending on the circumstances and lifestyles of certain groups of people. Understanding these beliefs and practices within the context in which they occurred shows that they existed long before colonial influences arrived, thus providing researchers with a new lens into how astronomy developed. This chapter contributes to the overall argument of this thesis as it considers various indigenous groups in South Africa and their own interpretation of the night sky. Their beliefs and practices cannot be marginalised and should be reconstructed as an important part of our long, shared history. They may not have formally contributed to the institutionalised development of astronomy, but their ways of interpreting the sky remain crucial in understanding the progression of understanding the stars over the *longue durée*.

[228] E. Hadingham: *Early Man and the Cosmos,* (United States of America, University of Oklahoma, 1984), p. 5.

Chapter Three: The introduction and early development of Scientific Astronomy in South Africa, c. 1685 – 1830.

This chapter investigates how the advancement of technology and science, in the context of voyages of exploration, trade, colonialism and imperialism, facilitated the development of astronomy, as both a scientific and professional discipline in the country. This chapter focuses on key developments that took place in South Africa from the early 17th and into the 18th century. In doing so, it demonstrates how the introduction and development of Western astronomy was an entirely new approach to the study of the cosmos, self-consciously predicated on scientific principles. This means that as the improvement of technology and science occurred over time, more and more groups of global scholars became less focused on the spiritual explanations of the cosmos, and instead set out to "conquer new frontiers, whether within the mind, the body or the terrestrial and extra-terrestrial world around us"[229] through science. Especially following the Enlightenment period, not only was there a desire for knowledge and greater understanding, but there was also the impact of shifting socio-political and economic circumstances.

As Saul Dubow argues "Astronomy's principal object of fascination is the universal, non-human domain of the cosmos."[230] Looking back to the early astronomical theories of Aristotle and Ptolemy, human interest in the cosmos has a long history. Aristotle's main aim was to provide an explanation of the universe in a physical sense. He believed that "all apparent phenomena of changes in the heavens … must be interpreted in a "meteorological" sense as happening in the Earth's atmosphere."[231] In some sense, Ptolemy's theories were similar, however his idea was to present a mathematical explanation for celestial occurrences. "Ptolemy wanted to calculate the planetary positions with respect to the ecliptic[232], and he

[229] P. Harris, *Toward Human Emergence: A Human Resource Philosophy for the Future,* (United States of America, HRD Press Inc., 2009), p. 30.
[230] S. Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," *Journal of Southern African Studies,* 45, 4, 2019, p. 664.
[231] A. Fantoli, *Galileo for Copernicanism and for the Church,* (Italy, Vatican Observatory Publications, 1994), p. 2.
[232] *The ecliptic is the line along which lunar eclipses take place.* In O. Gingerich, *The Eye of Heaven: Ptolemy, Copernicus, Kepler,* (American Institute of Physics, New York, 1993), p. 7.

made use of mathematical theory to specify the longitude measured in degrees north or south of the ecliptic.[233]

With this in mind, there is no doubt that human interest in astronomical research progressed significantly during the post Enlightenment period. In fact, following the development of mathematics, physics and science, and the improvement of the telescope by Galileo Galilei in 1609, the practice of astronomy became far more focused on "the structure of the universe… beyond any practical application, to satisfy the craving for truth."[234] The debate surrounding the first inventor of the telescope remains contested today, however Galileo's improvements to the telescope significantly impacted the abilities and subsequent discoveries of astronomers. This can be said as some scholars such as A. Righini and George Miley claim that advanced astronomical studies began during the early 15th century. For example, the publication of *Astronomia Nova* by Johannes Kepler in 1609[235] and the birth of telescopic astronomy in 1609, following the further development of Galileo's telescope[236], contributed to the study of astronomy becoming more scientific. Furthermore, Miley states that while navigation was an important factor behind the development of early astronomy, the practice of astronomy was also carried out for economic reasons in 15th century Europe.

This is because this period in history was characterised by "great voyages of discovery," and thus there was an increase in the need to explore unknown lands. The need for natural resources, the imperial and colonial desire for conquest as well as the expansion of Western civilisation, all required a certain level of precision and skills in terms of navigation, in order to achieve those goals. Some scholars contend that it was rather the questions posed by 15th century scientists, mathematicians and astronomers that boosted astronomy as a scientific and technological field of inquiry. On the other hand, there are others who claim that it was only at the beginning of the 17th century that "…new instruments were invented (such as the

[233] O. Gingerich, *The Eye of Heaven: Ptolemy, Copernicus, Kepler,* (American Institute of Physics, New York, 1993), p. 7.
[234] A. Pannekoek, *A History of Astronomy,* (New York, Dover Publications Inc, 1961), p. 14.
[235] A. Righini: "The telescope in the making, the Galileo first telescopic observations," *Galileo's Medicean Moons: their impact on 400 years of discovery IAU Symposium,* 269, 2010, p. 27.
[236] O. Gingerich: "Kepler, Galileo and the birth of modern astronomy," *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 175.

telescope), permitting the birth of an observational science of the sky."[237] Despite the evident discrepancies in this debate, the supposed 'beginning' of astronomical studies is still important to mention here.

17th Century Astronomy at the Cape

This section investigates the historical and localised development of astronomy at the Cape in South Africa, following the arrival of Dutch settlers in 1652. While a number of scientists and astronomers in the Northern hemisphere had already begun tracking the movement of stars, meteors, and other celestial bodies during the 1500s, it was during the late 1600s that scientific based astronomy reached the shores of South Africa. According to J.A. Van Wyk, the introduction of scientific astronomy in South Africa can be traced back to the arrival of a French priest, named Father Guy Tachard in 1685.[238] A number of sources claim that Tachard was travelling through South Africa on his way to Siam (present day Thailand), with the task of completing a scientific expedition to the Indies and China.[239] On his journey, while passing through the Southern tip of Africa, he established a temporary observatory in present day Cape Town. While there is little information surrounding what Tachard observed during these early years, as John McAleer notes, when Tachard arrived at the Cape he set out investigating bodies orbiting Jupiter, while at the same time, he "also discovered that the brightest star in the Southern Cross is … a double star."[240] Considering his achievements at the time, Father Guy Tachard is arguably the first astronomer who laid the foundations for scientific planetary studies in southern Africa.

Over half a century later, Tachard was succeeded by a French scientist named Abbe Nicolas-Louis de La Caille. In 1751, La Caille, who was serving as a representative of the France Royal Academy of Sciences, established an astronomical observatory in present-day Cape Town today, with the primary goal of determining an Arc of the Meridian from the

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[237] P. Zarka: "Astronomy and astrology," *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 421.
[238] J. A. Van Wyk, "South Africa's Space Policy and Interests: A New Dawn or a Black Hole?" *Strategic Review for Southern Africa,* 31, 2, 2009, p. 47.
[239] J. McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteeth-century British Empire," *The British Journal for the History of Science,* 46, 3, 2013, p. 395.
[240] McAleer, "'Stargazers at the world's end'", p. 395.

Cape of Good Hope.[241] Archival sources at the Western Cape National Archives reveal that La Caille's astronomical observatory was initially situated on the corner of (what is today known as) Adderley and Strand Street in present day Cape Town.[242] Details of this building are featured in a number of letters that date back to the 1970s. These letters are useful to mention here because they provide further insight into how La Caille's legacy and heritage at the Cape are still being considered almost 200 years later. The letters of correspondence are between various municipal offices and City engineers, who were requesting the preservation of a plaque that had been placed at the Old Lennon Building in Strand Street. According to a letter sent by the secretary of the National Monuments Council, dated the 26th of February 1970, a special request was filed for "a bronze commemorative plaque on … [a] building in Strand Street"[243] to be preserved. The plaque is also mentioned in an article published in an issue of the Monthly Notes of the Astronomical Society of Southern Africa in 1973.[244] The letter informs the reader that this plaque was erected many years prior by the South African Philosophical Society as a means of marking the site of Abbe de la Caille's astronomical research. What these letters indicate La Caille's work in and influence on astronomy at the Cape. It is evident that his legacy necessitated a plaque being put up to commemorate where the first temporary observatory was in present day Cape Town. Moreover, the letters indicate there was public interest in maintaining the plaque.

At the temporary observatory, over a period of three years, La Caille successfully chartered more than ten thousand stars, identified forty-two nebulas and discovered fourteen new constellations.[245] In addition to this, La Caille also became well known for his "observations of the declination of Mars."[246] Similarly to Tachard, there are very few sources that document what La Caille achieved during his time at the Cape and how his accomplishments influenced the advancement of astronomy in South Africa. However, David Evans suggests that La

[241] Van Wyk, "South Africa's Space Policy and Interests: A New Dawn or a Black Hole?", p. 47.
[242] KAB 3/CT, 4/1/11/491, G23/73 Memorials, Statues, Monuments, etc. Plaque at Site of Abbe De la Caille's Astronomical Researches. Thomas Cook Building, Strand Street. 1970 – 1980.
[243] KAB 3/CT, 4/1/11/491, G23/73 Memorials, Statues, Monuments, etc. Plaque at Site of Abbe De la Caille's Astronomical Researches. Thomas Cook Building, Strand Street. 1970 – 1980.
[244] *Monthly Notes of the Astronomical Society of Southern Africa*, "La Caille's Observatory," 32, 10 11 & 12, December 1973.
[245] Van Wyk, "South Africa's Space Policy", *Strategic Review for Southern Africa*, p. 47.
[246] W. P. Koorts, "The 1882 transit of Venus: The British expeditions to South Africa," *Monthly Notes of the Astronomical Society of Southern Africa,* 63, 2004, p. 36.

Caille set up "a transit circle … 28 inches [in] length and half an inch in diameter… [which he] used … to determine offsets in declination of stars which passed through his instrument above or below the preset position…"[247] This observational technique had not yet been introduced in the developing world of astronomy in southern Africa and was thus seen as a significant step towards the overall scientific development of the field.

The Royal Observatory at the Cape of Good Hope

While Tachard and La Caille are the first known international intellectuals to introduce astronomy as a scientific subject of inquiry in southern Africa, in 1685 and 1751 respectively, the French astronomical legacy at the Cape of Good Hope would soon begin to change its trajectory. In fact, French domination in the field began to decrease with the arrival of British colonial power at the Cape at the turn of the 19th century. A central idea presented by Walker et al, is that "the roots of the modern science of astronomy… lie in South Africa's much more recent colonial past."[248] Indeed, as many scholars attest to how the next major milestone in the development of astronomy in South Africa was the proposal to build and the eventual construction of the British Royal Observatory at the Cape of Good Hope in 1820. The Royal Cape Observatory was established by Order in Council, as members of the Board of Longitude believed that it would play a crucial role in the improvement of astronomy and navigation.[249] Construction of the Observatory began in 1825 and was only completed in 1828. The observatory became a monumental development within the space of astronomy because the astronomical activities conducted there were mostly practical and focused on "…navigation, meteorology, time-keeping, tidal observations, hydrography and boundary mapping…"[250] In terms of the historical development of astronomy in South Africa, these above-mentioned activities were perceived to be at the forefront of innovation and progress.

[247] D. S. Evans, "Historical Notes on Astronomy in South Africa," *Vistas in Astronomy,* 9, 1967, p. 272.
[248] C. Walker., D. Chinigò & S. Dubow: "Karoo Futures: Astronomy in Place and Space – Introduction," *Journal of Southern African Studies,* 45, 4, 2019, p. 629.
[249] Evans, "Historical Notes on Astronomy in South Africa," p. 278.
[250] Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," p. 664.

Prior to this, astronomers such as Tachard and La Caille had been focusing on the placement and tracking of large stars and other celestial bodies. Thus, the more scientific aspect of astronomy was still a fairly new development at the time and the subsequent transfer of information, data and research between astronomers and scientists had not yet (at least not up until this point) been carried out on such a large scale. Furthermore, prior to 1825, there were only a handful of smaller, temporary observatories that had been set up in and around the Cape. While it is not to say that these smaller, temporary observatories were any less influential in the introduction and early development of astronomical research in South Africa, the establishment of the Royal Observatory at the Cape of Good Hope was special in the sense that it was the first formally introduced institution at the time, with strong colonial connections. The earlier established smaller observatories certainly had links to Western ideals, but this was largely transferred through the practices of the individual who set out to establish it. However, in the case of the Royal Observatory at the Cape of Good Hope, its establishment was far more monumental, because it was set up with the purpose of facilitating astronomical research in collaboration with the British Empire and the Royal Observatory at Greenwich. In fact, the Royal Observatory at the Cape of Good Hope has been described as "a defining moment in the formalisation of astronomical links between the northern and southern hemispheres."[251]

An article published by the Astronomical Society of the Pacific in 1909, activities carried out at the Royal Observatory at the Cape of Good Hope, particularly between 1826 and 1909, "…[gave] it the unchallenged rank as the oldest permanent astronomical foundation in the southern hemisphere."[252] Dr. Ian Glass supports this notion as he claims that some of the most noteworthy achievements of the Observatory during the early years are "…the first successful measurements of the distance of a star … in 1832 and 1833" and "the first use of

[251] Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," p. 665.
[252] H. D. Curtis, "Astronomical Problems of the Southern Hemisphere," *Publications of the Astronomical Society of the Pacific,* 21, 129, 1909, p. 231.

photography to make a systematic sky survey in 1885."[253] In addition to this, the telescope at the Observatory captured an 'exceptionally good' photograph of the moon in 1869.[254]

Reverend Fearon Fallows was the first resident astronomer at the Royal Observatory at the Cape of Good Hope.[255] Fallows was sent to the Cape with the task of finding a suitable site for the establishment of the Royal Observatory. He first set up a temporary observatory in what is today known as Kloof Street, before the first Royal Observatory was built.[256] In addition to this, he was sent to tackle the "primary task of improving [known] star positions" [257] According to several primary sources and personal accounts presented in academic articles by historians and other researchers, it is known that Reverend Fallows arrived at the Cape in 1821, with the aim of carrying out his task. He died a decade later in 1831. While at the Cape, he was successful in finding a suitable site for the new Observatory, as construction of the Observatory was completed in 1828, however apart from setting up a variety of instruments to make magnetic measurements, Fallows was unable to make full use of the newly constructed facilities in such a short period of time.[258]

After Fallows' death, Thomas Henderson was the next astronomer selected to serve as "Her Majesty's Astronomer at the Cape from 1831 to 1833."[259] Henderson was a Scottish lawyer and astronomer, who became well known for "measuring the distance from the earth to Alpha Centauri (one of the bright stars 'pointing' to the Southern Cross constellation)…"[260] Similarly to his predecessor, Fallows, Henderson's work in astronomy at the Cape was also short-lived as he resigned from the position after only one year. However, despite the fact that his stay at the Cape was short lived, he did make some major contributions to the field, some

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[253] I. S. Glass, "The Royal Observatory, Cape of Good Hope, a Valuable Cultural Property," *International Council on Monuments and Sites,* 18, 2009, p. 211.
[254] C. D. Laney, "African Starlight: Astronomy in South Africa and the SAAO: Part 2," *Monthly Notes of the Astronomical Society of Southern Africa,* 55, 1996, p. 110.
[255] McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," p. 394.
[256] R. F. Hurly, "Presidential Address: Astronomers and Surveyors," *Monthly Notes of the Astronomical Society of Southern Africa,* 38, 7 – 10, 1979, p.61.
[257] L. L. Leeuw. & J. Holbrook, "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," *Under One Sky: The IAU Centenary Symposium,* 349, 2019, p. 242.
[258] B. Warner, "Early Years of the Magnetic Observatory," *South African Journal of Science,* 74, 1978, p. 82.
[259] Koorts, "The 1882 transit of Venus: The British expeditions to South Africa," p. 36.
[260] Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," p. 666.

of which remain the most influential today. For example, Henderson is most well-known for his work on determining the direct trigonometrical distance of a star, apart from the sun.[261]

After Henderson resigned, Thomas Maclear was offered the position as the next Royal Astronomer at the Cape and he assumed this role from 1834 to 1870.[262] After being elected as a fellow of the Royal Astronomical Society in 1831,[263] and after accepting the position as the next Royal Astronomer, Maclear was able to formally begin his career as an astronomer. His interest in astronomy, chemistry, and electricity (in the years prior to his appointment as the next Royal Astronomer) equipped him with the necessary knowledge and skills to build his own small observatory, which he used to make detailed astronomical observations. The Western Cape National Archives has a number of volumes including original, handwritten diaries and notes made by Maclear, dating from 1840 to 1875. These diaries are very informative as they give details and descriptions of the daily activities of Thomas Maclear during this period. For example, diary entries beginning on the 28th of May to 2 June 1858 refer to Maclear "working away at Observatory calculating"[264] and even provide a period for his observations that often lasted from early in the morning to around midnight.[265] On the 11th of October 1858, Maclear notes in his diary that a "large comment [was] seen yesterday at 7 'o clock," and the following day gives a brief description of the comet, stating that it was a "splendid object", with a large nucleus that was orange in colour.[266] Later on that year, on 17 November 1858, Maclear mentions that he "swept carefully for Faye's Comet"[267] but was unsuccessful. This is just a few examples of Maclear's interest and work in astronomy and the observation of celestial phenomena. During his time at the Cape, he is known to have "observed the brighter southern stars with the mural circle" and later published his observations in a "catalogue of precise declinations for 172 stars."[268]

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[261] M. Feast, "South African Astronomy: Lessons for the Future from the Past," *Monthly Notes of the Astronomical Society of South Africa,* 55, 1996, p. 7.
[262] Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," p. 666.
[263] McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," p. 398.
[264] CAD, A515, 58, "Maclear-Mann Collection," Western Cape Archives and Records Service, 1811 – 1909.
[265] KAB, CAD, A515, 58, Maclear-Mann Collection. 1811 – 1909.
[266] KAB, CAD, A515, 58, Maclear-Mann Collection. 1811 – 1909.
[267] KAB, CAD, A515, 58, Maclear-Mann Collection. 1811 – 1909.
[268] B. Warner, "Thomas Henderson and and αCentauri," *Transits of Venus: New Views of the Solar System and Galaxy IAU Colloquium,* 196, 2004, p. 198.

Maclear was also involved in writing and publishing reports on various astronomical topics. For example, on October 28 1858, Maclear notes in his diary that he was "engaged in writing a report for the magazine on Comets."[269] It is unclear which magazine this report was to be published in, but nevertheless, the publication of these reports would have likely had an influence on the development of astronomy, as the dissemination of such information likely increased public interest and also could have created opportunities for further correspondence. An article published in the Government Gazette on 28 August 1840 by Mr. John Bell, who was the Secretary to government at the time, details that a letter was sent by Maclear, to the Governor, explaining that he received "…instructions from Her Majesty's Government to re measure an Arc of the Meridian at the Cape of Good Hope, for the purpose of discovering the Curvature of the Earth, and for fixing Geographical points of reference…" [270] This letter indicates further Maclear's role in astronomical observations and his efforts to re measure the Arc of the Meridian at the Cape of Good Hope, as La Caille had attempted in the mid 1700s. Archival sources show a shift in the organisation and leadership of the Royal Observatory as there is evidence that Maclear posted his letter of resignation in 1870, and that Mr. Mann, who had served as the 1st assistant to Maclear for the last 31 years, requested that he be considered to fill this position.[271]

In 1879, the same year that Maclear died, Sir David Gill was appointed as the next director of the Royal Observatory. Having arrived nearly half a century after the first Royal director of the Observatory, Reverend Fallows, "[Gill] found [the] observatory with limited, ageing equipment [that was]…poorly maintained."[272] During his time at the Cape, not only did Gill make a significant effort to improve the Observatory and its stargazing facilities, but he was also involved in various aspects of astronomical studies, including "astrophotography, astrometry and geodesy."[273] One of the most significant achievements made at the Observatory under Gill's command was the creation of "an extensive photographic map of

[269] KAB, CAD, A515, 58, Maclear-Mann Collection. 1811 – 1909.
[270] KAB, CAD, A515, 58, Maclear-Mann Collection. 1811 – 1909.
[271] KAB CAD A515 95 – 96, Maclear-Mann Collection, Diverse Papers, 1837 – 1872.
[272] Laney, "African Starlight," p. 110.
[273] Leeuw & Holbrook, "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," p. 242.

the southern skies, from declination -19° to the south pole."[274] As previously mentioned, the first declination observation of Mars had been made by La Caille in the 1600s and this new achievement by Gill indicates how the early development and use of such observational techniques and technology filters down through the institution over centuries. Gill kept a number of observation logbooks, one of which can be located at the Western Cape National Archives. The logbook is entitled "Observation Book of the Magnetic Observatory," and it is dated 1856.[275] Logbooks like this were very important in the early days of astronomy, as taking handwritten notes was the only means of keeping a record of observations and shifts in celestial positions. Using the Observatory, Gill was able to keep comprehensive logs of his observations and calculations throughout his time as the director of the Royal Observatory.

A significant collection of observations and recordings are accessible at the Western Cape National Archives and an investigation of these papers shows the extent of Gill's labours as the Royal Astronomer during his appointment at the Royal Observatory.[276] One such example includes his observations of Alpha Centauri, conducted using the Heliometer of Ascension in 1877.[277] According to his observations, it was recorded that, over a period of four months, there was a 0.5" change in distance and a 20 degree shift in position angle.[278] This shows that Gill's work was influential because his further understanding and data of Alpha Centauri would have contributed to later studies by other astronomers.

In addition to this, Gill was also the first astronomer to establish modern Astrophysics at the Royal Observatory. His determined efforts in the advancement of astronomical research certainly paid off, because he was the first to take "guided wide-angle photographs of a comet [in 1882], which led to the realization of the potential of photography for astrometry in general…"[279] While there were many other Royal Astronomers who followed Gill, the

[274] Curtis, "Astronomical Problems of the Southern Hemisphere," p .231.
[275] KAB, CAD, A2435, 1-3, Sir David Gill Collection. 1829 - 1893.
[276] KAB, CAD, A2436, 22/7, Sir David Gill Collection, Diverse Observatory and Astronomical Papers, 1832 – 1882 & undated.
[277] KAB, CAD, A2436, 22/7, Sir David Gill Collection, Diverse Observatory and Astronomical Papers, 1832 – 1882 & undated.
[278] KAB, CAD, A2436, 22/7, Sir David Gill Collection, Diverse Observatory and Astronomical Papers, 1832 – 1882 & undated.
[279] B. Warner, "The Development of Astrophysics in South Africa," *Astrophysics and Space Science,* 230, 1995, p. 2.

success of the observatory during these years was linked to the "extremely valuable and extensive work"[280] that was carried out and the fact that the facility at the Cape of Good Hope formed "part of a process of drawing diverse places into the world of European science and empirical observation."[281] This suggests that the introduction of astronomical studies in South Africa encouraged the consolidation of technological resources, skills and knowledge in the field and thus, "…the positional astronomy pursued by professional astronomers in national observatories as well as by many amateurs, ultimately came to dominate nineteenth-century astronomy."[282]

Therefore, this subsection has discussed the various activities and influences those certain key individuals had in the overall development of astronomy in South Africa during the colonial period in order to argue that their role and activities had a significant effect on the research and development that took place later on in the field. These above-mentioned examples are also relevant to this discussion because they fit in with the first historiographical school of "Great Man" history. This is because these well-known names are often the main features of academic studies and commentary on the development of astronomy in South African during the colonial period. Where this chapter fits in with the overall argument of this thesis, is that it highlights their influence but also likens them to the individual, amateur astronomers who were also influential. The following subsection therefore follows on from this discussion and turns its attention to the rise of independent astronomy at the Cape. The aim of this subsection is to show how the increase in the number of professionals, who brought their own practices, data, and observational tools to the Cape, contributed to more amateur individuals and aspiring astronomers to join the field, and make their own contributions as well.

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[280] Curtis, "Astronomical Problems of the Southern Hemisphere," p .231.
[281] McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," p. 391.
[282] S. Case, "'Land-marks of the universe': John Herschel against the background of positional astronomy," *Annals of Science,* 72, 4, 2015, 418.

"Flying Solo": The rise of independent Astronomy at the Cape

While many of the 'professional' astronomers who travelled to the Cape during this early period were linked to the Royal Observatory, there were also some independent, amateur astronomers who emerged between the arrival of French astronomers in the late 1600s and early 1700s, and the establishment of the first permanent Royal observatory in 1820. One of the most influential individuals in the steadily growing group of amateur astronomers was Sir John F. W. Herschel. Herschel was an English philosopher who arrived at the Cape in the same year that Maclear began his career at the Royal Observatory. Herschel was considered to be the "most prominent independent astronomer in Britain during the first half of the nineteenth century"[283] and he travelled to the Cape in 1834, with the goal of establishing his own private observatory. Herschel's time at the Cape was mostly spent inspecting the sky through his 20-foot telescope.[284] Some of his most important achievements at his private observatory include, "the charting of celestial objects in the southern hemisphere, especially nebulae, clusters and double stars [as well as] the development and institution of the first systematic technique for measuring star magnitude."[285]

While Herschel spent a great deal of time working on his own observations and techniques, he was also given the task of processing and publishing some of the observations made by Nicolas-Louis de La Caille in the 16th century. Herschel was given this task because it was later found that the thousands of stars previously observed and chartered by La Caille during his time at the Cape "…were unreduced, unpublished, and therefore inaccessible and useless to astronomy."[286] This lack of access was a major loss to the astronomical community because La Caille was, and still is, seen as the founding father of astronomy in southern Africa. La Caille arrived at the Cape with a proposed goal "to observe the positions of all the stars in the southern sky…; to determine the longitude of the Cape; and to make geodetic and astronomical observations…"[287] While at the time his goals seemed over-ambitious, he was

[283] E. G. Musselman, "Swords into ploughshares: John Herschel's progressive view of astronomical and imperial governance," *The British Journal for the History of Sciences,* 31, 4, 1998, p. 420.
[284] Warner, "The Development of Astrophysics in South Africa," p. 1.
[285] Musselman, "Swords into ploughshares", p. 420 – 421.
[286] Case, "'Land-marks of the universe': John Herschel against the background of positional astronomy," p. 427.
[287] Evans, "Historical Notes on Astronomy in South Africa," p. 270.

largely successful in achieving them, and thus Herschel took it upon himself to work through the documents and observations made by La Caille.

In addition to his role in the publication of La Caille's work and the development of his own astronomical observations, Herschel also became closely linked to the Royal Observatory at the Cape. For example, Hershel formed a close friendship with Maclear, as both arrived at the Cape only days apart. Their relationship would later prove to be very successful in establishing and encouraging networks with other astronomers further afield.[288] During their time at the Cape, Maclear and Herschel collected large quantities of information, material, and data which they then shared between themselves. This connection proved to be particularly fruitful as these two men were successful in furthering the discoveries and overall operation of the Royal Observatory at the Cape. One of the most noteworthy discoveries, completed as a joint effort by Maclear and Herschel, was their observation of Halley's Comet in 1835.[289] This sighting of Halley's Comet from the Cape was in fact not the first sighting of the comet, as there are accounts in official settler records of "the appearance of Halley's comet in 1682."[290]

Other archival evidence suggests that Halley's Comet was sighted on another occasion in 1836, as there are hand drawings of Halley's Comet, which were illustrated by Sir David Gill in 1836.[291] Nevertheless, this type of astronomical event at this time caught the imagination of the general public as well as professional and amateur astronomers. It can be argued that the reason for its widespread publicity was because it was published in newspapers, academic journals and was discussed at length at gatherings of astronomers and scientists in the field. As stated by McAleer, the link between independent astronomers and institutionalised astronomers is an important one as it "…illustrates the possibility of developing a collaborative and international approach to positional and navigational astronomy."[292] During

[288] McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," p. 398.
[289] Dubow, "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array," *Journal of Southern African Studies,* 45, 4, 2019, p. 668.
[290] Evans, "Historical Notes on Astronomy in South Africa," *Vistas in Astronomy,* 9, 1967, p. 268.
[291] KAB CAD A2436 5/1 – 5/2 & 6/2. David Gill Collection: Drawings and Diagrams, Drawings Halley's Comet. 1836.
[292] McAleer, "'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," p. 398.

his time at the Cape, Herschel was also "involved in establishing scientific networks and associations with footholds in local colonial society."[293] This notion will be discussed in greater detail in Chapter 6, as his efforts in education and scientific networks had an influence on the development and introduction of astronomy as an academic discipline in the country.

Another amateur astronomer who made significant strides in astronomy in southern Africa was Alexander William Roberts. Born in Scotland in 1857, Roberts emigrated to South Africa in 1883 to teach at a Missionary Institution in Lovedale in the Eastern Cape.[294] Upon his arrival in Lovedale, with no observational equipment or much experience in the field, Roberts began working on "an ambitious variable star programme… using an old surveyor's theodolite to scan the southern heavens…"[295] His high level of intrigue and determination certainly paid off because over a period of two years, Roberts successfully "discovered no less than twenty long period variable stars."[296] Considering his limited background in the subject and his lack of proper equipment and data, this was an impressive achievement. So impressive that it caught the attention of Sir David Gill, who was the head astronomer at the Royal Observatory at the time. Gill provided some much-needed astronomical data and advice to Roberts to assist him with his observations, as well as assisted in obtaining a photometer.[297] With access to the correct equipment and a growing familiarity with the southern sky, Roberts was able to accumulate an enormous arsenal of astronomical data such as "raw observations, lists of magnitude estimates, hand-drawn charts and sequences, and manuscripts on each star…"[298]

While Herschel and Roberts were certainly not the only amateur astronomers to travel to South Africa with the goal of establishing their own observatory or tracking the movement of celestial bodies, the fact that these two men were amongst some of the first independent astronomers to settle here in South Africa and achieve such great things is an indication that

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[293] Beinart, & Dubow, *The Scientific Imagination in South Africa: 1700 to the Present, (*United Kingdom, Cambridge University Press, , 2021), p. 10.
[294] T. Cooper, "The Contribution of A. W. Roberts' Observations to the AAVSO International Database," *JAAVSO,* 47, 2, 2019, p. 254.
[295] M. D. Overbeek, "Amateur Astronomy in South Africa," *Astrophysics and Space Science,* 230, 1995, p. 480.
[296] Overbeek, "Amateur Astronomy in South Africa," p. 480.
[297] *Ibid.*
[298] Cooper, "The Contribution of A. W. Roberts' Observations to the AAVSO International Database," p. 254.

amateur astronomers were already situating themselves amongst the professionals of the time and were indeed making noteworthy contributions to the growth of astronomy in the country. These two examples also show that it is very likely, and fair to assume, that amateur astronomers were involved in the early development of astronomy in the country during the 17th, 18th, and 19th centuries, which would have undoubtedly influenced the development of the field in the years to come. Furthermore, with the establishment of international observatories and the influence of foreign astronomers who laid down their foundations in South Africa, the development of a national astronomical endeavour also began to take shape during the late 19th and 20th centuries. The overall argument of this chapter is to show that it was not only professionally trained astronomers or scientists who played a role in laying the foundations of astronomical inquiry at the Cape. As the previous subsection shows, there were a number of individuals who also made significant contributions to the overall development of astronomy over time. Drawing on the argument against the first historiographical school, the purpose of this chapter is to show how "Great Man" history can result in the exclusion of key individuals, who may not fit into that narrative, from the overall historiographical school. The following chapter investigates the progression of southern African astronomy in terms of the local developments that took place, which enabled the field of astronomy to gain significant momentum into becoming formally recognised as an academic field of study for the people of South Africa.

Chapter Four: The development of national astronomical aspirations in South Africa, c. 1902 – 1920.

A sense of national interest began to grow amongst people, thus enabling the development of national astronomical aspirations in South Africa. This chapter discusses various developments that took place, such as the construction of key astronomical infrastructure and the acquisition of advanced technology, as well as the activities that occurred between 1902 and 1920 within the field of astronomy in the country. This chapter aims to explain how and why local interest in the field expanded over time, eventually resulting in the formalisation of astronomy through infrastructure, scientific research, and development on a national level in South Africa during the early 20th century. It argues that astronomical aspirations in South Africa, particularly between 1902 and 1920, were the main driving factor behind the overall development of astronomy in the country at this time. This chapter situates its discussion between 1902 and 1920 because this period was characterised by some of the largest developments in astronomy and because the existing historiographical school draws a lot of its argumentations from this time period as well. This chapter seeks to address how national astronomical developments, institutions, and organisations, as well as individuals such as Jan Smuts, featured in and contributed to the accumulative development process of professionalised astronomical practice during this period. This is done in an effort to address how changes in the application and practice of science through the construction of observatories and the shift in political discourses relating to science in the country also featured in the overall development of astronomy during the early 20th century.

The Transvaal/Union Observatory

One of the most noteworthy developments in South African based astronomy – astronomy research facilitated and promoted by members of the local population – is the construction of the Transvaal Observatory in Pretoria. Research into the history of the Observatory reveals its extensive history as both a scientific institution and a national symbol. The first petition sent to the government, requesting the construction of an Observatory for meteorology and astronomy, was drafted in 1902. The main aim of the petition was to gather state support for the construction and maintenance of the institution. In addition to state support, this project

was also heavily supported by the South African Association for the Advancement of Science, and a large number of the institutions later successes can be attributed to the involvement of the South African Association of the Advancement of Science.[299] The first petition was somewhat successful as the Transvaal Meteorological Department was founded on the 1st of April 1903.[300] The main purpose of the Meteorological Department was "for the collection and distribution of meteorological observations throughout the Transvaal colony." [301] After the Observatory was constructed and formally established as a working institution, the Association for the Advancement of Science maintained its involvement in the activities carried out at the Observatory. In a sense, one could say that this national scientific institution, which was funded largely by the South African government, was a significant factor in the growth of meteorological studies in the country at the time. This is because the initial purpose of the observatory was to focus on meteorological work and weather forecasting.

However, there were some individuals and key events that influenced the structure and the activities of the observatory over time. Some of the first major changes were brought about by the institution's first director, Robert Thorburn Ayton Innes, also referred to as R. T. A. Innes. Robert Innes was recommended as a possible candidate for the position of director of the new observatory in Johannesburg by Sir David Gill, who served as the director of the Royal Observatory at the Cape between 1879 and 1907. Innes took up the position as the Director of the Johannesburg Observatory in 1903 and through his work and leadership was able to transform the observatory into a more astronomically focused observatory by 1907.[302] For example, as the newly appointed director, Innes began reaching out to other local and international astronomers, in an attempt to source equipment and better technology for the Union Observatory. Innes was also "fully involved in organising the new Meteorological Department,"[303] which suggests that he was actively involved in the formation as well as the

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[299] H. E. Wood, "The History of the Union Observatory, Johannesburg," *South African Journal of Science,* 23, 1926, p. 168.
[300] *Ibid.*
[301] J. Hers, "The Establishment of the Transvaal Observatory," *Astronomical Society of Johannesburg Private Archive Publications,* p. 1. [Accessed on 1 December 2020].
[302] The Astronomical Society of South Africa Website, Astronomers Section on Innes, R.T.A. http://assa.saao.ac.za/sections/history/astronomers/innes_rta/#sources (Accessed 15 July 2021).
[303] J. Hers, "The History of the 26-inch telescope in Johannesburg," *Monthly Notes of the Astronomical Society of Southern Africa,* 46, 5 & 6, 1987, p. 75.

administration of the new Union Observatory. The proactive leadership of Innes, combined with other developments that took place during the formative years of the Observatory, the Union Observatory began to develop into a fully functioning astronomical institution.

One particularly important development in the history of the Transvaal Observatory took place in 1905, two years after Dr. Innes assumed his position as the Observatory director. According to archival sources obtained from the Johannesburg branch of the Astronomical Society of Southern Africa, a meeting between the British and South African branches of the Association for the Advancement of Science was scheduled to take place in South Africa in August 1905. As the Association for the Advancement of Science has other international branches - particularly one in Britain - and because South Africa was a British colony at the time, it was rather fitting for the British branch of the Association to have some involvement in the development of astronomy in the country. It was at this meeting that a second petition was drafted which called for the purchase of a telescope, the purpose of this was so that the telescope could be used for astronomical activities and research at the Observatory. At the time of the meeting, the cost of the proposed telescope was £6000. Unfortunately, the Government was unable to provide the necessary funding at the time of the request and the proposal was postponed.[304] Despite this, this second petition was still highly influential in shaping the history of the Observatory because it kickstarted the process of adapting the capabilities of the observatory towards becoming more astronomical at a later stage. Despite the best efforts of both branches of the Association and due to the lack of funding, the Meteorological Department remained unchanged from 1903 to 1909 and no telescope was purchased.

However, this all changed in early 1909, when the Minister of Lands, the Honourable J. B. Rissik, authorised the purchase of a 26-inch refracting telescope.[305] According to Hers, this development came about after Innes was called to a meeting with Jan Smuts and Minister Rissik. The purpose of the meeting was to promote the reasoning behind the request for a telescope and why government funds should be allocated to the further development of the

[304] Hers, "The History of the Transvaal Observatory II. The 9-Inch Telescope," p. 39.
[305] Hers, "The History of the 26-inch Telescope in Johannesburg," *Monthly Notes of the Astronomical Association of Southern Africa,* 46, 5 & 6, 1987, p. 79.

observatory. Based on evidence presented in Hers' paper on the history of the 26-inch telescope in Johannesburg, Innes made a successful pitch to President Smuts and the Minister of Lands because the request was immediately accepted, a quote was obtained and an order was placed by mid-1909.[306] This can be seen as the first major step in the change to the observatory's primary focus because it gave a sense of hope that once the construction and installation of the telescope was completed, it would allow astronomers within the Transvaal observatory to begin astronomical studies. Later in 1909, the Meteorological Department diverged from the observatory and the institution became formally known as the Transvaal Observatory. Soon to be equipped with a 26-inch refracting telescope, enabling it to focus more attention on astronomical studies and research.

Following the divergence of the meteorological department, and the formal recognition of the observatory as a predominantly astronomical observatory, there were some other subsequent shifts that took place. The first shift came about around the time of the unification of South Africa in 1910. In this year, the four pre-existing colonies of South Africa – the Transvaal, the Orange Free State, the Cape Colony and Natal – came together to form a Union, administered by a newly formed Union government. As a result, the four previous colonies passed the control of their existing observatories in Johannesburg and Natal over to the Minister of the Interior within the Union government of South Africa and the existing infrastructure and equipment was amalgamated under one Union Observatory. This is significant to mention because, while some astronomers and colonial government officials had tried their very best to develop and improve the colony's ability to study the stars in the years prior, it took an event as monumental as the Union of South Africa to bring about significant change. Not only did the structure and operations of the observatory change, but it was also once again renamed to the Observatory of the Union of South Africa (more commonly referred to as the Union Observatory). The previous Meteorological Department was also renamed the Union Meteorological Department in Pretoria in 1912.

With the acquisition of new technology and the overall advancement of science, physics and mathematics, the establishment of the Union Observatory was a step in the right direction in

[306] *Ibid.*

formalising the study of astronomy in South Africa, specifically as an academic discipline. This can be said as the Union Observatory became accessible to students, professors, and scientists from a number of different fields, and garnered a great deal of collaborations between different individuals, while also serving as a facility for education and training. Research into the history of this institution has shown that over time its unwavering support and interest for the study of the stars has been a significant contributing factor in the overall development of astronomy in South Africa, as both an academic and scientific field. Without the Transvaal, and later the Union Observatory, South Africa may not have made such large strides in the field of astronomy. The Union Observatory must be remembered for its critical role in the development of astronomical studies in South Africa because it played such a key role in promoting research and development. In addition to this, the Union Observatory remained a lasting influence on astronomical; inquiry in the country because the Union Observatory was later combined with the Royal Observatory in Cape Town in 1972, to form what is known as the South African Astronomical Observatory.[307]

Therefore, what this subsection has shown is that the Union Observatory played a major role in formalising astronomy as a scientific discipline and enabled both professionals and amateurs to participate in research and training. It argues that the Union Observatory facilitated a growing social sphere of astronomy, enabling various groups of people to come together and participate in research at various scientific and astronomical institutions. The following subsection investigates the kinds of local astronomical activities that were taking place in South Africa and how information and knowledge was shared amongst people in the field and abroad.

Interest in local astronomical activities in South Africa

After the establishment of a national observatory in South Africa, there was a noticeable increase in interest in the night sky and space. It is important to mention from the outset that this interest arose amongst both professionals and aspiring amateurs, and the result of which can mostly be seen in the formation and establishment of local and international groups

[307] Interview with Dr. Ian Glass conducted by Paige Smith, via Zoom, Cape Town, 22 June 2021.

within the field of astronomy, as well as through the activities these groups engaged in. In a recent interview with Dr Ian Glass, a radio astronomer associated with the South African Astronomical Observatory and a member of the Astronomical Society of Southern Africa, recollections of his early experience at the South African Astronomical Observatory (SAAO) bolsters the notion that the growth of astronomy in South African can be largely attributed to the formalisation of astronomy through institutions and activities. This is because he was closely involved in the development and construction of key technology and equipment. For example, Dr. Glass was involved in X-Ray astronomy in the early years of his training as an astronomer and his main area of development was in infrared equipment. The largest telescope for optical and infrared astronomy in South Africa is housed at the Sutherland facility of SAAO and it has been the largest telescope in the country for the last 45 years.[308] When asked about his individual contributions to the development of technology at the Observatory, Glass recalls that "the other astronomers were very keen to use the equipment I had developed… a quarter or third of the activity at the Observatory was to do with infrared, mostly because I had introduced it and made it possible for that to happen…"[309] Brian Warner states that the administrative and technical headquarters of SAAO are at the former Royal Observatory buildings in Cape Town and the facility is home to "…a twin 18/24 inch refractor and an 18-inch photometric reflector."[310] While these above-mentioned developments are just a few examples of the kinds of scientific advancements that were taking place in the country at this time, their influence on the effectiveness of astronomical observations and the nature of research at institutions such as SAAO must be emphasised.

In conjunction with technological developments in the field, there were also some influential individuals who advocated for the advancement of science. While the previous section has detailed how interest in astronomy, and the broader arena of science, was largely precipitated amongst members of the general public, there was also a drive amongst certain political figures to promote the development of science within the country, particularly following the Union of South Africa in 1910. One example of such an individual is Jan Smuts. Dubow

[308] R. S. Stobie, "The Future of Astronomy in South Africa," *Monthly Notes of the Astronomical Society of Southern Africa,* 55, 9 & 10, 1995, p. 125.
[309] Interview with Dr. Ian Glass conducted by Paige Smith via Zoom, Cape Town, 22 June 2021.
[310] B. Warner, "Astronomy in South Africa," *Highlights of Astronomy,* 10, 1995, p. 674.

shows how Smuts was "a South African statesman who was also concerned with the political dimensions of science."[311] His interest in science was articulated in his addresses and publications, and his overall argument was that South Africa could make a contribution to the "sum total of human knowledge." [312] In 1925, Smuts addressed the South African Association for the Advancement of Science, and he attempted to turn scholarly attention away from the European contributions to 19th century science that tended to dominate the ongoing discussions and aimed to promote the idea that focus should rather be on the southern hemisphere, and how it can be used to contribute to scientific knowledge.[313] One could argue that the postulations of political figures, such as Smuts, worked towards increasing public interest and acceptance of scientific development in conjunction with the development and assimilation of astronomical research institutions. Smuts promoted the benefits and possible areas for further development in science and technology. In the 1920s and 1930s, Smuts acted as an advocate for the 'Africanisation' of science and promoted the "deepening [of] local intellectual capacity while maintaining strong connections with Britain."[314] This shows a concerted effort being made to broaden scientific scope and research in the country as an attempt to highlight South Africa's potential within the broader arena of universal science.

According to Professor Patrick Woudt, the development of key infrastructure and technology in the country later on in the century did have an impact on the level of interest that is expressed in the subject of astronomy and space research. In a recent interview, when asked about his perception of the current growing interest in astronomy, Woudt confirmed that the first offering of astronomy as a major in the 90s was at first not very popular. However later on, "…with the SKA on the horizon, and SALT, and astronomy in the news, our intake in the major has substantially increased."[315] While these are two separate examples pertaining to the development of astronomical interest in South Africa over time, when one considers them jointly, it becomes clearer that over time the development of key infrastructure and the

[311] S. Dubow, "Global Science, National Horizons: South Africa in Deep Time and Space," *The Historical Journal,* 63, 5, 2020, p. 1089.
[312] S. Dubow, *A Commonwealth of Knowledge: Science, Sensibility and White South Africa 1820 – 2000,* (United States of America, Oxford University Press, 2006), p. 207.
[313] Dubow, "Global Science, National Horizons: South Africa in Deep Time and Space," p. 1089.
[314] W. Beinart, & S. Dubow, *The Scientific Imagination in South Africa: 1700 to the Present, (*United Kingdom, Cambridge University Press, , 2021), p. 13.
[315] Interview with Professor Patrick Woudt conducted by Paige Smith via Zoom, Cape Town, 19 July 2021.

improvement of astronomical technology had a significant effect on the level of interest shown in astronomy. Up until this point, by focusing on the development of the first national observatory and the developments that took place within and around it, this chapter has sought to emphasise is that there is a very close link between individuals, infrastructure, and institutions in the field of astronomy, which ultimately brings about a higher level of interest amongst scholars and scientists alike. Therefore, the following subsection progresses on to discuss the kinds of local astronomical activities that were taking place in South Africa during the 18th and 19th centuries and how interest in such activities and institutions was disseminated amongst the general public. This is an important factor to consider when talking about the overall development of astronomy during the late 19th and early 20th century because it gives a reflection of the kinds of early developments that were taking place and also assists in promoting the argument that local individuals, research groups and formalised institutions were as influential in the development of astronomy in South Africa as the professionals.

Andy Fabian presented an interesting nation in his presidential address in 2020, as he claimed that "the search for fundamental knowledge motivated by curiosity is as useful as the search for solutions to specific problems."[316] This statement closely relates to certain individuals in the field of astronomy because their activities and astronomical discoveries were ultimately the cause for increasing interest amongst members of the general public. Information regarding the activities of individuals and organisations were either published in local newspapers or shared via the organisation's publications and journals. Because newspapers and other forms of print media were far more widely accessible to members of the general public, newspapers served as the main source of information to the general public. In order to show how this took place, a number of archival newspaper sources were consulted.

The first investigation into the role of print media in disseminating astronomical information during this time period was conducted via the online archive of the Rand Daily Mail newspaper publications, which spans from 1902 to 1985. A number of articles that were

[316] A. Fabian: "The Impact of Astronomy," *Presidential Address: A & G,* 51, 2010, p. 3.25.

published over this period were used as the primary source of evidence for this section. While this is a fairly extensive time period to investigate, it is important to mention that covering the entire scope of the archive was crucial to this investigation, as it gives an indication of change over time in terms of what is being published, who it was informing and when information was being shared. A search of these online archives reveals that the earliest article in the Rand Daily Mail, relating specifically to astronomical development, refers to the construction of the Transvaal Observatory near Johannesburg and is dated the 7 February 1903.[317] Another article published on 14 January 1905, informs the public that the Johannesburg Observatory will only be formally opened on the coming Tuesday of that month. This particular article also explains the extent of the institution itself, explaining the way it has been constructed and the equipment it will facilitate. The article also states that "a huge telescope… is considered to be an essential part of its equipment…"[318] By the 1930s, the Rand Daily Mail was providing information regarding the observations made by Dr H. E. Wood and how information was passed on between astronomers in different countries. According to the brief article, Wood, who had recently attended a meeting of the International Astronomical Union in America in September of that same year, had seen a partial eclipse from his location in Magog, Canada.[319]

What this investigation revealed was that the publication of information in publicly accessible newspapers was crucial in the development of astronomy in the country during the first half of the 20th century. It can be argued that by increasing public interest and garnering support for astronomical development, the government would have been better able to allocate state funds for further development and research, as well as give institutions the opportunity to expand their membership and assimilate more amateurs into the field. This presents a very clear pattern of collaboration between the state, publicly run research organisations and amateur astronomers. As this thesis aims to show, the pattern of collaboration and the role of research organisations and amateurs cannot be ignored, because their influence in the

[317] Rand Daily Mail Newspaper Article, Johannesburg, edition published on 7 February 1903, p. 5.
[318] Rand Daily Mail Newspaper Article, Johannesburg, edition published on 14 January 1905, p. 8.
[319] Rand Daily Mail Newspaper Article, Johannesburg, edition published on 6 October 1932, p. 10.

astronomical research field remained significant in terms of their efforts in information dissemination and observations.

Another example of print media being used to disseminate information is the publication of journals and handbooks by various astronomical societies and groups. In the early years of astronomical development in South Africa, there were very few locally led astronomical societies or research groups, however this all changed in 1922 with the formation of the Astronomical Society of Southern Africa. As the following chapter discusses a more in-depth history of the society, as well as provides evidence to explain its key involvement in the development of astronomy in South Africa over time, only minimal detail on its formation and work will be mentioned here.

The purpose of this subsection is to discuss how the Astronomical Society of Southern Africa and its members were pivotal in garnering interest and spreading information about activities throughout the country and abroad. This was largely achieved through the publication and distribution of journals and handbooks. Over time, various members of the astronomical society also contributed greatly to the advocation of astronomical studies both within the country and abroad through the publication of these astronomical handbooks and journals. Some of these handbooks can now be obtained from the Astronomical Society of Southern Africa's website and online archive, which proved to be an important asset to this investigation. A search of this digital archive revealed that the first publication of the society was the Journal of the Astronomical Society of South Africa, and it appears that the journals were published either annually or biannually, depending on the activities of the society in that given year. While the online archive does not include an entire collection of all the copies of each journal, it does however state that all the published journals were compiled into four volumes, between 1923 and 1935. The reason for the publication's abrupt end was due to lack of funding and the publication of these journals ended in 1935.[320]

[320] The Astronomical Society of Southern Africa: *Publications of the Astronomical Society of Southern Africa,* http://assa.saao.ac.za/sections/history/assa-archive/publications-of-the-astronomical-society-of-southern-africa/ , [accessed 22 July 2021].

Publications of the Astronomical Society of South Africa

In 1945, the Society restarted its publications with the creation of the "Monthly Notes of the Astronomical Society of South Africa", also referred to as MNASSA. It was in these monthly notes that various handbooks were published, the first being released in 1946 and the last printed copy was in 2002. According to a recent interview with Dr. Ian Glass, there were a number of both amateur and professional members of the newly formed Astronomical Society of Southern Africa in the early 1920s who published their work through MNASSA, and this helped to spread ideas, knowledge, and expertise amongst members of the astronomical and scientific community. From 2003 onwards, the MNASSA publication was published as the Sky Guide.

The preface of the 1948 edition of the *Handbook* outlines the purpose of the publication and it explains that "…the Handbook is fulfilling a definite need among members of the Society and … it forms a useful adjunct to the star charts and other astronomical information published elsewhere."[321] In the first section of the 1948 edition, key explanations, time sheets and diagrams relating to the movements of the Sun, the Moon and the Planets are provided. In addition to this, another section gives detail on the existence of meteors and constellations. For example, one paragraph states "Many of the constellations are of very ancient origin, though most of those near the South Pole are of comparatively recent origin, being arranged either by Bayer… in 1603, or by La Caille … in 1751 and 1752."[322] This quote confirms that although this particular astronomical society was only formed during the early 20th century, astronomical studies and discoveries had been occurring for centuries prior. While the society's handbooks could not have been the only astronomical publication of the time, due to the awareness they created and the widespread audiences they reached, these handbooks played a significant role in the sharing of astronomical knowledge and expertise amongst amateur astronomers. It is also very likely that these publications would have undoubtedly contributed to the dissemination of information as well as the encouragement of international collaborations amongst scholars, astronomers, professors, and scientists alike.

[321] The Astronomical Society of South Africa: *Handbook for 1948 of the Astronomical Society of South Africa,"* 1948, p. 1.
[322] *Ibid,* p. 8.

What these two above-mentioned examples suggest is that print news media and official societal publications played a significant role in the dissemination of astronomical information. This is because the spread of such information would have also contributed to more people becoming involved in the development and growth of astronomy over time. Also, it can be said with some degree of certainty that particular individuals and the early activities they engaged in also played a key role in facilitating the formation and establishment of other local astronomical research groups. In a similar way to the South African Astronomical Society, which will be discussed in greater detail in the following chapter, it was sometimes the discoveries, sightings and activities of individuals and newly formed astronomical groups that often drew more people into the field, after they appeared in print news and were discussed at length in official publications.

In addition to this, the increase in global interest combined with a dramatic rise in astronomical technology, innovations and knowledge gave ordinary people access to information, thus further boosting their interest in the study of the stars. The dissemination of ideas and techniques took place globally, stemming largely from the West, however it was also a major factor in South Africa. The increase in access to information contributed to the formation of local astronomical organisations and societies during the early 20th century. Research has revealed that there were a number of influential astronomical societies and supporting institutions that emerged during the early 20th century. However, two of the most noteworthy include the Astronomical Society of Southern Africa and the South African Astronomical Observatory. Both of them have a long history and have remained prominent in the field until the present. The following chapter discusses these two organisations in more detail, referencing from both primary and secondary sources. Primary source material was obtained from personal interviews with both previous and existing members of said groups and employees of institutions, which were conducted by the primary researcher. Secondary source material was obtained from a wide variety of academic journal articles, book chapters and newspapers.

Chapter Five: Local astronomical research organisations and their role in the development of astronomy in South Africa, c. 1920 – 1960.

As discussed in Chapter Three, formal astronomical inquiry first took root at the Cape of Good Hope during the 17th century, as part of global merchant and imperial forces. Subsequent to this, there was a noticeable increase in the number of both amateur and professional astronomers and scientists at the Cape, and throughout the rest of the country. This was largely due to the establishment of observatories and research groups that enabled more people to engage in education and research. However, from the start of the 20th century, which featured important events such as the Industrial Revolution, two World Wars, and the overall advancement of scientific technology in the West, there appears to have been a significant shift in people's perspective of the world and the processes that took place within it. The advancement of science and technology was one of the biggest contributing factors to this shift as it ultimately resulted in what has been termed the "modern astronomical revolution."[323]A number of scholars have attempted to pinpoint exactly where this revolution stemmed from, and it has proven difficult. This is largely because the development of astronomy has not taken place along a linear line, nor has it had the same effect on all population groups. As previous chapters have shown, the development of astronomy in precolonial southern Africa was largely different to the development of astronomy in other parts of the world, such as Europe.

With that in mind, while the global development of astronomy remains a significant factor to consider, this chapter focuses more on how certain local southern African astronomical activities, organisations and institutions contributed to such development and raised awareness of space in South African society. As a quote by Harris states, "The immensity and complexity of the universe has always been a source of wonderment for humanity."[324] Therefore, the following chapter investigates two key astronomical organisations that emerged in South Africa during the early 20th century, in order to show how each functioned, served the interests of popularising astronomy and even how each made contributions to the

[323] G. Miley, "Influence of Society on Astronomical Discovery," *Proceedings of Science,* 2009, p. 2.
[324] P. Harris, *Toward Human Emergence: A Human Resource Philosophy for the Future,* (United States of America, HRD Press Inc., 2009), p. 30.

overall development of astronomy in South Africa, specifically in terms of the development of the field, the propagation of popular astronomy, and its subsequent impact in academia.

The Astronomical Society of Southern Africa

One of South Africa's biggest advantages in the astronomical and other scientific observational fields is its geographical location. A number of scholars agree that due to South Africa's latitudinal and longitudinal position, as well as its relatively clear skies, astronomical activities and observations are far more reliable and accurate here.[325] This advantage therefore enabled people to carry out many hours of observation and tracking. As a result of this, one of the earliest astronomical societies to be established in South Africa was the Astronomical Society of Southern Africa, which was formed in 1922.[326] This national society was in fact created through the amalgamation of the Cape Astronomical Association, founded in 1912, and the Johannesburg Astronomical Association. The first draft of the Constitution of the new Association was negotiated by both branches and the Society was officially established on the 23rd of August 1922.[327] The first President of the South African Society was Mr. S. S. Hough, who had previously been working as His Majesty's Astronomer as well as the Honorary President of the Cape Astronomical Association.

Being a predominantly South African Association, a large majority of the members of the society were scattered around the South African region. For example, the Cape Centre itself includes members from Windhoek, Northern Rhodesia, Cape Town, and Durban.[328] As mentioned in the previous chapter, these widely spread-out members therefore facilitated the dissemination and sharing of information, data, and techniques amongst members from different parts of South Africa. What is also most interesting to note here is that this local group was primarily made up of ordinary people, many of whom had regular jobs and who led ordinary lives outside of the society. Their shared interest was in the night sky and outer

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[325] M. W. Feast, "Recent Developments in South African Astronomy," *South African Journal of Science,* 74, 1978, p. 5 – 7.; J. McAleer, " 'Stargazers at the world's end': telescopes, observatories and 'views' of empire in the nineteenth-century British Empire," *The British Journal for the History of Science,* 46, 3, 2013, p. 389 – 413.; D. S. Evans, "Historical Notes on Astronomy in South Africa," *Vistas in Astronomy,* 9, 1967, p. 265 – 282.

[326] The Astronomical Society of South Africa: *Constitution and Bye-Laws*. Cape Town: Townsend, Taylor, and Snashall Printers, 1922, p. 1.

[327] I. S. Glass, "Jacob Karl Ernst Halm (1865 – 1944)," *Monthly Notes of the Astronomical Association of Southern Africa,* 73, 1 – 2, 2014, p. 14.

[328] A. W. Long, "The Foundation and Development of the Astronomical Society of South Africa," *Presidential Address,* 1928 – 1929, p. 153.

space, their main goal was to gain a better understanding of the occurrences that take place within it. It is clear, from the increasing popularity of the society overtime, that this group of individuals were motivated by the need or desire to experience the excitement of astronomy. This can be said as there are a number of archival sources that indicate a growing interest and participation in astronomy, dating back to before the amalgamation of the two branches. As mentioned earlier, the Astronomical Association of Southern Africa was initially divided between two branches, one in Cape Town and one in Johannesburg. Interestingly, the Cape Town branch of the Association is documented as being the oldest Astronomical Society in Southern Africa.[329]

During the initial years of the society's existence, when the association was still split between two cities, there were a number of annual reports published by both centres, which provide key evidence to support the notion that astronomical interest was increasing in South Africa during these formative years. A summary of the Annual Report published by the Cape Astronomical Association for the period between 1921 and 1922, accessed from the ASSA online archive, reveals that the Cape Council had met ten times during that year to discuss the various undertakings of the Association. The report also includes a list of lectures and papers that were contributed to the society during this time. For example, some titles in this list include a paper written by Dr. J.K.E. Halm, entitled "Modern investigations into the distribution of Stars", and another by A.W. Long and T. MacKenzie entitled "Observations of the New Moon."[330] Contributions made by Dr. Halm are significant because Dr. Halm was initially a Chief Assistant at the Royal Observatory at the Cape of Good Hope from 1907 to 1927[331], as he worked alongside Her Majesty's Royal Astronomer at the Cape at the time, Mr. H. S. Jones. Halm's main role was to assist Jones in "determining the solar parallax (distance of the Sun) through observations of Mars."[332] A. W Long is also a very important figure to mention as he was in fact one of the individuals who advocated for the establishment of the

[329] Astronomical Society of Southern Africa: "ASSA Archive – Cape Centre: History of the Cape Centre. URL: http://assa.saao.ac.za/sections/history/assa-archive/assa_archive_cape_centre/. Accessed: 21 July 2021.
[330] Cape Astronomical Association, "Summary of Annual Report, Session 1921-2," *Journal of the Astronomical Society of South Africa,* 1923, 1, 1, p. 14.
[331] Glass: "Jacob Karl Ernst Halm (1865 – 1944)," *Monthly Notes of the Astronomical Society of Southern Africa,* 73, 1 & 2, 2014, p. 14.
[332] *Ibid*, p. 18.

Cape Astronomical Association in 1912.[333] He served as a member of the Council from the very beginning and moved up the ranks to become joint vice-president in 1916 and then president in 1921. For 25 years, A. W. Long prepared monthly star charts that were published in the *Cape Times* and were circulated through South Africa.[334] This made him an important contributor to the dissemination of astronomical knowledge amongst the population of South Africa, which ties closely with the notion that certain individuals and their publications in print media and journals were crucial in promoting the study of the stars in South Africa. In addition, what these two examples show is that there was indeed some significant progress being made within the society at the time of its formation and a wide variety of individuals were making their scientific and academic contributions to it.

The Astronomical Society of Southern Africa still exists today and continues to advocate the importance of astronomy and outer space research. The Society's continued commitment and contribution to the advancement of astronomy in South Africa were significant. Indeed, arguably, without the development of such a well-established, well-connected organisation, such as the ASSA, astronomy in South Africa may not have grown at the rate that it did during the early 1900s. Along with sharing astronomical information and research, the role of the society was not only to connect members of the general public and members of academia who shared the enthusiasm for a similar endeavour. In a recent virtual interview with Dr. Ian Glass, who was a member of the Society and who worked as a primary researcher and developer at the South African Astronomical Observatory, he claimed that the Society was initially made up of some "very serious amateurs" and then some astronomers from the professional community. This reveals a close connection between the two groups, and also draws attention to the necessity of mentioning the inputs of both groups when talking about the historical development of astronomy in South Africa. For example, Valls-Gabaud and Boksenberg claim that astronomy is one of the few sciences where amateurs still play an essential role.[335] This is likely because amateur astronomers make observations and calculations in their free time, more as a hobby than an occupation, and they are encouraged

[333] C. Plug, "Long, Mr. Arthur William," *S2A3 Biographical Database of Southern African Science,* 2020, URL: http://www.s2a3.org.za/bio/Biograph_final.php?serial=1711. Accessed: 28 July 2021.
[334] *Ibid.*
[335] D. Valls-Gabaud & A. Boksenberg, "The role of astronomy in society and culture," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 7.

to share their findings amongst fellow enthusiasts and members of these kinds of astronomical societies. Even though there are more amateur astronomers than professional astronomers in South Africa,[336] what this subsection argues is that the establishment and availability of astronomical organisations such as the Astronomical Society of Southern Africa, enables a wider scope of communication and learning amongst these two groups, which ultimately contributes significantly to the overall growth of the field.

Furthermore, the Society's contribution to the study of astronomy can be seen in the discoveries and publications it fostered. According to Dr. Glass, summaries of certain discoveries made by both amateurs and professionals were published in the Monthly Notes and then would be later submitted for publication in an international journal. Glass states that "There [were] still amateurs… doing original work and who publish in MNASSA." What this further confirms is that the work and research of both factions of astronomical research, as well as the subsequent publications in both local and international journals, were crucial to the growth and development of the Society as it created awareness and increased interest in what was taking place within the society at the time.

The South African Astronomical Observatory

As discussed in Chapter Four, the establishment of the Union Observatory can be regarded as one of the first developmental shifts in astronomical studies in South Africa during the 18th century. Another key development, which will be discussed in this subsection, is the establishment and construction of the South African Astronomical Observatory. In a recent interview with Professor Peter Martinez, he confirmed that "… the [South African Astronomical] observatory was established through the amalgamation of other existing observatories in South Africa during the 1970s. There were telescopes in Pretoria, the Radcliffe telescope, there was a telescope in Johannesburg, there were two telescopes in Cape Town that were combined and established by the CSIR."[337] The CSIR is the Council for Scientific and Industrial Research in South Africa, and it was established by the government

[336] R. S. Stobie, "The Future of Astronomy in South Africa," *Monthly Notes of the Astronomical Society of Southern Africa,* 55, 9 & 10, 1995, p. 122.
[337] Interview with Professor Peter Martinez conducted by Paige Smith, via Zoom, Cape Town, 5 July 2021.

in 1945 with the primary aim of advocating the development of science and technology in South Africa.[338]

The CSIR played a key role in funding and supporting the amalgamation of the various observatories across the country. Dr Ian Glass further substantiates this in saying that the government supported the amalgamation and that the Royal Observatory was merged with the Union Observatory in 1972.[339] Therefore, as a result of this large scale effort, "from the late 70s and throughout the 80s and 90s, the South African Astronomical Observatory became the leading institution for optical astronomy on the African continent."[340] Even prior to the observatory becoming a national establishment, the original observatory has continued to operate, under a variety of names, since 1820 with the Royal Observatory being the main facility back then. Martinez confirms that the observatory is a key facility in the development of astronomy in South Africa because it hosts and operates many large telescopes, which are available to both the international and local scientific community. This gives the sense that the observatory facilitates a global system of mutual interest in the stars and the betterment of science. Martinez is quoted saying that "it [the South African Astronomical Observatory] played a major role in the sense that all the senior South African astronomers in the country today received their training at SAAO if they were observing astronomers."[341] What this indicates is that this national facility has an ongoing legacy and involvement in the development of astronomy in South Africa, particularly as an academic discipline. This is because the observatory enabled practicing astronomers from all over the world to learn new techniques, test out new equipment and share their observations and data amongst themselves, within the global interconnected field of science.

Another individual with close ties to the South African Astronomical Observatory is Dr. Ian Glass. Dr. Glass has an extensive history of involvement in the development of the observatory and the activities it was involved in. In his early years as a PhD student and later as an astronomer, Dr. Glass was involved in X-ray astronomy and radio astronomy. When

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[338] *CSIR Through the Years: a selection of highlights from our research and technological innovation journey.* URL: https://www.csir.co.za/our-history. Accessed: 20 July 2021.
[339] Interview with Dr. Ian Glass conducted by Paige Smith, via Zoom, Cape Town, 22 June 2021.
[340] Interview with Professor Peter Martinez conducted by Paige Smith, via Zoom, Cape Town, 5 July 2021.
[341] Interview with Professor Peter Martinez conducted by Paige Smith, via Zoom, Cape Town, 5 July 2021.

asked about his personal contribution to the institution, Glass mentions that he was more involved in the technical side of astronomy than most other astronomers and he developed a number of key technologies at the observatory such as infrared telescopes and software. "I felt any instrument I built I should use and get the most out of. In those days, infrared was still a fairly young subject and so it was quite easy to find… interesting things to do with the equipment I built…"[342] Once his equipment was constructed and operational, Glass states that the other astronomers associated with the Observatory, as well as some international scholars who travelled to Cape Town during that time, were interested in using the equipment he had developed. "A quarter or third of the activity at the Observatory was to do with infrared, mostly because I had introduced it and made it possible…"[343]

Along with the development of new technologies and techniques, the South African Astronomical Observatory was shaped by its directors, engineers, scientists, and scholars. Many of the projects and research carried out at SAAO included international collaborations with astronomers from all over the globe. Stobie claims that the Observatory has a unique advantage being the primary observatory for optical and infrared astronomy in Africa. This is because SAAO fulfils the role of making astronomy available to other African countries, to boost their scientific and technological development.[344] Professor Peter Martinez supports this claim by stating that "the observatory played a critical role in keeping, at least a part, of the South African scientific community engaged internationally… they did some extremely good work in several branches of astronomy and really fundamental work that underpins many of the subsequent developments."[345]

This statement presents the notion that the South African Astronomical Observatory was integral to the infrastructural as well as the academic and technological development of astronomy. The institution did not only bring together like minded individuals, with particular skill sets and training, but it also assisted in launching South Africa into the international scientific arena and presented South African astronomy as a viable and successful endeavour to pursue. Moreover, the formation of the Astronomical Society and other research groups

[342] Interview with Dr. Ian Glass conducted by Paige Smith, via Zoom, Cape Town, 22 June 2021.
[343] Interview with Dr. Ian Glass conducted by Paige Smith, via Zoom, Cape Town, 22 June 2021.
[344] Stobie, "The Future of Astronomy in South Africa," p. 124.
[345] Interview with Professor Peter Martinez conducted by Paige Smith, via Zoom, Cape Town, 5 July 2021.

can be closely attributed to the Observatory itself, as it was the first formally recognised national institution that enabled scientists and astronomers to carry out their work. Dr. Ian Glass was a very influential individual during his early years at SAAO because he was one of the primary technicians and researchers involved with the construction, maintenance, and improvement of the Observatory's equipment. When asked, in a recent interview about his contributions to the technology at the Observatory, Dr. Glass stated that he was "probably more involved than most astronomers in the technical side of astronomy, designing instruments… also programming them [and] using them. I felt that any instrument I built I should use and get the most out of."[346]

Considering the two above-mentioned examples of locally established astronomical institutions and groups in the previous section, South Africa has been, and still remains, very active in astronomy, both locally and internationally. This is because, with a number of formally established observatories and inter-connected research groups, there is also a significant amount of foreign interest in the astronomical activities that have been carried in the country throughout the 20th and into the 21st century.[347] These international collaborations can be seen as a further impetus for development in the field as it opens up the country. The following subsection investigates several international collaborations that have occurred within the field of astronomy and outer space research in the early 20th century.

International boycotts and collaborations

"Astronomy is a subject that naturally promotes partnership and cooperation internationally."[348] This is because astronomy is an expensive and time-consuming practice, it often requires the input and observations of a number of people from various places in the world. In order for the cosmos to be holistically studied and understood, there is a need for the collaboration and communication between scientists, astronomers, physicists, and other scholars in related fields. The main argument of this subsection is that the development of astronomy in South Africa can also be attributed to the international connections and collaborations that were fostered during its development process. In addition to this, there are also some instances

[346] Interview with Dr. Ian Glass conducted by Paige Smith, via Zoom, Cape Town, 22 June 2021.
[347] Evans, "Historical Notes on Astronomy in South Africa," *Vistas in Astronomy,* 9, 1967, p. 265.
[348] Valls-Gabaud, & Boksenberg, "The role of astronomy in society and culture," p. 6.

where international sanctions and political boycotts hindered development in the field of science and technology, which would have had an overall effect on the development of astronomical growth later on. Therefore, this subsection gives a very brief contextualisation of the South African historiography during the apartheid era, focusing specifically on the period between the election of the NP government in 1948 and the first democratic elections in 1994. This contextualisation is then used to discuss how the international boycotts that South Africa experienced during this period, as well as the subsequent international collaborations in astronomy and science, influenced the development of astronomy in the country over time.

Even before 1948, the segregation of racial groups in South Africa was a prevalent feature of South African society. For example, the 1903–05 South African Native Affairs Commission was one of the first displays of racial segregation in South Africa.[349] The Commission essentially culminated in the 1913 Land Act, which promoted a system of "territorial separation" where Africans were to be moved to land that was specifically earmarked for African reserves.[350] However, when the National Party was elected into power in 1948, the party's primary aim was to institutionalise racial segregation between 'Europeans' or 'Whites' and 'coloureds' or 'Natives' [to use the nomenclature of the time]. Early apartheid policies aimed "to deepen [the] existing racial segregation between European and Native populations, in order to consolidate economic prosperity and political power for white South Africans."[351] Other interpretations of said segregation policies are presented by Paul Rich and Martin Legassick. Legassick emphasizes the role of class, rather than ethnicity, in the process of segregation. His idea was that racial ideas underpinned a segregationist ideology that was utilised in an attempt to systematise "a doctrine of pre-capitalist economies in the Africa reserves." Paul Rich presents his opinion in a paper which reflects on the legitimization of white supremacy in South Africa prior to the election of the NP government in 1948, and his

[349] S. Dubow, *Racial segregation and the origins of apartheid in South Africa, 1919 – 36,* (United States of America, Palgrave Macmillan, 1989), p. 5.
[350] Dubow, *Racial segregation and the origins of apartheid in South Africa, 1919 – 36,* p. 5.
[351] J. Seekings, "The National Party and the Ideology of Welfare in South African under Apartheid," *Journal of Southern African Studies,* 46, 6, 2020, p. 1150.

paper ultimately argues that segregation ideologies cannot not be regarded as "merely rationalisation[s] of capitalist class interests in South Africa" at the time.[352]

The period of political transition in South Africa, which emerged after the first democratic elections held in 1994, has since been characterised by a number of discussions and debates about the segregationist policies of the apartheid government. As a result, the apartheid era has been critically analysed, interpreted, and debated by many scholars. The justifications for and ideology behind apartheid has been investigated in terms of its segregationist and discriminatory basis, and there are several contrasting arguments pertaining to its origin and development over time.[353] The term 'apartheid' itself is said to have only emerged in the early 1940s, when it first appeared in an article of *Die Burger* in 1943.[354] In January 1944, D. F. Malan elaborated on the term, stating that 'apartheid' is a system that "will give the various races the opportunity of uplifting themselves on the basis of what is their own."[355] What is particularly interesting about this statement is that what apartheid turned out to be and how it is described by Malan were two entirely different things. The apartheid era was characterised by widespread discrimination, racial tensions and legislation that ultimately resulted in the country becoming divided along racial and ethnic lines. The NP, the ruling party at the time, was largely responsible for this as their apartheid legislations forced people of colour to become marginalised, and in some cases excluded, from South African society.

The political and social agenda of the apartheid government was pilloried by many countries and international administrations. News began to travel about the injustices and mistreatment of the majority of the South African population across the globe. Many international governments imposed economic, political, and social sanctions on South Africa, in an attempt to force the South African state to reconsider their Apartheid legislation. From the 1950s, until 1994, South Africa was subjected to a variety of international sanctions and boycotts,

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[352] P. Rich, "Race, Science, and the Legitimization of White Supremacy in South Africa, 1902 – 1940," *The International Journal of African Historical Studies,* 23, 4, 1990, p. 666.
[353] For further discussions on this refer to: P. Alexander, *Workers, War & the Origins of Apartheid; labour and politics in South Africa, 1939 -48*; S. Dubow, *Racial segregation and the origins of apartheid in South Africa, 1919 – 36*; D. A. Lowenberg. & W. H. Kaempfer, *The Origins and Demise of South African apartheid: a public choice analysis.*
[354] H. Giliomee, "The Making of the Apartheid Plan, 1929 – 1948," *Journal of Southern African Studies,* 29, 2, 2003, p. 374.
[355] *Ibid.*

which were largely aimed at reducing the country's access to resources, connections to political allies and ultimately also aimed at limiting their communication and collaboration with other countries in terms of research, medicine, education, technology, finance, trade, and manufacturing. For example, by 1960, countries like India, Jamaica, Antigua, and Malaya had already imposed sanctions on South Africa, while Britain tried to maintain strategic and economic links as best as possible until the 1980s.[356] One of the most serious of boycotts at this time were financial sanctions, which could have caused half a percentage point loss of GDP for the country in the mid-1980s.[357]

Academic boycotts impacted on South Africa's overall output and standing within the global academic arena. Throughout the apartheid era, the control and regulation of access to education and knowledge was used as means of imposing subjugation and social segregation.[358] According to Dubow and Beinart, the rise of segregation and apartheid legislation "established an extreme system of racial division that for many years excluded the bulk of the population from scientific training and opportunity."[359] However, in some respects, the roles became reversed once international institutions and administrations imposed their own form of segregation and subjugation on South Africa. One example of an academic boycott in South Africa during this time was known as the 'book boycott'. This international academic boycott of South African universities was launched by British academics in 1957, and it had a significant impact on tertiary education and scientific departments' access to information.[360] This was because governments, publishers, vendors and libraries took action and denied materials to be sent to South Africa.[361] Universities lacked access to published study materials and thus had to rely on other means, such as illegal photocopying, to get information to students in schools and universities. On top of this, it also resulted in fewer international scholars, scientists, and students travelling to South Africa for joint research projects, and restrictions placed on South African scholars from entering foreign countries. For example,

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[356] S. Dubow, "New Approaches to High Apartheid and Anti-Apartheid," *South African Historical Journal,* 69, 2, 2017, p. 311.
[357] S. Dubow, *Apartheid 1948 – 1994,* (United Kingdom, Oxford University Press, 2014). p. 224.
[358] E. Gray, and L. Czerniewicz, "Access to Learning Resources in Post-apartheid South Africa," from *Shadow Libraries: Access to Knowledge in Global Higher Education,* p. 108.
[359] W. Beinart, & S. Dubow, *The Scientific Imagination in South Africa: 1700 to the Present,* (United Kingdom, Cambridge University Press, 2021), p. 3.
[360] Gray and Czerniewicz, "Access to Learning Resources in Post-apartheid South Africa," p. 112.
[361] F. W. Lancaster & L. J. Haricombe, "Anatomy of a Book Boycott," *American Libraries,* 26, 7, 1995, p. 685.

according to a United Nations document calling for concerted international action against Apartheid South Africa, "In 1974, the Government of Japan decided that no visas would be issued to South African nationals for the purpose of interchanges in the fields of sport, culture and education."[362] Other stipulations of the boycott are outlined by Lancaster and Haricombe. They include "refusal to publish South African manuscripts internationally, the refusal of international scholars to collaborate with South Africans, refusal by some publishers to provide access to information (e.g., books, computer software.) and [the] denial of access to South African academics by certain institutions abroad."[363] What these stipulations indicate is that the overall aim of the academic boycott on South Africa was to drastically reduce academic output from the country as well as deny access to information for South African scholars. This an attempt to force the ruling government to reform their segregation policies. These international boycotts are a key factor to mention here because the period of reduced contact between South Africa and international research organisations, universities and academics resulted in a disruption in the overall development of South Africa's scientific and academic fields, astronomy included.

Despite the political turmoil that transpired during and shortly after the Apartheid era, South Africa entered into a transition period. Following the first democratic elections in 1994, there were some shifts in the international perspective of the country and its government. As a result, there was a gradual reopening of communication and interaction between South Africa and the rest of the world. One of the largest areas for development was science and technology. As this thesis focuses specifically on developments of science and research in the field of astronomy, one primary example of international collaboration in the South African context, is the development of a Deep Space Station at Hartebeeshoek in the 1960s.

The Deep Space Station at Hartebeeshoek was initially commissioned by NASA, the National Aeronautics and Space Administration of the United States. The facility should be perceived as an important development in the field of South African astronomy because the station was involved in carrying out a variety of lunar and planetary investigations. The

[362] United Nations Centre against Apartheid, "Call for Concerted International Action Against Apartheid South Africa," *JSTOR Primary Sources,* 12 – 01 – 1985, p. 5.
[363] Lancaster & Haricombe, "Anatomy of a Book Boycott," p. 685.

station can also be seen as an indication of a shift in terms of international relations in astronomy, because prior to this, the majority of astronomical development in the country was as a result of European influences from the Dutch and the British. The contributions made by American astronomical knowledge and technical advances must be mentioned here because they also made significant contributions to the overall development of astronomy and outer space research in the country. For example, Thembisa Waetjen suggests that the Hartebeeshoek facility was designed to "support interplanetary robotic missions..."[364], which further emphasises the importance of the facility, as it was one of the first of its kind in the country. Following the development of the Hartebeeshoek Space Station, the South African government started to focus on "developing local capacity in astronomy… as part of its general investment in boosting national scientific expertise…"[365] While some scholars perceive this as an attempt to boost South Africa's position in both domestic and international space sectors, another popular notion is that these developments were aimed at building up a military-industrial complex as well as boosting socio-economic standings for those in close proximity or directly influenced by the developments. For example, the Square Kilometre Array, which is proposed to be developed near the small town of Carnarvon in the Northern Cape, has had some serious implications for local development and for the people who live in that area.

In a recent interview with Professor Cherryl Walker, who is a professor of Sociology and Social Anthropology at Stellenbosch University and who has an interest in the large-scale impacts of certain infrastructural developments on local people, claims that the sustainable development of the SKA must be maintained in order for all parties to benefit from such a large-scale development. Her main argument is that the primary purpose of the construction of SKA is "… not to serve local development needs, it is [rather] about national development… [and] also about national and global science and astronomy."[366] In her opinion, the local benefits and impacts come secondary to the much larger goal of promoting

[364] T. Waetjen, "Sputnik from Below: Space Age Science and Public Culture in Cold War Southern Africa," *Interventions,* 18, 5, 2016, p. 692.
[365] C. Walker, D. Chinigò, & S. Dubow, "Karoo Futures, Astronomy in Place and Space – Introduction," *Journal of Southern African Studies,* 45, 4, 2019, p. 629.
[366] Interview with Professor Cherryl Walker, conducted by Paige Smith via Microsoft Teams, Cape Town, 13 July 2021.

South Africa as an international player in the astronomical arena. In some sense, one could say that while the local benefits and impacts are only considered after the international and national benefits are reaped, there is one offshoot of such a large development. This is the formalisation and promotion of national pride and interest in the science and research that is to be carried out at the facility as well as increasing awareness around other smaller, but similar, developments.

As the SKA is supported by a global consortium of investors, and has representatives in a number of countries, there is no doubt that having the SKA developed here in South Africa will place the country under the international spotlight for advanced astronomical and scientific research. As previously mentioned, this is a very important factor to consider when looking at the overall development of astronomy, as both a scientific and academic endeavour in the country overtime. Without substantial international support and global collaborations, such as the SKA, it would be very difficult for a country like South Africa to succeed. This is not to say that South Africa has failed to succeed in astronomical studies prior to the bid for SKA being placed and subsequently awarded, but there are certainly some grounds to state that without the international community supporting the SKA in South Africa, there would have been little chance of success for South Africa on her own. In an interview with Professor Martinez, which was carried out by the primary researcher on the 5th of July 2021, Martinez supported the claim that international collaborations are crucial to the development of astronomy on a local level because "…the development of SALT and to a larger extent, MeerKAT, and SKA, those have greatly enlarged the astronomical community. In fact, MeerKAT and SKA have changed the character of the astronomical community in South Africa in several ways."[367] This further substantiates the argument that international collaborations are specifically influential in scientific and astronomical development. Another interesting international connection within the field that is important to mention, one which closely links South Africa to the global scientific community, is the Royal Society of South Africa. The society was first established in 1908 by King Edward VII, after he signed a charter establishing the Royal Society of South Africa. According to Jane Carruthers, the society was formed with the primary intention of providing "an institutional structure to

[367] Interview with Professor Peter Martinez conducted by Paige Smith, via Zoom, Cape Town, 5 July 2021.

generate and share knowledge," but its other goals was to promote local and international scientific excellence and education as well as provide a place for research and academic collaborations.[368] The first President of the Royal Society in South Africa was Sydney S. Hough, who was an English astronomer, a Fellow of the Royal Society of London as well as His Majesty's Astronomer at the Cape in 1907 until 1923. Over time, the Society was known to have brought a number of international scholars, academics, and scientists together, each of whom contributed to growing astronomical knowledge and expertise in South Africa and abroad through collaborative activities and data dissemination.

Lastly, possibly one of the largest international collaborative efforts in astronomy is the International Astronomical Union (IAU). The Union was established after negotiations between the Royal Society of England and the Paris Academy of Science led to the formation of the International Research Council in 1919.[369] The research council's main purpose was to promote international co-operation in scientific research, and it was in charge of organising a group of international unions dealing with various fields of science – the International Astronomical Union was one of the first of these unions that was established.[370] The International Astronomical Union became the leading astronomical organisation, made up of members from a variety of countries across the globe.

South Africa joined the International Astronomical Union in 1920,[371] and according to Peter Martinez, South Africa dominates African membership within the IAU, holding 45% of the African membership.[372] Over a period of three years, between 2006 and 2008, African membership within the IAU increased by 13%, with South Africa contributing the largest portion of this percentage.[373] As Martinez states, this increase is a good reflection of a growth in astronomical communities in South Africa. The role of the IAU in the fostering and

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[368] J. Carruthers, "Scientists in Society: The Royal Society of South Africa," *Transactions of the Royal Society of South Africa,* 63, 1, 2008, p. 2.
[369] W. S. Adams, "The History of the International Astronomical Union," *Publications of the Astronomical Society of the Pacific,* 61, 358, 1949, p. 8.
[370] *Ibid.*
[371] L. L. Leeuw & J. Holbrook, "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," *Under One Sky: The IAU Centenary Symposium Proceedings IAU Symposium,* 349, 2019, p. 242.
[372] P. Martinez, "Building capacity for astronomy research and education in Africa," *Astronomy for the developing world IAU Special Session,* 5, 2006, p. 90.
[373] *Ibid.*

maintenance of astronomical interest is important to mention here because being a member of the IAU, offers the opportunity for scholars, scientists, and astronomers from various member countries to connect and collaborate with each other in various fields of astronomy. The IAU is also largely involved in establishing and administering "astronomy outreach projects in developing countries,"[374] which can be seen as a way of generating more interest and development in the field. According to Dr. Delhaize, the IAU develops curriculum programmes for students in schools, which are all based on astronomy but focus on certain aspects like history and literature as well as science.[375] George Miley supports this by stating that the IAU "conducts a range of activities directed towards education and development, with emphasis on universities and research."[376] In conjunction with fostering interest and generating knowledge amongst students, the IAU and its activities are also largely motivated by the notion that all countries should be given the opportunity to participate in international astronomical research, in order to collectively contribute to astronomy development in as many countries as possible.[377]

With these discussions in mind, despite the political and social upheaval caused by the apartheid regime, South Africa was still successful in promoting itself as a potential partner for international collaborations and research projects. With the SKA being a primary example, one can see that there has been a significant shift away from the previous animosity towards and rejection of South Africa during apartheid, to a more inclusive, mutually beneficial system of development. Leeuw and Holbrook make the claim that two centuries ago, astronomy was used to improve knowledge of star positions and for navigation purposes, which was ultimately the central development that enabled the British to establish the Cape Colony. However, in present times, astronomy has come to be the centre of development in South Africa, "through its digital, big data and scientific advances, as well as human capital development."[378] With this notion in mind, what this chapter has attempted to show is that despite South Africa's destructive and troubled past, the country was still able to resurface as

[374] Interview with Dr. Jacinta Delhaize, conducted by Paige Smith via Zoom, Cape Town, 23 June 2021.
[375] Interview with Dr. Jacinta Delhaize, conducted by Paige Smith via Zoom, Cape Town, 23 June 2021.
[376] G. Miley, "Astronomy for international development," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 544.
[377] *Ibid,* p. 543.
[378] Leeuw & Holbrook, "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," p. 246.

a major player in the international arena of science and technology, while simultaneously situating itself as an influential contributor to astronomical development and research.

Chapter Six: The recognition of Astronomy as an academic discipline in South Africa, c. 1929 – 1970.

> "If South Africa is to succeed in the world, we must establish a culture here which will allow science and technology to flourish. To do this we must diffuse an understanding of what science is all about throughout the entire population, at every level of age and education."[379]
>
> M. Feast, 1996

The development of any academic discipline is seldom linear, nor uncomplicated. As with all changes in academia, science, and technology there are a number of factors that directly and indirectly influence the formation, growth, and establishment of an academic subject. "Most contemporary historians of any national literature… recognise that ideas derived from philosophical systems have had a wide, and sometimes a profound and decisive influence upon the minds and the writings of the authors whose works they study…"[380] From a political perspective, scholars such as Keith Gottschalk and Peter Martinez claim that outer space research and astronomy development in South Africa was largely driven by political changes, rather than for the benefit of the field and industry as a whole. In a general sense, Gottschalk claims that space related sciences such as Astronautics and Astronomy often develop in relation to one another, as he states that "the political drivers for astronautics and astronomy hugely overlap."[381] This suggests that the early advancement of astronomical research and the subsequent development of outer space-related infrastructure, both locally and internationally, can be linked to the combined effort of governments, scientists and scholars within the field of astronomy. This is one argument that emerges throughout the literature on the topic, however it should not be considered as the only argument. While Gottschalk presents a valid argument, the early development of astronomy was in fact driven more by a public interest in outer space observation and research, and thus only later morphed into a fully recognised scientific and academic subject.

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[379] M. Feast, "South African Astronomy: Lessons for the Future from the Past," *Monthly Notes of the Astronomical Society of South Africa*, 55, 1996, p. 9.
[380] A. O. Lovejoy, "Reflections on the History of Ideas," *Journal of the History of Ideas,* 1, 1, 1940, p. 6.
[381] K. Gottschalk, "South Africa's space programme – Past, present, future," *Astropolitics,* 8, 1, 2010, p. 35.

Professionals and amateurs as teachers of astronomy

"The pursuit of astronomy as a scientific discipline in a country requires a much higher level of professional and political commitment than the popularisation of astronomy."[382] This statement by Peter Martinez shows that there is a divide between the professional and amateur factions of researchers in the astronomical field. However, considering all the above-mentioned developments within South African astronomy, within both the amateur and professional sphere, there is some justification to challenge this statement. This can be said as, with the contributions made by locally led astronomical societies and institutions, such as the ASSA and SAAO, there is little room to doubt that amateur astronomers, some who may not have had any prior tertiary schooling in the field, were still able to make contributions to the field through their own private activities. This chapter therefore seeks to summarise the development of astronomy as an academic discipline in South Africa. This chapter will draw together a number of arguments presented in previous chapters in order to create a cohesive timeline of development in the country over time.

With the establishment of the Royal Observatory at the Cape of Good Hope in 1820 and the formation of local astronomical research groups in the early 1900s, the teaching and practice of astronomy in South Africa was in fact occurring long before the subject was formally introduced as a subject of inquiry at tertiary education institutions. This is because the collaboration between professional and amateur astronomers who worked in astronomical institutions, like observatories, and the sharing of astronomical data across various astronomical organisations, enabled the study of astronomy to occur long before it was formally introduced at tertiary education level. Drawing on evidence from reports of the Astronomical Society of Southern Africa, there is evidence of certain scholars, scientists, professionals, and amateurs being involved in the sharing of information and research amongst fellow members at annual meetings. In addition to this, the publication of astronomical journals, reports and articles detailing various recent discoveries and astronomical theories were also a crucial aspect of sharing knowledge and educating those who were interested in the field. The 1923 report of Council of the Astronomical Society of South Africa states that free copies of the Astronomical Society's journal for that year were

[382] P. Martinez: "Building capacity for astronomy research and education in Africa," p. 89.

provided to all members of the Society as well as were made available to 9 South African newspapers, and the publication featured 5 publications relating to astronomical subjects.[383] The report also mentions that the main objectives of the society are to encourage and stimulate the study of astronomy throughout South Africa and to maintain the association of observers and their organisation in the work of astronomical observation and research.[384] What this shows is that the organisation was focused largely on facilitating the collaboration of scientists, astronomers and other scholars in the field of astronomy as well as sharing information about the discoveries and research carried out by members. The publication of Astronomical Journals and Reports of the Society would also contribute to increasing interest amongst people to join the society. As explained in the 1990 Astronomical Society of Southern Africa Handbook, the Astronomical Society is "a body consisting of both amateur and professional astronomers [in which] membership is open to all interested persons, regardless of knowledge or experience."[385]

The inclusion of amateur astronomers in various astronomical organisations and institutions is also an important factor to discuss because amateurs tend to pursue astronomy as more of a hobby than a dedicated career. There are some instances where amateur astronomers are in fact professionals in other scientific and technical fields, and thus their training in those fields makes them very much equipped to participate in astronomical research as well. J. R. Percy mentions that "amateur astronomers are united by one characteristic – their interest and enthusiasm for astronomy."[386] The enthusiasm and dedication to astronomy by amateurs means that amateurs are able to make significant contributions to the growth of the field, sometimes even more so than professionals.[387] In addition to this, the seemingly simple observational nature of astronomy often allows for the inclusion of amateurs because, in a very basic sense, one does not require much skill, technology or technique to look up at the night sky and take regular notes on what one sees. According to Marc Rothenberg,

[383] Astronomical Society of South Africa, "Report of Council for Year Ended 25th July 1923," p. 66.
[384] Astronomical Society of South Africa, "Report of Council for Year Ended 25th July 1923," p. 66.
[385] Astronomical Society of Southern Africa, "Astronomical Handbook for Southern Africa 1990," p. 2.
[386] J. R. Percy, "The Role of Amateur Astronomers in Astronomy Education," in *International Astronomical Union Colloquium,* 162, p. 205.
[387] J. M. Bailey & D. Lombardi, "Blazing the Trail for Astronomy Education Research," *Journal of Astronomy & Earth Sciences Education,* 2, 2, 2015, p. 77.

professional astronomers soon came to realise that individuals with "…limited training and access to relatively small instrumentation could still contribute to the progress of science."[388]

Despite the study of astronomy being regarded as an 'exclusive' area for learning and for the acquisition of specific skills, as well as the fact that is often seen to be dominated by professionals, there are some instances where amateurs played a role in the formalisation of astronomy within the country and various institutions. One example is Sir John Herschel. While his role in and contributions to the development of astronomy at the Cape was previously discussed in Chapter 3, he is mentioned here again because he was an independent astronomer who "played a leading role in devising a state-funded educational system that … [was] geared to the acquisition of secular and scientific knowledge."[389] When he arrived at the Cape of Good Hope in 1834, he constructed his own private telescope in his garden in the rural areas of Claremont, and spent long hours gazing at the night sky, keeping a record of the star clusters, nebulae and double stars that he observed.[390] While holding the title of astronomer and being a leading member of the Royal Society of London, Herschel was also elected the president of the South African Literary and Scientific Institution in 1834. His impact on this organisation's activities were significant because he was able to turn attention to metropolitan scientific concerns. Through his various positions of authority, Herschel was involved in the initiation of a number of scientific projects at the Cape and collaborated with other scholars to "found a state-funded educational system at the Cape."[391] While he was not directly associated with the Royal Observatory at the Cape, he did develop a strong professional relationship with Thomas Maclear, who was the astronomer royal at the time.

Astronomy in academia

Considering that astronomy had been practiced in South Africa since the 17th century, it is surprising to see that astronomy, at academic institutions, was only offered from the 1970s onwards. This was considerably later than the rest of the world, as American universities had

[388] M. Rothenberg, "Organisation and Control: Professionals and Amateurs in American Astronomy, 1899 – 1918," *Social Studies of Science,* 11, 3, 1981, p. 306.
[389] S. Dubow, "Global Science, National Horizons: South Africa in Deep Time and Space," *The Historical Journal,* 63, 5, 2020, p. 1083.
[390] *Ibid.*
[391] J. Carruthers, "Scientists in society: The Royal Society of South Africa," *Transactions of the Royal Society of South Africa,* 63, 1, 2008, p. 8.

begun to establish astronomy curricula in the 1960s, as a result of the upsurge in astronomical interest and the demographics of the community.[392] In addition to this, astronomy programmes saw a marked increase in participation in astronomy programmes at Caltech between 1948 and 1972.[393] This indicates that academic programmes were being offered at institutions from the 1940s, which is substantially earlier than South Africa. Kevin Donnelly speaks to the growth of astronomy in Europe and America during the early 19th century by stating that "the popularity of astronomy was reflected by a tremendous interest in creating national, public and private observatories."[394] Over a period of a century, between 1810 and 1910 the number of European and American observatories increased sevenfold, from 31 to 234.[395] This is another example which shows how the development of astronomy, at an academic and institutional level in other countries, has been occurring for many years prior to when South Africa emerged.

In South Africa, while some school subjects, like maths, physics, and chemistry, would have built the foundation for later education in the highly scientific field, there were no formal undergraduate degrees or courses offered in the field of astronomy. One reason for this was because, as stated by Peter Martinez, space activities in South Africa had previously taken place "…in an isolated, uncoordinated *ad hoc* fashion."[396] However, with the emergence of local astronomical groups in the early 1900s, one could say that these groups were the first to propel astronomical studies into the academic realm. This can be said as a large amount of information and knowledge was disseminated amongst these groups and thus could have facilitated later astronomical development into a more formalised field. As discussed in the previous chapter, the role of astronomical societies and institutions, such as the South African Astronomical Observatory and the Astronomical Society of Southern Africa, was not only to gather researchers and like-minded individuals under one governing body. These organisations were also instrumental in the dissemination of information and the further education of its members.

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[392] W. P. McCray, "How Astronomers Digitized the Sky," *Technology and Culture,* 55, 4, 2014, p. 915.
[393] *Ibid.*
[394] K. Donnelly, "On the boredom of science: positional astronomy in the nineteenth century," p. 485.
[395] *Ibid.*
[396] P. Martinez, "The development and initial implementation of South Africa's national space policy," *Space Policy,* 37, 2016, p. 31.

In order to explain this notion further, one can begin by looking at the role of organised scientific groups that emerged in South Africa during the late 18th and early 19th centuries. According to Rothenberg, the inclusion of amateur astronomers in this field of research and discovery required a "complex organisational structure," in order to effectively administer and monitor the discipline.[397] The growing popularity and widespread interest in astronomy during the late 18th and early 19th centuries therefore necessitated the establishment of a national astronomical society, which was dominated by professionals. However, with that being said, the community of professional astronomers has doubled in the last 15 years, but still remains relatively small.[398] Whitelock explains further that the largest proportion of these professionals are involved in optical astronomy, while some are involved in radio astronomy which has been on the rise as well.

In South Africa, the national society for astronomy was established as the Astronomical Society of Southern Africa in 1922. It included members from all over the country, with two main branches operating in Cape Town and Johannesburg, thus it already had a broader reach beyond the borders of the nation-state. This national body of amateurs and professionals was designed for optimal productivity and favourable research outputs. A common stereotype that exists in the field is that professionals are better trained and are thus seen to be better equipped to achieve and succeed in their chosen field. However, what previous chapters have demonstrated, this was not always the case. Growing interest amongst the general public resulted in the emergence of specialised societies, which were ultimately dominated by amateurs. It was within these societies that a large amount of learning and dissemination of information occurred. The ASSA held regular meetings, usually once a month and then one larger meeting annually, and these gatherings offered a perfect opportunity to present astronomical theories and information to members. At most meetings, a series of lectures and seminars were organised, and, in many instances, these discussions were presented by both amateurs and professionals. Thus, it can be argued that these societies were the ones to lay the early foundations of astronomical education in South Africa.

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[397] Rothenberg, "Organisation and Control: Professionals and Amateurs in American Astronomy, 1899 – 1918," p. 306.
[398] P. A. Whitelock, "Astronomy in post-apartheid South Africa," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium*, 260, 2009, p. 592.

Considering the widespread influence that astronomy and outer space research has on people, it is plausible that this could have been a motivating factor behind the effort to establish a better coordinated collection of organisations and operations. Furthermore, there is also very little doubt that in order for any significant social, economic, or technological development to take place in the astronomical field, it was necessary for all outer space-related organisations, astronomical agencies, and scientific developers, as well as the activities they engaged in, to be coordinated and connected with one another. In order for a national programme of interconnected organisations and individuals, there is also a need to establish a well-rounded education system, which can facilitate the continued improvement and success of the field over time. Astronomy has become an important driver for the development of advanced technology in global science and the link between astronomy and tertiary education makes a major contribution to furthering this kind of development. Students are often drawn to the study of physical sciences at university level and this interest is important for the study of astronomy because it provides "an excellent preparation for many careers in technology and management."[399]

Astronomy was introduced as a formally recognised academic discipline in South African universities in 1970, with the establishment of the country's first Department of Astronomy at the University of Cape Town (UCT). In an interview with Professor Patrick Woudt, who is the current Head of the Astronomy Department at UCT, it was confirmed that the first official Department of Astronomy was established there in 1970, and that it was as a result of the extension of the pre-existing Physics Department. According to Woudt, an individual by the name of Dick Stoy was an honorary professor in Physics and Astronomy within the Physics Department at the time and around the period of his retirement, "the university then made the choice to set up an astronomy department to ensure continuity of the work that was [being] done."[400] Martinez suggests in his discussion on capacity building in astronomy research and education, it is crucial to ensure that the necessary "human capital is developed through training,"[401] and this notion can be closely applied to the development of tertiary education in the field of astronomy. In the case of Southern African tertiary institutions, there is a need to

[399] G. Miley, "Astronomy for international development," *The Role of Astronomy in Society and Culture Proceedings IAU Symposium*, 260, 2009, p. 540.
[400] Interview with Professor Patrick Woudt conducted by Paige Smith, via Zoom, Cape Town, 19 July 2021.
[401] Martinez, "Building capacity for astronomy research and education in Africa," p. 93.

invest in the education and training of young students because they can later prove to be very beneficial to the continued improvement of astronomical studies in the country. The teaching of courses and practical techniques is crucial in laying the foundation for further specialisation at university level.

Drawing from statistics and student enrolment records published in the *Monthly Notes of the Astronomical Society of Southern Africa*, it can be said that the establishment of specific departments in the fields of mathematics, physics, and astronomy, contributed to a wider involvement of students in these subjects, while simultaneously enabled the offering of more systematised and specific courses that students could enrol in. These include degrees in astronomy, astrophysics or applied mathematics, to name a few. While these degrees are of course largely diverse from one another, particularly in terms of application and theoretical frameworks, there are some clear overlaps in the focus of certain subjects offered within those courses. The Astronomical Society of Southern Africa online archive was consulted to obtain Reports from Universities published in the MNASSA volumes, to show how enrolment and subjects changed overtime. These reports feature figures from the University of Cape Town, and they are from the years 1979, 1983 and 199 respectively. These reports are from the Department of Astronomy and are used in this chapter to show change over time in terms of student numbers and course options.

The first report is dated 1979 and was compiled by the Head of the Department at that time, Professor Brian Warner. The report is fairly detailed as it mentions "two half courses [in] Descriptive and Mathematical Astronomy" being offered at second year level and that there were a total of 30 and 35 students enrolled in these courses respectively.[402] The report also gives details about the research and extramural activities that are conducted within the Department. Most interestingly, it mentions that Professor Warner was elected as a Fellow of the University of Cape and that he gave a series of evening lectures for the Department of Extra Mural Studies, entitled "History of South African Astronomy" and "General Astronomy" respectively.[403] It is unclear who might have attended these lectures, but there is

[402] B. Warner, "Reports from the Universities: 1979 University of Cape Town, Department of Astronomy," *Monthly Notes of the Astronomical Society of Southern Africa,* 38, 1 & 2, February 1979, p. 2.
[403] *Monthly Notes of the Astronomical Society of Southern Africa,* "Reports from the Universities: 1979 University of Cape Town, Department of Astronomy,", 38, 1 & 2, February 1979, p. 2.

a possibility that students from other departments and faculties might have been in attendance, along with students from within the Department of Astronomy. The hosting of evening lectures at the University is very similar to the seminars and discussions that were held by members of the Astronomical Society of Southern Africa because the information shared and discussed at such gatherings would have undoubtedly spread interest and sparked debate amongst like-minded individuals who were in attendance. Another interesting aspect of this report is the detail it gives on the research that was being carried out by the Department at this time. For example, Professor Warner is mentioned as having "continued his observations of cataclysmic variables" and that "[his] book on the History of the Royal Observatory at the Cape is completed and in press."[404] What this indicates is that a strong connection and interest amongst scholars and professors relating to the growth and development of astronomy in South Africa remained at the forefront of research and discussion, which ultimately translated to further enrolments in years to come.

The second report from 1983, also authored by Warner, gives a bit more insight into the changes in enrolments within the department. For example, the same two second year half courses were still being taught, however enrolment for the Descriptive Astronomy course had increased to 55 students, while the Mathematical Astronomy course enrolment dropped to 24 students.[405] This shows that there was a noticeable trend in increasing interest in Descriptive Astronomy, which can be defined as "A general description of the heavenly bodies; of their magnitudes, distances, motions and configuration; of their appearance and structure."[406] Essentially, Descriptive Astronomy encompasses everything relating to celestial bodies and their movements that are observed or calculated. It can be deduced from these numbers that perhaps the attraction to Descriptive Astronomy was larger due to the night sky being so widely accessible and students could thus draw their own conclusions from their own observations. It is possible that Mathematical Astronomy might have decreased due to the specialised practice of it, especially considering that a fairly well-rounded background in mathematics was required for this course. The research section of this report speaks of a

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[404] *Ibid,* p. 3.
[405] *Monthly Notes of the Astronomical Society of Southern Africa*, "Reports from the Universities: 1983, Department of Astronomy, University of Cape Town,", 42, 1 – 4, April 1983, p. 2.
[406] C. J. White, *Elements of Theoretical and Descriptive Astronomy - 6th Edition,* (New York, John Wiley & Sons, 1896), p. 12.

number of international collaborations between students from the University of Cape Town and other universities abroad. For example, it mentions a study of a star within a particular class, 3A0729+103, that was being carried out in conjunction with the Physics Department at the University of Leicester.[407] This shows that the level of collaboration and communication between South African students and other departments in the world was increasing, thus indicating the general rise in South Africa's inclusion in global astronomical research.

The final report, dated 1997, is a lot more detailed in the sense that it gives more information about changes within the Departmental staff and their appointments. For example, Brian Warner was the Vice President of the Royal Society of South Africa in this year and had subsequently taken over the role as Foreign Secretary as well.[408] This report has a section on travel and collaborations within the Department and gives insight into the work of Patrick Woudt, who at the time was a doctoral student within the department. The report states that Woudt spent one month at the "Observatoire de Paris-Meduon with Dr. Kraan-Korteweg" and while he was there, he continued his search for galaxies beyond the Milky Way, and found over 1500 new galaxies that were in addition to the 7000 that had already been found.[409] This was a fairly remarkable achievement for a doctoral student in the Department at this time and Patrick Woudt, whom is now a Professor in the Department as well as the Head of the Department, reiterated this in a recent interview. "I found… new galaxies in one small part of the universe and that became my PhD." He explains that as a result of this research he has been studying "ultra compact binaries" and now makes use of radio and optical astronomy to do so, for the last 15 to 20 years.[410]

What the above-mentioned discussion seeks to show is that the evolution of astronomical studies and general interest in the subject has been increasing for a number of years. Looking back on the trajectory of astronomical research in the country, from the arrival of European settlers in 1652, there is little doubt that those early foundations, as discussed in Chapter 2,

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[407] *Monthly Notes of the Astronomical Society of Southern Africa*, "Reports from the Universities: 1983, Department of Astronomy, University of Cape Town,", 42, 1 – 4, April 1983, p. 3.
[408] *Monthly Notes of the Astronomical Society of Southern Africa,* "Reports from Institutions, University of Cape Town, Department of Astronomy," 56, 5 – 8, August 1997, p. 59.
[409] *Monthly Notes of the Astronomical Society of Southern Africa,* "Reports from Institutions, University of Cape Town, Department of Astronomy," 56, 5 – 8, August 1997, p. 59.
[410] Interview with Professor Patrick Woudt conducted by Paige Smith via Zoom, Cape Town, 19 July 2021.

have led the country to where it stands today. It can be argued that without the formal institutionalisation of astronomy at tertiary levels and within local astronomical groups, the development of the practice itself, in contemporary terms, would not have occurred the way that it did. Throughout the six chapters, this thesis set out to outline the development of astronomy in South Africa, from the precolonial indigenous knowledge systems of African groups to the development of advanced technology and theoretical explanations for celestial occurrences. Ultimately, the primary argument of this chapter is that the institution of astronomy as an academic discipline in South African universities was the next big step in towards achieving global recognition for the scholarly and scientific advances that have taken place since the 1700s.

Conclusion

Over time astronomy, as a field of scientific and academic enquiry, has produced an insurmountable amount of information and expertise regarding the universe. As previous chapters have highlighted, the study of the stars did not begin with the invention of the telescope or the first sighting of a comet. In a sense, astronomy is rather a field that has progressed alongside human development, a field that has since emerged in many different shapes and forms.

Thomas Jefferson once said, "The field of [scientific] knowledge is the common property of all mankind, and any discoveries we can make in it will be for the benefit of yours and of every other nation, as we are our own."[411] This statement exemplifies the core argument of this thesis as it highlights how science in general has come to be a global study, and those who take part in it have become bound together by the shared goal of gaining a better understanding of the heavens. In terms of astronomy and its development in South Africa, one can draw a similar conclusion as the role of local organisations, research groups, institutions, and individuals each made their own contributions to the overall understanding of astronomy in the country, which would ultimately benefit each of us in the future. By investigating some of the key influences and role players in the historical development of astronomy in South Africa, from the precolonial period to 1970, this thesis has not only provided a cultural and professional history of this development, but it has also highlighted possible avenues for further research.

While this thesis has looked at the indigenous practices of certain southern African groups, the role of European influences and development during the colonial period, as well as the subsequent post-colonial period of development in the field, there remains a lot more to be said on this topic. For example, a more in-depth discussion could be formulated on the role of indigenous cosmological narratives and how it should be reframed and discussed from an anti-colonial perspective. There is room for further discussions on this issue because the existing body of literature pertaining to indigenous cultural practices and astronomical beliefs

[411] D. Valls-Gabaud and A. Boksenberg, "The role of astronomy in society and culture," *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 4.

has largely been used to convey ideas about colonialism, imperialism, and domination by Westernised groups, rather than to share indigenous stories and gain a deeper understanding of their origin and impact on these people. As Govender and Snedegar state, there is still a lot more to be researched about the understandings we draw from indigenous narratives and visual representations of cosmological beliefs, and this can thus be regarded as a potential avenue for further research. Another interesting aspect, which this thesis was not able to comment on, is the implications of Eurocentric ideology and popular culture on our perception of astronomy and its history. This is another potential avenue for further research as there are a number of alternative viewpoints one can draw from in order to challenge the "Great Man" history school of thought. The apparent ongoing discussion in contemporary academic circles is that there are only a select few individuals who feature as the forbearers of advanced scientific thinking and as the providers of clarity on previously unanswered questions, However, as this thesis has attempted to show, there is an extensive cultural history that exists within this field that needs to be addressed in greater detail in order to do it justice.

Lastly, a third avenue of further research is the implications of astronomy development on politics, people, and the places they inhabit. Some scholars have looked into this notion include Cherryl Walker, David Chinigò, Peter Martinez and Keith Snedegar, however there is potential for attention to be given to this aspect. This is because cultural heritage and scientific knowledge are intrinsically linked, and thus this should be acknowledged when considering the development of certain astronomical projects and developments. This thesis touched on the role of the Square Kilometre Array and the Southern African Large Telescope; however, this thesis did not focus on the cultural limitations and implications these developments had on people and places, thus potential for further research lies here.

In summary, one can regard this thesis as an overall attempt to draw connections between the cultural and professionalisation of astronomical development in South Africa over the short and *long durée.* What this thesis has shown is that there is a distinct difference between the two, however both cannot exist in isolation. This is because, based on the cultural interpretation of and links to astronomy in the precolonial period, the development of astronomy in South Africa began long before the arrival of Western settlers. However, by the

same token, Western astronomical developments and practices in the country can also not be seen as an interloper. What this thesis has ultimately argued is that astronomy development in South Africa, particularly from the precolonial period until 1970, was neither a linear nor isolated progression of change. It was rather one that was characterised by shifts in perspective, ideology, and understanding, which in turn, has led the country to where it stands today within the global astronomical field, under the southern skies.

Reference List

Primary Sources

Cape Town Archives (KAB)

KAB GH 1/26 322 Papers received from Secretary of State London: General Dispatches. Erection of an Observatory at the Cape of Good Hope. 1820.

KAB GH 1/131 2056 Papers received from Secretary of State London: General Despatches. Requiring Assistance to be Given to the Officer Proceeding to the Cape for the Erection of a Magnetic Observatory. 1839.

KAB PWD 2/5/83 E43 Cape. Royal Observatory. Mowbray Road. 1892 – 1898.

KAB GH 23/40 95 General Despatches. Regarding Establishment of a Meteorological and Magnetical Observatory. 1895.

KAB GH 23/40 General Despatches. 1893 – 1897.

KAB A515 5/1/8 139 vols. Maclear-Mann Collection. 1811 – 1909.

KAB A515 5/1/8 95 - 96. Maclear-Mann Collection, Diverse Papers. 1837 – 1872.

KAB A515 5/1/8 53 - 59. Maclear-Mann Collection, Diaries. 1840 – 1875.

KAB A515 5/1/8 5/2. Maclear-Mann Collection, Mann Letters. 1811 – 1909.

KAB A515 5/1/8 22/7. Sir David Gill Collection, Diverse Observatory and Astronomical Papers. 1832 – 1833; 1881 – 1882 & undated.

KAB CAD A2436 2/1. Sir David Gill Collection, Letters Received. 1873 – 1890.

KAB CAD A2436 2/5. Sir David Gill Collection, Letters Received. 1873 – 1890.

KAB CAD A2436 5/1 – 5/2 & 6/2. Sir David Gill Collection, Drawings and Diagrams: Drawings Halley's Comet. 1836.

KAB 3/CT 4/1/11/491 G23/73. Memorials, Statues, Monuments, etc. Plaque at site of Abbe de la Caille's astronomical researches. Thomas Cook building, Strand Street. 1970 -1980.

University of Cape Town Centre for Curating the Archive

Collections, The Digital Bleek and Lloyd Collection, University of Cape Town, digitized 1 June 2005, URL: http://lloydbleekcollection.cs.uct.ac.za.

Collections, the Digital Bleek and Lloyd Collection, University of Cape Town, BC 151 A2 1 034, p. 2505 - 2524. URL: http://lloydbleekcollection.cs.uct.ac.za/books/BC_151_A2_1_034/index.html

South African Newspapers

Rand Daily Mail

Oral Sources

Delhaize, J. Physicist and Radio Astronomer, currently conducting radio astronomy research in South Africa with MeerKAT as a fellow at the South African Radio Astronomy Observatory. Interviewed via Zoom by Paige Smith on 23 June 2021.

Glass, I. Professional Infrared and Radio astronomer, scientific historian, author, and Member of the South African Astronomical Observatory. Interviewed via Zoom by Paige Smith on 22 June 2021.

Jarret, J. NRF South African Research Chair in Astrophysics and Space Science, author of publications in infrared astronomy and astrophysics. Interviewed via Zoom by Paige Smith on 23 June 2021.

Martinez, P. Professional Astronomer, Author, former member of the South African Astronomical Observatory, member of the International Astronomical Union, the International Academy of Astronautics, and a Fellow of the Royal Astronomical Society. Interviewed by Paige Smith via Zoom on 5 July 2021.

Van Wyk, J. Professor in the Department of Political Sciences at the University of South Africa, and a South African National Research Foundation rated researcher. Interviewed by Paige Smith via Zoom on 25 June 2021.

Walker, C. Profession of Sociology in the Department of Sociology and Social Anthropology at the University of Stellenbosch. Interviewed by Paige Smith via MS Teams on 13 July 2021.

Woudt, P. Professional astronomy, professor of Astronomy, and Head of the Department in the Astronomy Department of the University of Cape Town. Interviewed by Paige Smith via Zoom on 19 July 2021.

Astronomical Society of Southern Africa Archive

Monthly Notes of the Astronomical Society of Southern Africa, "La Caille's Observatory." 32, 10 11 & 12, December 1973.

Monthly Notes of the Astronomical Society of Southern Africa, "Reports from the Universities: 1979. University of Cape Town, Department of Astronomy." 38, 1 & 2, February 1979.

Monthly Notes of the Astronomical Society of Southern Africa, "Reports from the Universities: 1983. University of Cape Town, Department of Astronomy." 42, 1 - 4, April 1983.

Monthly Notes of the Astronomical Society of Southern Africa, "Reports from Institutions, University of Cape Town, Department of Astronomy." 56, 5 – 8, August 1997.

Secondary Sources

Books and Chapters

Afolayan, F: *Culture and Customs of South Africa,* Greenwood Press, United States of America, 2004.

Alcock, P: "The Stellar Knowledge of Indigenous South Africans," in *African Indigenous Knowledge and the Sciences,* eds. G. Emeagwali and E. Shizha, Sense Publishers, The Netherlands, 2016.

Alcock, P: *Venus Rising: South African Astronomical Beliefs, Customs and Observations,* South Africa, 2014.

Alexander, P: *Workers, War & the origins of apartheid: labour & politics in South Africa 1939-48,* James Currey, Oxford, 2000.

Barnard, A: *Hunters and Herders of Southern Africa: A comparative ethnography of the Khoisan peoples,* Cambridge University Press, Cambridge, 1992.

Barnard, A: *Anthropology and the Bushmen,* Berg, United Kingdom, 2007.
Barnard, A: *Hunters and Herders of Southern Africa: A comparative ethnography of the Khoisan peoples,* Cambridge University Press, Cambridge, 1992.

Beinart, W. & Dubow, S: *The Scientific Imagination in South Africa: 1700 to the Present.* Cambridge University Press, United Kingdom, 2021.

Brier, B & H. Hobbs: *Daily Life of the Ancient Egyptians,* Greenwood Press, United States of America, 1999.

Burns, W. E: *Science in Enlightenment: An Encyclopaedia,* ABC – CLIO, United States of America, 2003.

Chukwuezi, B: "The Relationship between Human Destiny and the Cosmic Forces – A Study of the IGBO Worldview." In *African Cultural Astronomy – Current Archeoastronomy and Ethnoastronomy Research in Africa.* Eds. J. Holbrook, R. T. Medupe & J. O. Urama. Springer Science + Business Media, 2008.

Cape Astronomical Association, "Summary of Annual Report, Session 1921-2." *Journal of the Astronomical Society of South Africa,* 1, 1, 1923, p. 14.

Collins, J. J: "Cosmology: Time and History" in *Ancient Religions,* ed. Sarah Iles Johnston, The Belknap Press of Harvard University Press, United States of America, 2007.

Chami, F. A: "Evidence of Ancient African Beliefs in Celestial Bodies." In *African Cultural Astronomy,* (eds.) J. Holbrook, R. Medupe, J. Urama, *Springer,* 2008, p. 121 – 130.

Dubow, S: *A Commonwealth of Knowledge: Science, Sensibility, and White South Africa 1820 – 2000,* Oxford University Press, United States of America, 2006.

Dubow, S: *Racial Segregation and the Origins of Apartheid in South Africa, 1919-36,* Palgrave Macmillan, United States of America, 1989.

Dubow, S: *Apartheid 1948 – 1994,* Oxford University Press, United Kingdom, 2014.

Emeagwali, G. and Shizha, E (eds.): *African Indigenous Knowledge and the Sciences: Journeys into the Past and Present,* Sense Publishers, The Netherlands, 2016.

Fantoli, A: *Galileo for Copernicanism and for the Church,* Vatican Observatory Publications, Italy, 1994.

Gates, C: *Ancient Cities: The archaeology of urban life in the Ancient Near East and Egypt, Greece, and Rome [Volume 2],* Routledge, United States of America, 2011.

Gingerich, O: *The Eye of Heaven: Ptolemy, Copernicus, Kepler,* The American Institute of Physics, New York, 1993.

Grant, E: *Science and Religion, 400 B.C. to A.D. 1550,* Greenwood Press, United States of America, 2004.

Gray, E. & L. Czerniewicz: "Access to Learning Resources in Post-apartheid South Africa," in J. Karaganis (ed.) *Shadow Libraries: Access to knowledge in Global Higher Education,* The MIT Press, Cambridge, Massachusetts, 2018.

Hadingham, E: *Early Man and the Cosmos,* University of Oklahoma Press, United States of America, 1984.

Harris, P: *Towards Human Emergence: A Human Resource Philosophy for the Future,* HRD Press Inc., United States of America, 2009.

Hewitt, R: *Structure, Meaning and Ritual in the Narratives of the Southern San,* Helmut Buske Verlag, Germany, 1986.

Holbrook, J. C: "Chasing the Shadow of the Moon: The 2006 Ghana Eclipse Conference." in *African Cultural Astronomy: Current Archaeoastronomy and Ethnoastronomy research in Africa.* Springer: 2008.

Holbrook, J. C., Medupe, R. T. & Urama, J. O: *African Cultural Astronomy – Current Archaeoastronomy and Ethnoastronomy research in Africa.* Springer Science + Business Media, 2008.

Johnston, S. I, *Ancient Religions,* The Belknap Press of Harvard University Press, United States of America, 2007.

Lewis-Williams, J. D: *A Cosmos in Stone: Interpreting Religion and Society through Rock Art,* AltaMira Press, United States of America, 2002.

Leverington, D: *Babylon to Voyager and Beyond: A History of Planetary Astronomy,* Cambridge University Press, United Kingdom, 2003.

Lockyer, J. N: *The Dawn of Astronomy: A study of the temple-worship and mythology of the Ancient Egyptians,* Cassel and Company Limited, London, 1894.

Lowenberg, D. A. & Kaempfer, W. H: *The Origins and Demise of South African apartheid: a public choice analysis,* University of Michigan Press, United States of America, 1998.

Pannekoek, A: *A History of Astronomy,* Dover Publications Inc, New York, 1961.

Quack, J. F: "Astronomy in Ancient Egypt." *The Oxford Handbook of Science and Medicine in the Classical World,* 2018.

Rochberg, F: *The Heavenly Writing: Divination, Horoscopy, and Astronomy in Mesopotamian Culture.* Cambridge University Press, United States of America, 2004.

Smith, A., Malherbe, C., Guenther, M. & Berens, P: *The Bushmen of Southern Africa: A Foraging Society in Transition,* South Africa, New Africa Books, 2000.

Wilkinson, J. G: *The Manners and Customs of the Ancient Egyptians,* Volume 2, William Clowes and Sons, London, 1878.

Wilson, R: *Astronomy Through the Ages,* CRC Press, United States of America, 1996.

White, C. J: *The Elements of Theoretical and Descriptive Astronomy – 6th edition,* John Wiley & Sons, New York, 1896.

Journal Articles

Adams, B: "Cooperation in space: An international comparison for the benefit of emerging space agencies." *Acta Astronautica,* 162, 2019, p. 409 – 416.

Adams, W. S: "The History of the International and Astronomical Union." *Publications of the Astronomical Society of the Pacific,* 61, 358, 1949, p. 5 – 12.

Alcock, P. G: "The Stellar Knowledge of Indigenous South Africans." Chapter in *African Indigenous Knowledge and the Sciences: Journeys into the Past and Present,* Sense Publishers, The Netherlands, 2016, p. 117 – 133.

Americos, M: "A brief history of premodern astronomical models." *The Classical Outlook,* 92, 3, 2017, p. 94 – 101.

Assmann, J. & Frankfurter, D: "Egypt" in *Ancient Religions,* ed. Sarah Iles Johnston, The Belknap Press of Harvard University Press, United States of America, 2007.

Astronomical Society of Southern Africa: "Astronomical Handbook for Southern Africa 1990", p. 1 – 50.

Aveni, A. F: "Archaeoastronomy in the Ancient Americas." *Journal of Archaeological Research*, 11, 2, 2003, p. 149 – 191.

Bailey, J. M. & Lombardi, D: "Blazing the Trail for Astronomy Education Research." *Journal of Astronomy and Earth Sciences Education,* 2, 2, 2015, p. 77 – 88.

Baki, P: "Astronomy in the cultural heritage of African societies." *Astronomy for the developing world IAU Special Session no. 5*, 2006, p. 99 – 102.

Baneke, D: "Let's Not Talk About Science: The Normalization of Big Science and the Moral Economy of Modern Astronomy," *Science, Technology, & Human Values,* 45, 1, 2020, p. 164 – 194.

Bard, K. A: "Political Economies of Predynastic Egypt and the Formation of the Early State." *Journal of Archaeological Research,* 25, 1, 2017, p. 1 – 36.

Buckley, D. A. H., Charles, P. A., and O'Donoghue, D: "Science with the Southern African Large Telescope." *South African Journal of Science,* 101, 2005, p. 531 – 545.

Campion, N: "Astronomy and political theory." *The Role of Astronomy in Society and Culture Proceedings IAU Symposium,* 260, 2009, p. 595 – 602.

Campion, N: "Astronomy and Culture in the Eighteenth Century: Isaac Newton's Influence on the Enlightenment and Politics." *Mediterranean Archaeology and Archaeometry,* 16, 4, 2016, p. 497 – 502.

Carruthers, J: "Scientists in Society: The Royal Society of South Africa." *Transactions of the Royal Society of South Africa,* 63, 1, 2008, p. 1 – 30.

Cillie, G. G: "Brief Survey of the development of Astronomy in South Africa," *Monthly Notes of the Astronomical Society of South Africa,* 32, 8, 1973, p. 59 -64.

Case, S: "'Land-marks of the universe': John Herschel against the background of positional astronomy." *Annals of Science,* 72, 4, 2015, p. 417 – 434.

Conman, J: "It's about Time: Ancient Egyptian Cosmology." *Studien zur Altägyptischen Kultur,* 2003, 31, 2003, p. 33 – 71.

Cooper, T: "The Contribution of A. W. Roberts' Observations to the AAVSO International Database." *JAAVSO,* 47, 2, 2019, p. 254 – 263.

Curtis, H. D: "Astronomical Problems of the Southern Hemisphere." *Publications of the Astronomical Society of the Pacific.* 21, 129, 1909, p. 231- 244.

Culkin, K: "Doing Historian Business: Local History, Student Historians, and the Hall of Fame for Great Americans." *Transformations: The Journal of Inclusive Scholarship and Pedagogy,* 26, 2, 2016, p. 246 – 255.

Cherry, M: "Astronomy in South Africa: The long shot." *Nature,* 480, 7377, 2011, p. 308 – 309.

Datson, L: "Observation and Enlightenment. Introduction: The Age of Observation." *Scholars in Action,* 2, 2013, p. 657 – 677.

Deflem, M: "Warfare, Political Leadership, and State Formation: The Case of the Zulu Kingdom, 1808 – 2879." *Ethnology,* 38, 4, 1999, p. 371 – 391.

De Santillana, G: "Greek Astronomy." *Scientific American,* 180, 4, 1949, p. 44 – 47.

Donnelly, K: "On the boredom of science, positional astronomy in the nineteenth century." *The British Journal for the History of Science,* 47, 3, 2014, p. 479 – 503.

Dubow, S: "200 years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array." *Journal of Southern African Studies,* 45, 4, 2019, p. 663 – 687.

Dubow, S: "New Approaches to High Apartheid and Anti-Apartheid." *South African Historical Journal,* 69, 2, 2017, p. 304 – 329.

Eldredge, E. A.: "Sources of Conflict in Southern Africa, C. 1800 – 30: The 'Mfecane' Reconsidered." *The Journal of African History,* 33, 1, 1992, p. 1 – 35.

Evans, D. S: "Historical notes on astronomy in South Africa." *Vistas in Astronomy,* 9, 1967, p. 265 – 282.

Fabian, A: "The Impact of Astronomy." *Presidential Address: A&G,* 51, 2010, p. 3.25 – 3.30.

Fernie, J. D: "The teaching of astronomy in South African universities." *MNASSA: Monthly Notes of the Astronomical Society of South Africa,* 18, 10, 1959, p. 147 – 150.

Fitzgerald, J. T: "Cosmologies of the ancient Mediterranean world." *In die Skriflig/In Luce Verbi,* 47, 2, 2013, p. 1 – 7.

Galloway, J. D: "Popular Interest in Astronomy." *Publications of the Astronomical Society of the Pacific,* 24, 141, 1912, p. 97 – 106.

Gingerich, O: "Kepler, Galileo and the birth of modern astronomy," *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 175 – 181.

Govender, K: "Astronomy for African development." *The Role of Astronomy in Society and Culture Proceedings IAU Symposium* 260, 2009, p. 577 – 586.

Glass, I. S: "The Royal Observatory, Cape of Good Hope, a Valuable Cultural Property." *International Council on Monuments and Sites,* 18, 2009, p. 211 – 215.

Glass, I. S: "Jacob Karl Ernst Halm (1865 – 1944)." *Monthly Notes of the Astronomical Society of Southern Africa,* 73, 1 & 2, 2014, p. 14 – 23.

Hannah, R: "The roles of observational astronomy in ancient Greece." *Scientific Culture,* 1, 2, 2015, p. 47 – 56.

Hers, J: "The Establishment of the Transvaal Observatory." *Astronomical Society of Johannesburg Private Archives,* p. 1 -2. Accessed on 1 December 2020.

Hers, J: "The History of the 26-inch telescope in Johannesburg." *Monthly Notes of the Astronomical Society of Southern Africa,* 46, 5 & 6, 1987, p. 75 – 84.

Houghton, H. E: "Some South African Amateur Astronomers." *Monthly Notes of the Astronomical Society of Southern Africa,* 6, 1947, p. 4 – 15.

Holbrook, J. C: "African Cosmology." *Cosmology Across Cultures ASP Conference Series,* 409, 2009, p. 138 – 144.

Holbrook, J. C: "Astronomy, Indigenous Knowledge, and Interpretation: Advancing studies of Cultural Astronomy in South Africa." *Journal of Astronomy in Culture,* 1, 1, 2016, p. 1 – 7.

Holbrook, J. C. & J. M. de Prada-Samper: "|Xam skylore of the Karoo Desert, South Africa." *Mediterranean Archaeology and Archaeometry,* 16, 4, 2016, p. 81 – 86.

Hollmann, J. C: "'The Sky's Things:' |Xam Bushman '*Astrological Mythology*' as recorded in the Bleek and Lloyd Manuscripts." *African Skies,* 11, 2007, p. 8 – 12.

Hunger, H: "The relation of Babylonian astronomy to its culture and society." *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 62 – 73.

Hurly, R. F: "Presidential Address: Astronomers and Surveyors." *Monthly Notes of the Astronomical Society of Southern Africa,* 38, 7 – 10, 1979, p. 59 – 64.

Kahn, M. J. & Reddy, B. D: "Science and Technology in South Africa: Regional Innovation Hub or Passive Consumer?" *Daedalus,* 130, 1, 2001, p. 205 – 234.

Kanu, A. I: "*Igwebuike* as an Igbo-African Philosophy for Christian-Muslim Relations in Northern Nigeria." In *Igwebuike: An African Journal of Arts and Humanities,* 2, 2, 2016, p. 1 – 100.

Koorts, W. P: "The 1882 transit of Venus: The British expeditions to South Africa." *Monthly Notes of the Astronomical Society of Southern Africa,* 63, 2004, p. 34 – 57.

Lancaster, F. W. & Haricombe, L. J: "Anatomy of a Book Boycott." *American Libraries,* 26, 7, 1995, p. 685 – 688.

Leeuw, L. L & Holbrook, J: "The Role of the IAU Gleaned from Oral Histories of Individuals Involved in Astronomy in South Africa," *Under One Sky: The IAU Centenary Symposium Proceedings,* 349, 2019, p. 240 – 247.

Long, A. W: "The Foundation and Development of the Astronomical Society of South Africa." *Journal of the Astronomical Society of Southern Africa, 2, 1930*, p. 153 – 180.

Lovejoy, A. O: "Reflections on the History of Ideas." *Journal of the History of Ideas,* 1, 1, 1940, p. 3 – 23.

Marcus, G. J: "The Mariner's Compass: It's influence upon navigation in the later Middle Ages." *History,* 41, 141/143, 1956, p. 16 -24.

Marks, S: "Khoisan Resistance to the Dutch in the Seventeenth and Eighteenth Centuries," *Journal of African History,* 13, 1971, p. 55 – 80.

Manxoyi, S: "African Skies: astronomy." *Quest,* 13, 1, 2017, p. 18 – 21.

McCluskey, S. C: "Traditional Astronomical Concepts: Linking Space, Time and Culture." *Archaeoastronomy,* 23, 2010, p. 8 – 18.

McCray, P. W: "How Astronomers Digitized the Sky." *Technology and Culture,* 55, 4, 2014, p. 908 – 944.

McGranaghan, M: "'Hunters-With-Sheep': The |Xam Bushmen of South Africa Between Pastoralism and Foraging." *Africa,* 85, 3, 2015, p. 521 – 545.

McLaughlin, T. J.: "Astronomy: Queen of the Specific Sciences." *Angelicum,* 87, 4, 2010, p. 1015 – 1041.

Miley, G: "Astronomy for international development." *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 539 – 546.

Miley, G: "Influence of Society on Astronomical Discovery." *Proceedings of Science,* 2009, p. 1 – 7.

Murdin, P: "Introduction: the development of astronomy in Europe." *European Review,* 10, 2, 2002, p. 159 – 169.

Musselman, E. G: "Swords into ploughshares: John Herschel's progressive view of astronomical and imperial governance." *The British Journal for the History of Science,* 31, 4, 1998, p. 419 – 435.

Musselman, E. G: "Worlds displaced: projecting the celestial environment from the Cape Colony." *Kronos: Journal of Cape History,* 28, 1, 2002, p. 64 – 85.

Numbers, R. L: "Science and Religion." *Osiris, Historical Writing on American Science,* 1, 1985, p. 59 – 80.

Overbeek, M. D: "Amateur Astronomy in South Africa." *Astrophysics and Space Science,* 230, 1995, p. 479 – 493.

Oxby, C: "A Review of African Ethno-Astronomy: With Particular Reference to Saharan Livestock-Keepers." *La Ricerca Folklorica,* 40, 1999, p. 55 – 64.

Parker, R. A: "Ancient Egyptian Astronomy." *Philosophical Transactions of the Royal Society of London. Series A, Mathematical and the Physical Sciences,* 276, 1257, 1974, p. 51 – 65.

Parkington, J, Morris, D, & de Prada-Samper, J. M: "Elusive Identities: Karoo |Xam Descendants and the Square Kilometre Array." *Journal of Southern African Studies,* 45, 4, 2019, p. 729 – 747.

Percy, J.R: "The Role of Amateur Astronomers in Astronomy Education," in *International Astronomical Union Colloquium,* 162, Cambridge University Press, 1998, p. 205 – 210.

Petrus, T. S. & Bogopa, D. L: "Natural and Supernatural: Intersections Between the Spiritual and Natural Worlds in African Witchcraft and Healing with Reference to Southern Africa," *Indo-Pacific Journal of Phenomenology,* 7, 1, 2007, p. 1 – 10.

Rich, P: "Race, Science, and the Legitimization of White Supremacy in South Africa, 1902 – 1940." *The International Journal of African Historical Studies,* 23, 4, 1990, p. 665 – 686.

Righini, A: "The telescope in the making, the Galileo first telescopic observations." *Galileo's Medicean Moons: their impact on 400 years of discovery IAU Symposium,* 269, 2010, p. 27 – 32.

Rochberg, F: "A consideration of Babylonian astronomy within the historiography of science." *Studies in History and Philosophy of Science,* 33, 2002, p. 661 – 684.

Romer, A: "The Welcoming of Copernicus's *De revolutionibus:* The *Commentariolus* and its Reception." *Physics in Perspective,* 1, 1999, p. 157 – 183.

Rothenberg, M: "Organisation and Control: Professionals and Amateurs in American Astronomy, 1899 – 1918." *Social Studies of Science,* 11, 3, 1981, p. 305 – 325.

Sarma, N: "Diffusion of astronomy in the ancient world." *Endeavour,* 24, 4, 2000, p. 157 – 164.

Scully, P: "Rape Race, and Colonial Culture: The Sexual Politics of Identity in the Nineteenth-Century Cape Colony, South Africa." *The American Historical Review,* 100, 2, 1995, p. 335 – 359.

Seidelmann, P. K: "A History of Western Astronomical Almanacs." *Journal of Astronomical History and Heritage,* 22,1, 2019, p. 93 – 112.

Seekings, J: "The National Party and the Ideology of Welfare in South Africa under Apartheid," *Journal of Southern African Studies,* 46, 6, 2020, p. 1145 – 1162.

Schoonwinkel, A. & Milne, G. W: "University research and development of a microsatellite." *R&D Management,* 27, 1, 1997, p. 37 - 44.

Snedegar, K. V: "Stars and Seasons in Southern Africa." *Vistas in Astronomy,* 39, 1995, p. 529 – 538.

Śpelda, D: "The history of science as the progress of the human spirit: The historiography of astronomy in the eighteenth century." *Studies in History and Philosophy of Science,* 63, 2007, p. 48 – 57.

Stobie, R. S: "The Future of Astronomy in South Africa." *Monthly Notes of the Astronomical Society of Southern Africa,* 55, 9 & 10, 1995, p. 122 – 125.

Stow, G. W: *The Native Races of South Africa,* S. Sonneschein & Company limited, London, 1905.

Steele, J. M: "Celestial Measurement in Babylonian Astronomy." *Annals of Science,* 64, 3, 2007, p. 293 – 325.

Steele, J. M: "Astronomy and culture in Late Babylonian Uruk." *"Oxford IX" International Symposium on Archaeoastronomy,* 278, 2011, p. 331 – 341.

Sylvain, R: "Class, Culture and Recognition: San Farm Workers and Indigenous Identities." *Anthropologica,* 45, 1, 2003, p. 111 – 119.

Taylor, U. C: "Astronomy Through the Eyes of the Ancients." *Journal of the Royal Astronomical Society of Canada,* 25, 1931, p. 55 – 63.

Urama, J. O: "The Challenges of Astronomy in Nigeria." *Physica Scripta,* 97, 2002, p. 20 – 23.

Urama, J. O. & Holbrook, J. C: "The African Cultural Astronomy Project." *The Role of Astronomy in Society and Culture Symposium,* 260, 2009, p. 48 – 53.

Urama, J. O: "The Challenges of Astronomy in Nigeria." *Physica Scripta,* 97, 2002, p. 20 – 23.

Valls-Gabaud, D. & Boksenberg, A: "The role of astronomy in society and culture." *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 4 – 8.

Van Wyk, J.A: "South Africa's Space Policy and Interests: A New Dawn or a Black Hole?" *Strategic Review for Southern Africa,* 31, 2, 2009, p. 46 – 73.

Voss, A. E: "The Image of the Bushmen in South African English Writing of the Nineteenth and Twentieth Centuries." *English in Africa,* 14, 1, 1987, p. 21 – 40.

Waetjen, T: "Sputnik from Below: Space Age Science and Public Culture in Cold War Southern Africa." *Interventions,* 18, 5, 2016, p. 687 – 708.

Walker, C. Chinigò, D. & Dubow, S: "Karoo Futures: Astronomy in Place and Space – Introduction." *Journal of Southern African Studies,* 45, 4, 2019, p. 627 – 639.

Warner, B: "Early Years of the Magnetic Observatory." *South African Journal of Science,* 74, 1978, p. 82 – 83.

Warner, B: "The Development of Astrophysics in South Africa." *Astrophysics and Space Science,* 230, 1995, p. 1 – 7.

Winkler, M. G. & Van Helden, A: "Representing the Heavens: Galileo and Visual Astronomy." *Isis,* 83, 2, 1992, p. 195 – 217.

Wessels, M: "The Discursive Character of the |Xam Texts: A Consideration of the |Xam "Story of the Girl of the Early Race, Who Made Stars." *Folklore,* 118, 3, 2007, p. 307 – 324.

Wessels, M: "New directions in |Xam studies: some of the implications of Andrew Bank's *Bushmen in a Victorian world: the remarkable story of the Bleek-Lloyd collection of Bushman folklore.*" *Critical Arts: A Journal of South-North Cultural Studies,* 22, 1, 2008, p. 69 – 82.

Wessels, M: "Foraging, Talking, and Tricksters." *Journal of Folklore Research,* 45, 3, 2008, p. 299 – 327.

Wood, H. E: "The History of the Union Observatory, Johannesburg." *South African Journal of Science,* 23, 1926, p. 168 – 171.

Worssell, W. M: "The Observation of Variable Stars." *The Journal of the Astronomical Society of South Africa,* 1, 3, 1924, p. 73 – 99.

Zarka, P: "Astronomy and astrology." *The Role of Astronomy in Society and Culture IAU Symposium,* 260, 2009, p. 420 – 425.

Internet Sources

"Anthropomorphism." The Oxford Dictionary of Philosophy. 2021. URL: https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095416392.
[Accessed: 2 March 2021]

Astronomical Society of Southern Africa Website & Online Archive. http://assa.saao.ac.za/sections/history/assa-archive/.

Astronomical Society of Southern Africa: "ASSA Archive – Cape Centre" http://assa.saao.ac.za/sections/history/assa-archive/assa_archive_cape_centre/#History.

CSIR Website: *CSIR Through the Years*. URL: https://www.csir.co.za/our-history. Accessed: 20 July 2021.

Plug, C: "Long, Mr. Arthur William." *S2A3 Biographical Database of Southern African Science,* 2020, URL: http://www.s2a3.org.za/bio/Biograph_final.php?serial=1711. Accessed: 28 July 2021.

The Astronomical Society of South Africa, "*Constitution and Bye-Laws."* Cape Town: Townsend, Taylor, and Snashall Printers, 1922, p. 1 – 16. Accessed on 20 May 2020. https://assa.saao.ac.za/wp-content/uploads/sites/23/2015/01/assa_const-1922.pdf

The Journal of the Astronomical Society of South Africa, 1, 3, April 1924, p. 73 – 99. Available: https://assa.saao.ac.za/wp-content/uploads/sites/23/2015/01/assaj_v1_n3_1924-Apr.pdf.

!Khwa ttu San Heritage Centre, "!Khwa ttu: San Spirit Shared," 2021. URL: https://www.khwattu.org/heritage-centre-museum/. [Accessed on: 15 September 2021].

!Khwa ttu San Heritage Centre, "!Khwa ttu: San Spirit Shared, Digital Archive" 2021. URL: https://www.khwattu.org/heritage-centre-museum/digital-archive/. [Accessed on: 15 September 2021].