UNIVERSITY OF SOUTHERN QUEENSLAND
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ALL THE HEAVENS JUST AND TRUE: CULTURAL AND HISTORICAL ASTRONOMY IN MANUSCRIPT COLLECTIONS FROM GEORGIA

A Thesis submitted by
Jefferson Lyman Sauter

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For Mom and Ted, my luminaries just and true.

ABSTRACT

The present study is about premodern astronomy in the former Soviet Republic of Georgia.[1] The focus is on cultural astronomy, which (in broad terms) investigates how people viewed and thought about the sky, in a wider cultural context. I also investigate writings relevant to applied historical astronomy, which uses naked-eye observations to address modern problems in astronomy and geophysics.

The core of this study is a chronological listing and review of astronomical and calendrical written sources in manuscripts comprising the four principal Georgian-language collections (fonds A, H, Q, and S) of the Korneli Kekelidze Georgian National Centre of Manuscripts (GNCM), located in Tbilisi, Georgia. From these approximately 9,000 manuscript codices (out of an estimated 11,000 extant worldwide), I discuss 532 produced in the 10th to early 20th century and translate – most for the first time into English – excerpts from over 350 manuscripts. I also give extended translations of several calendrical or astronomical-prognostication works preserved in Manuscripts (MSS) A-38, A-65, A-85, A-290, and A-620.

This review of Georgian manuscripts reveals written material that enhances our understanding of cultural astronomy as well as data of potentially scientific use to applied historical astronomy. Of the manuscripts with astronomical or calendrical material, those produced before the 18th century are, almost without exception, ecclesiastical in nature, whereas manuscripts devoted to philosophical or scientific topics appear generally only later. Many, if not most, of the writings are duplicated in multiple copies. This material encompasses a variety of religious treatises of an astronomical or chronological nature; prognostications and similar works based on astronomical, meteorological, and other natural phenomena; calendrical writings of varying sophistication; and later technical works, both original and translations into Georgian. Especially noteworthy are King Vakhtang VI's translation efforts, 19th-century observations of total solar eclipses (TSEs), and innovative guides on determining the date of Easter based on the Georgian calendar.

[1] In this study, the terms 'Georgia' and 'Georgian' refer neither to the U.S. State of Georgia nor to the era of British history during the reigns of the four Hanoverian kings named George (1714–1837).

Two case studies are also presented. In the first, I analyse a Georgian brontologion ('thunder book') preserved in MS A-620. For each month of the year starting in January, the brontologion gives succinct, formulaic predictions of political well-being, weather, agriculture, and popular health, based on the occurrence of specific natural phenomena: solar and lunar eclipses and halos, thunder, lightning, rainbows, earthquakes during the day, and earthquakes at night. At times, predictions are left out. In one instance, the syntax of the following prognosis points to an intentional omission, specifically with respect to solar eclipses in July. Whereas solar eclipses typically bade ill, I suggest that the copyist (or earlier redactor) of MS A-620 associated such events in July with miraculous accounts of the christianisation of the royal family of Georgia.

The second case study builds on the first. In the early 4th century, a sudden return of daylight after a darkening of the sky purportedly swayed King Mirian III of eastern Georgia (Kartli) to convert to Christianity. Medieval written sources and modern geophysical models indicate the possibility that Mirian, whilst on a mountain top near the city of Mtskheta, may have observed a TSE. Adjusting for both visibility corrections and constraints on the accumulated clock error known as ΔT, the local circumstances are examined of the TSE of 6 May 319, which Gigolashvili et al. 2007, 2009 have proposed as the most likely natural explanation. If the basis for the legendary accounts of Mirian's conversion is this TSE, then the value of ΔT inferred from written sources agrees well with generally accepted values, such as those derived by Morrison and Stephenson 2004, namely, $\Delta T \approx 7{,}450 \pm 180$ s in 319. Computer simulations show that the TSE of 6 May 319 would have been visible to the king and his entourage at his presumed location but not to the townspeople in the valley below – a crucial element in later Georgian sources. If it is the TSE of 6 May 319 that ancient and later written sources recount, then the date of Mirian's hunting expedition was five years earlier than 324, the year conventionally held by historians today.

CERTIFICATION OF THESIS

This Thesis is entirely the work of Jefferson Lyman Sauter, except where otherwise acknowledged, with the majority of the authorship of the papers presented as a Thesis by Publications undertaken by the Student. The work is original and has not previously been submitted for any other award, except where acknowledged.

Principal Supervisor: Professor Brad Carter
Associate Supervisor: Adjunct Professor Wayne Orchiston
Associate Supervisor: Emeritus Professor F. Richard Stephenson

Student and supervisors' signatures of endorsement are held at the University.

STATEMENT OF CONTRIBUTION

The following detail is the agreed share of contribution for the candidate and co-authors in the presented publications in this Thesis:

Article I (portions of Chapter 2): Sauter, J., Simonia, I., Stephenson, F., and Orchiston, W., 2015B. Historical Astronomy from the Caucasus: Sources from Georgia and Armenia. In: Orchiston, W., Green, D., and Strom, R. (eds.). *New Insights From Recent Studies in Historical Astronomy: Following in the Footsteps of F. Richard Stephenson.* Springer, New York, NY. Pp. 103–117. DOI: link.springer.com/book/10.1007%2F978-3-319-07614-0. The overall contribution of ***Jefferson Sauter*** was 55% to concept development, analysis, drafting, and revising the final submission; ***Irakli Simonia***, ***F. Richard Stephenson***, ***Wayne Orchiston*** contributed the other 20%, 15%, and 10%, respectively, to concept development, analysis, and editing.

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Besides Edward Dana Wallenthin Jr and my parents, Laurence Timothy Sauter and Mary Emily Smith Sauter (Dales), it behoves me to recognise (alphabetically by

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ABBREVIATIONS

A	Manuscript collection (fond) 'A' of the GNCM
A.D.	In the year of our Lord *(anno Domini)*, same as 'common era' (C.E.)
A.M.	In the year of the world *(anno mundi)*, years elapsed since the biblical creation of the world
b.	Born (year or century)
B.C.	Before Christ, same as 'before the common era' (B.C.E.)
c.	Approximately *(circa),* indicating an approximate period of time
C1	First contact of TSE
C2	Second contact of TSE
C3	Third contact of TSE
C4	Fourth contact of TSE
d.	Died (year or century)
f.	Manuscript folio page (plural 'ff.')
Fig.	Figure
fl.	Flourished *(floruit)* (period of individual's life, work)
E	Manuscript collection (fond) 'E', Institute of Oriental Manuscripts of the Russian Academy of Sciences, Saint Petersburg, Russia
GAM	Georgian astronomical manuscript (from Simonia et al. 2015A)
GNCM	Korneli Kekelidze Georgian National Centre of Manuscripts, Tbilisi, Georgia
H	Manuscript collection (fond) 'H' of the GNCM
JD	Julian date
LAST	Local apparent solar time
LE	Lunar eclipse
LMST	Local mean solar time
K	Kevanishvili manuscript (as listed in Kevanishvili 1951)
ME	Maximum eclipse
MS	Manuscript (plural 'MSS')
p.	Page (not folio page) (plural 'pp.')
PSE	Partial solar eclipse
r	Front *(recto)* side of manuscript folio
r.	Reigned *(rexit)* (duration of a sovereign's rule)

Q	Manuscript collection (fond) 'Q' of the GNCM
s	Seconds (for example, '7200 s')
S	Manuscript collection (fond) 'S' of the GNCM
Sin	Manuscript collection (fond) 'Sin' of the Sacred Monastery of the God-Trodden Mount Sinai, near Saint Catherine, Egypt
TT	Terrestrial Time, formerly known as Terrestrial Dynamical Time
TSE	Total solar eclipse
UT	Universal Time (UT1), Earth's rotational time
v	Reverse (*verso*) side of manuscript folio
ΔT	Delta *T*, the accumulated difference in seconds of UT and TT

Calendrical Notation

In the present study, unmarked years are generally A.D. ('anno Domini') unless followed by B.C. ('before Christ') or preceded by A.M. ('anno mundi'). Dates after 4 October 1582 until 2000 are generally given in 'Gregorian/Julian Calendar' format except when otherwise noted. Thus, 28/16 July 1851 means A.D. 28 July 1851 (Gregorian) and A.D. 16 July 1851 (Julian).

PREFACE

Background of Present Study

Conceptualisation of the present study began in March 2006. Keen to explore the history of astronomy in the Caucasus and having studied Georgian for several years,[1] I introduced myself via email to Professor Irakli Simonia of Ilia State University and sought his advice on suitable areas of research. Professor Simonia obliged and sent, amongst other things, photocopies of ff. 105–118 of MS A-620 of the Korneli Kekelidze Georgian National Centre of Manuscripts (GNCM) in Tbilisi, Georgia. Later, I received from him a transcript of Galaktion Kevanishvili's list of 'Georgian astronomical manuscripts'. This further encouraged me to review astronomical writings preserved in Georgian manuscripts.

Aware of Professor F. Richard Stephenson's decades-long work on applied historical astronomy, I also wondered about the extent to which Georgian written sources might include hitherto-unstudied astronomical data, such as observations of total solar eclipses (TSE),[2] sunspots, comets, and the like. At Professor Wayne Orchiston's initial suggestion, I investigated accounts of the TSE that King Mirian may have witnessed in the 4th century. With foundations for a larger study in place, I sifted through published catalogues of Georgian manuscripts, transcribed and translated a brontologion preserved in MS A-620, and looked into the possibility of whether accounts of the sudden darkening

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[1] I began learning Georgian in 2003 with tutorials from Dr Paul Crego of the United States Library of Congress. In 2005, I enrolled in a conversational Georgian class taught by Professor Manana Kobaidze of the University of Malmo and in a follow-up intermediate class in 2008. In the summer of 2007, I spent four weeks at Indiana University's Summer Language Workshop, in the second-year Georgian class taught by Dr Nana Danelia, where I was fortunate to have access to the collection of Georgian material of the Herman B. Wells library of Indiana University. Along the way, I worked through (and wrote an English translation of) Kita Tschenkéli's two-volume *Einführung in die georgische Sprache,* which (in my opinion) remains the best introduction to modern Georgian. To gain a working knowledge of Armenian, I took a semester-long course in Classical Armenian taught by Professor Monica Blanchard at The Catholic University of America in the summer of 2011 and several classes in both Eastern and Western Armenian at the Armenian Virtual College (AVC).

[2] In 2006, I accompanied a group of British astronomers and 'umbraphiles' (eclipse-enthusiasts) to Antalya, Turkey, to observe, for the first time, a TSE. I was struck by how mesmerising and moving the experience was. A week later, I gave a brief talk on this observational experience at Odessa State University in the Ukraine. Six years later, in May 2012, I flew to Albuquerque, NM, to view an annular solar eclipse. And five more years after that, I went to the Isle of Palms outside of Charleston, SC, to watch – with many others – the Great American Eclipse of 2017.

of the sky purportedly witnessed by a 4th-century Georgian king could, in fact, be a record of an observation of a TSE.

In October 2009, I returned to Georgia after almost 20 years.[3] I discussed possible doctoral research topics with Professor Simonia, who graciously invited me to stay with himself and his family, generously gave me a short list of manuscripts he deemed worthy of study, and put me in contact with Dr Buba Kudava, then director of the GNCM. During this trip, I familiarised myself with the workings of the National Parliamentary Library of Georgia, thanks in no small part to the kind assistance from Dr Maia Simonishvili. I was able to gather secondary literature and visit the city of Mtskheta, the ancient capital of eastern Georgia. I was also fortunate to meet Professor Timothy Grove, at the time a doctoral student researching Georgian astrological texts.

In January 2010, I was formally admitted as a Ph.D. student at James Cook University, Townsville, Australia. (In 2012, university officials disbanded JCU's Centre for Astronomy, through which my doctoral programme was administered; Centre for Astronomy staff arranged for their students to transfer to the University of Southern Queensland.) As I sifted through manuscript descriptions and read the related secondary literature, it became clear that there were less astronomical data than we initially had hoped for.

Therefore, we expanded our scope to Georgian cultural astronomy. In October 2014, I returned to Georgia for additional material. On the penultimate day of my trip, I was able to visit Mount Tkhoti, from where the Georgian king purportedly observed a sudden darkening of the sky and miraculous return of light in the 4th century. Upon returning home, I completed my survey of Georgian manuscripts and began to write up the findings.

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[3] In the spring of 1991 as a foreign exchange student in the USSR, the staff at the airport in Donetsk hustled me onto a crowded flight headed to what I assumed was my ticketed destination, Odessa, my host city. As our plane touched down on schedule an hour later, I spotted palm trees, an unfamiliar airport terminal, and a big, neon sign emblazing 'თბილისი'. This eldritch mix-up turned into my first-ever visit to the Republic of Georgia. It lasted just six days but coincided with the Georgian Independence Referendum on 31 March 1991, which was to serve just nine days later as the official basis for the Georgian leadership to declare the Republic of Georgia independent from the Soviet Union. (For a detailed account of the political situation during this period, see Slider 1991.)

In the summer of 2015, I met Dr John Graham, who in passing mentioned an exhibit he had seen on astronomical manuscripts housed at the GNCM and reported on Rustavi2, one of Georgia's main television stations.[4] The following May in 2016, I made a third trip to Georgia. During a visit to the GNCM, I (almost literally) bumped into Dr Tamar Abuladze, one of Professor Simonia's collaborators on the aforementioned exhibit. Dr Abuladze generously gave me a copy of *Astronomical Manuscripts in Georgia (DVD),* which has been incorporated into the present study as well. Finally, in September 2017, I travelled to Georgia one last time before submitting the thesis for formal examination the following year.

Organisation of the Present Study

The present study opens with two introductory chapters.[5] In Chapter 1 *(Introduction)*, I give a brief overview, present research questions and key findings, review relevant secondary literature, and discuss the methodological framework and research limitations.[6] The literature review in Section 1.3 covers four topics: Georgian manuscripts preserving astronomical material (Section 1.3.1), Georgian cultural astronomy (Section 1.3.2), and prior scholarship relating to the two supporting case studies in Chapters 4 and 5 (Section 1.3.3 and Section 1.3.4, respectively).

Chapter 2 *(Historical astronomy of the Caucasus. Sources from Georgia and Armenia)* sets the scene with historical and cultural background, principal findings of the listing and review of astronomical manuscripts in Chapter 3, and examples of applied historical astronomy taken from Georgian and Armenian written sources.

Chapter 3 *(Review of Astronomical manuscripts. The Georgian manuscript collections of the GNCM)* is the core of the present study. Here, I chronologically list and review 532 Georgian manuscripts and translate into English excerpts from over 350 manuscripts for the first time (all translations are mine unless otherwise noted), on topics of cultural astronomy and applied historical astronomy. Also included are extended translations of

[4] Website: youtube.com/watch?v=MiQTk0NuHcY&feature=youtu.be, last accessed 14 March 2018.
[5] Chapters 2, 3, 4, and 5 are preceded by abstracts, keywords, and lists of oral/poster papers.
[6] When a historical person is mentioned for the first time, I give the dates of birth and death (if known) and at least one biographic reference. If these dates are unknown, I indicate the period in which the person lived or worked.

several works. These manuscripts were selected from the four main Georgian-language collections (fonds A, H, Q, and S) housed at the GNCM.

In Section 3.1, I offer an overview of the manuscripts presented over the course of the next four sections. Manuscripts from the Georgian collections of the GNCM dated to (as early as) the 10th – 16th century are listed in Section 3.2; 17th century in Section 3.3; 18th century in Section 3.4; and 19th – early 20th century in Section 3.5, followed by manuscripts that are undated or which were transferred to the other collections.[7] For each manuscript, I give its overall characterisation (for example, 'compendium'), physical description, date of production based on published manuscript descriptions, type of script, name of copyist(s), and location within the manuscript of astronomically relevant content. The chapter ends with a brief review of these manuscripts in Section 3.6.

Two case studies follow. In Chapter 4 (*Case study in cultural astronomy. MS A-620: A Georgian brontologion*), I discuss a genre of prognostication literature known as brontologia ('thunder books') and translate a Georgian exemplar preserved on ff. 106r – 110v of MS A-620. I analyse the prognostications in terms of weather lore as well as the religious and cultural context in which the text was consulted and suggest that someone – copyist(s) or earlier redactor(s) – adapted the text for a specifically Georgian audience.

Chapter 5 *(Case study in applied historical astronomy. The legendary 4th-century total solar eclipse in Georgia: Fact or fantasy?)* is the second case study. I discuss the sudden onset of darkness witnessed during the day by King Mirian in ancient and later Georgian written sources as a possible record of an observation of a TSE.[8] I describe the local circumstances of the TSE of 6 May 319, noting how both the earlier Latin and later Georgian accounts depict striking emotional responses reminiscent even today of observers of totality during a TSE. I use computer simulations to show how the TSE of 6 May 319 would have been visible to Mirian and his companions at their presumed location on Mount Tkhoti, near Mtskheta, the ancient capital of Georgia – but not necessarily to the townspeople in the valley below, an element of the story found in some of the later Georgian sources. If it is the TSE of 6 May 319 that the ancient and later

[7] By earliest dated century. Thus, a manuscript dated to the '17th – 18th century' is listed in Section 3.3 (not Section 3.4).

[8] Few historical eclipse records exist from the 4th century, so depictions of eclipses dating from this era, however tenuous, can be of use to applied historical astronomy.

written sources recount, then values of ΔT for 319, as currently derived, need not necessarily be revised. Moreover, the date of King Mirian's conversion would have been earlier than the conventionally accepted year of 324.

The present study draws to a close with conclusions, references, and appendices. In Chapter 6 *(Conclusions)*, I summarise principal findings and suggest several areas for further investigation. (Concluding remarks also appear at the end of Chapters 2, 3, 4, and 5.) In *References*, I list primary and secondary works cited. In the *Appendices*, I produce translations and transcriptions of the tables found in the manuscripts reviewed in Chapter 3 *(Appendix 1);* images of manuscripts dated to the 10th – 16th *(Appendix 2),* 17th *(Appendix 3),* 18th *(Appendix 4),* and 19th – early 20th century *(Appendix 5);* notes to the review of Georgian manuscripts in Chapter 3 *(Appendix 6);* and an index of manuscripts listed alphabetically by GNCM designation *(Appendix 7).*[9]

[9] Updates to the present study can be found at usq.academia.edu/Sauter.