Companions in Astronomy
Margaret Lindsay Huggins and Agnes Mary Clerke

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1 Introduction

Ireland has recently had occasion to recall its past contributions to astronomy with the bicentenaries of Dunsink Observatory in 1985[1] and of Armagh Observatory in 1990[2]. The latter celebration has been accompanied by meetings of the British Astronomical Association in Armagh in 1990 and of the Royal Astronomical Society in Armagh in 1991. It may be a good opportunity to remember two Irish members of both of these societies who were pioneers in a very special way, being women who contributed significantly to astronomy at a time when the doors of higher education establishments were barely ajar for them. They are Margaret Lindsay Huggins (1848 - 1915) and Agnes Mary Clerke (1842 - 1907).

Margaret Huggins was the wife and collaborator of the illustrious astronomical spectroscopist, Sir William Huggins. Agnes Clerke, recently described as in her day "the chief astronomical writer of the English–speaking world"[3], was a historian and chronicler of astronomy and author of the still indispensible *A Popular History of Astronomy during the Nineteenth Century*[4].

Both women were born and brought up until their mid–twenties in Ireland; both settled in London where they got to know each other and, in Margaret's words, "entered on a friendship and a companionship in astronomy which have been among my best pleasures".

2 Margaret Lindsay Huggins

Though Margaret Huggins was some years younger than Agnes Clerke she appeared earlier on the astronomical scene. She was born Margaret Lindsay Murray in 1848 in Dublin, the daughter of a solicitor, John Murray. Educated privately at home and for a while at a school in Brighton, England, she learned languages, the classics, music and art. She came to love astronomy at an early age: she recounted in later life that she owed this interest to her Scottish grandfather who took her outdoors in the evenings and taught her to recognise the constellations.

Margaret read the popular books of Dick and Lardner and studied John Herschel's *Outlines of Astronomy*. She tried out simple scientific experiments and with her small terrestrial telescope was able to project an image of the Sun on which she studied sunspots. She did a little photography, then quite a fashionable hobby with artistic ladies, which was later to become one of her principal areas of activity. Then, in 1873, in the magazine, *Good Words* she read an article by the President of the British Association for the Advancement of Science on the exciting new field of astronomical spectroscopy and the work of William Huggins. Even before she met him in person she was an ardent admirer of her future husband.

William Huggins was one of the towering figures of his age. Self–taught and self-made, he had begun his researches in stellar spectroscopy in his own observatory which he built in 1856 at his house in Tulse Hill on the south-west of London. Having modest private means, he was able to devote himself entirely to astronomy from that time onwards. Following his successes in stellar spectroscopy in which he identified many chemical elements in the stars he turned his attention to the spectra of nebulae and made the momentous discovery of the gaseous nature of planetary nebulae and of objects like the Orion Nebula. He was also the first to show that radial velocities of stars could be observed from the Doppler shift of lines in their spectra and the first to observe the spectrum of a nova. In recognition of these achievements he received on long term loan from the Royal Society a set of new instruments designed according to his wishes and built by the optical firm of Grubb in Dublin. It was through Howard Grubb, the head of that firm, that William Huggins met Margaret Murray.

The couple were married in 1875. He was 51, she was 27. The marriage has been described as "one of the most successful husband–and–wife partnerships in the whole of astronomy"[5]. It was a happy

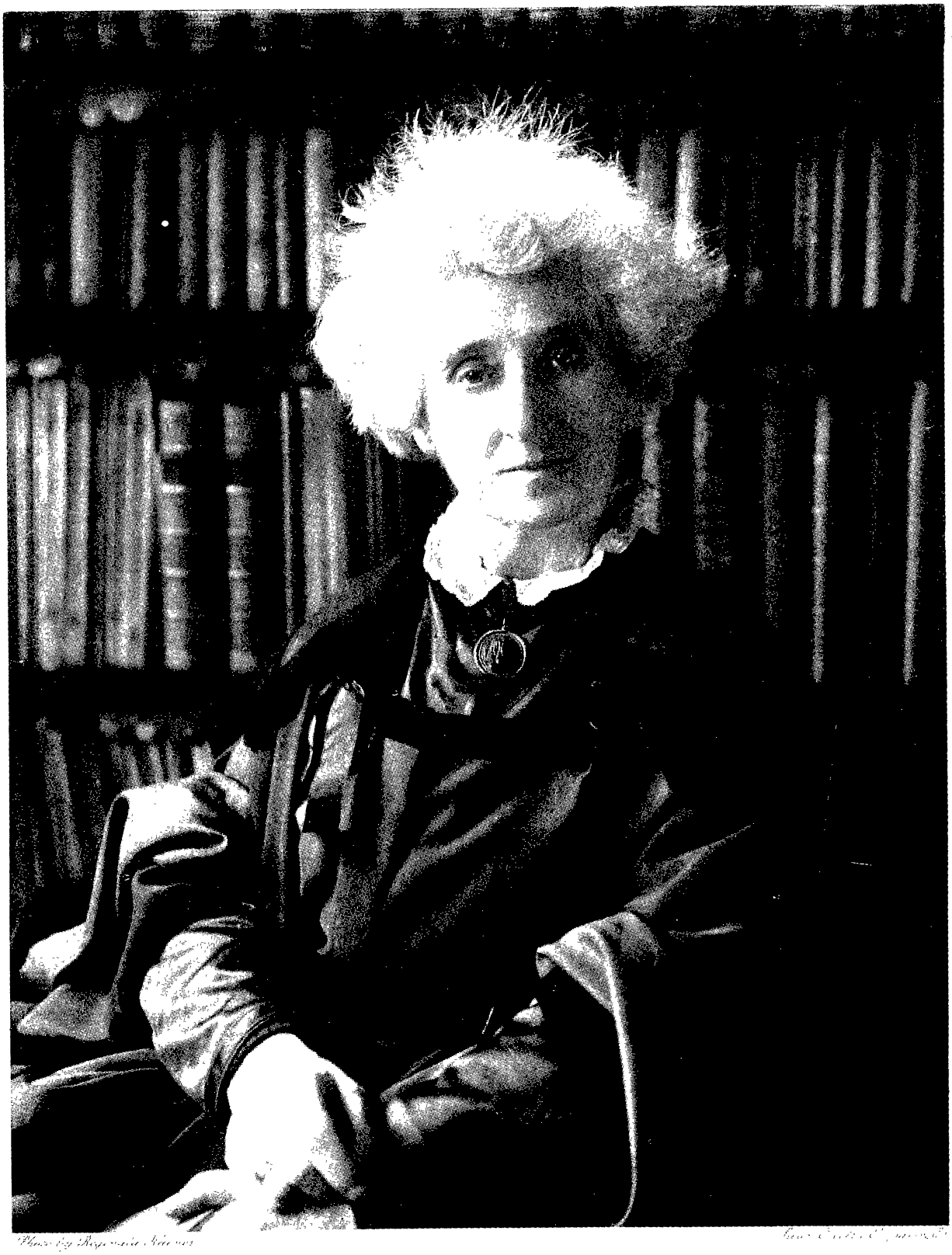

Figure 1: Margaret Lindsay Huggins

Figure 2: Agnes Mary Clerke

circumstance that they could begin their scientific life together by pioneering one of the major tools of observational astronomy, the dry gelatine photographic plate. The invention of the dry gelatine method in the 1870s to replace the wet collodian process brought about a revolution in photography, and William and Margaret Huggins were the first to apply it to astronomical spectroscopy. The optics of their spectrograph were transparent in the near ultraviolet, so they could combine photographic and visual records to produce spectra over the entire optical range. They were the first to observe and to identify the series of hydrogen lines (the Balmer lines) in the spectrum of the star Vega. In 1881 when Tebbutt's Comet appeared, the brightest in 20 years and the first since the introduction of the dry photographic plate, William and Margaret grasped the opportunity of photographing its spectrum.

William and Margaret Huggins had no children; their home was their place of work [6]. Their first jointly published papers, beginning in 1889, were studies of the spectra of the planets. These were followed by a fundamental study of the spectrum of the Orion Nebula. The brightest emission lines were due to hydrogen, but there were also mysterious green lines which did not coincide with any known terrestrial element. William and Margaret discovered two further violet lines which remained unidentified. It seemed likely that all the unknown lines originated in an element peculiar to the nebulae. The hypothetical element was given the name nebulium, a name first suggested by Agnes Clerke and launched by Margaret Huggins[7]. A whole generation of astronomers was to pass before the true identity of nebulium, ionised oxygen, was revealed.

They also investigated the spectra of Wolf- Rayet stars and measured the wavelengths of their bright emission features though they were unable to identify their origin which long remained, like nebulium, a complete mystery. They were also among those who observed the nova of 1892, Nova Aurigae; Margaret was responsible for the visual observations while together they obtained photographic spectra over several nights. They identified two sets of hydrogen lines, one bright and one dark, displaced relative to each other, and correctly interpreted the bright line spectrum as coming from the star's outwardly exploding envelope.

These various researches, made over a period of more than twenty years, kept William and Margaret Huggins in the forefront of astronomical spectroscopy. By the 1890s, however, there were younger spectroscopists at work in better climates and on better sites. They wound up their observing life with their magnificent and extremely useful *Photographic Atlas of Representative Stellar Spectra* published in 1897 and thereafter concentrated on laboratory spectroscopy. One of their projects concerned the spectra of calcium and magnesium, two conspicuous elements in the spectrum of the Sun and of sun–like stars. They attempted to discover how the relative strengths of lines in their spectra were dependent on varying physical conditions of the laboratory source in the hope of explaining the behaviour of the same lines in the spectrum of the Sun. Their observational data were the earliest illustration of the Saha law, formulated only in 1920.

William and Margaret Huggins' joint papers were published in the *Proceedings of the Royal Society.* However, Margaret contributed items from time to time to the *Observatory* magazine, such as the obituary notices of her husband's old astronomer friends, William Lassell (1799 - 1880) and Warren de la Rue (1815 - 1889), She also found time to make contributions to the fields of music and art. Music-making for relaxation was a feature of the Huggins home life. Margaret was an expert on the history of early musical instruments and wrote a monograph on the 16th century violin maker Gio Paulo Maggini, a predecessor of the more famous Stradivari and Guarneri[8]. She also became something of an authority on the history of astrolabes and armillaries, and contributed articles on these instruments to the 11th edition of the *Encyclopaedia Britannica.* At the celebration of the Diamond Jubilee of Queen Victoria in 1897 William Huggins was created a Knight Commander of the Order of the Bath. His citation was "for the great contributions which, with the collaboration of his gifted wife, he had made to the new science of astrophysics". Those honoured were all men; this reference to Margaret, now Lady Huggins, made her the only woman even remotely mentioned in the honours list.

William Huggins was President of the Royal Society from 1900 to 1905. A historic scientific event during his presidency was the award of the Society's Davy Prize in 1903 to the brilliant husband and wife Pierre and Marie Curie for their work on radioactivity for which, later in the same year, they received the Nobel Prize. Madame Curie did not attend the presentation of the Davy medal as she was ill. However, the Curies had previously visited London at the invitation of the Royal Institution, when Pierre Curie gave a lecture attended by a bevy of great British physicists[9]. It is most likely that on that occasion both William and Margaret Huggins met both Curies. What is certain is that

at this time they became interested in the subject of radioactivity and tried to devise ways of observing radioactive radiation spectroscopically in their laboratory. Their work in 1903 - 05 on the spectra of certain radioactive substances, described in four papers in the *Proceedings of the Royal Society,* was their last piece of scientific research.

3 Agnes Mary Clerke

Agnes Clerke was born in 1842 in Skibbereen, County Cork, the younger daughter of J. W. Clerke, a bankmanager, and his wife Catherine. Agnes, her sister Ellen and her brother were educated at home by their scholarly parents. The father, a classics graduate of Trinity College Dublin, was a keen amateur astronomer: he had a telescope with which he used to observe transits of stars for a local time service and to show the planets to the children. The mother, a member of the distinguished Deasy family of Clonakilty, was a gifted musician. The children grew up with a sound knowledge of Latin, Greek, mathematics and astronomy, as well as a deep love of learning for its own sake.

Agnes' health was not good, and on this account mother and daughters spent most of each year from 1867 onwards in Italy. They were based in Florence where the two young women devoted themselves to study and educated themselves to an astonishing degree. Agnes' main field of interest was the history of science, Ellen's was chiefly Italian literature. In 1877, when Agnes was 35 years old, the entire Clerke family settled in London where the brother now worked as a barrister. In that same year Agnes had two articles published which she had written while in Italy. The first was on the Sicilian Mafia, the second on astronomy in Italy in the age of Copernicus. They appeared in the highbrow literary quarterly, the Edinburgh Review, and were so well regarded that Agnes became a regular contributor, providing two articles a year on a variety of topics - history of science, astronomy and world affairs - for the rest of her life. The Review articles took the form of dissertations on recent important books, and were unsigned.

Contemporary astronomy first made its appearance in Agnes Clerke's work with an account of the development of astronomical spectroscopy in the Review entitled *The Chemistry of the Stars* in 1880[10]. This article was the genesis of her major book, *A Popular History of Astronomy during the Nineteenth Century* in 1885. Until this time Agnes, an extremely shy person, had worked virtually alone. The first astronomer whom she got to know personally was Norman Lockyer, the solar physicist, who had heard from the librarian at the Science Library of the reader who "always asked for books on astronomy". She also, in preparing her *History,* had communicated with Ralph Copeland, then Director of Lord Crawford's Observatory in Scotland, and Edward Holden, later Director of Lick Observatory. To most astronomers, however, she was a dark horse; Margaret Huggins referred to her as the "Unknown". It was only after the book came out that the two women met and became steadfast friends.

A Popular History of Astronomy during the Nineteenth Century was a timely work. Historical treatments of astronomy usually began with the ancients and virtually ended with Newton. Agnes Clerke's book began where others left off, with William Herschel's researches into the structure of the universe, and progressed to the latest spectroscopic discoveries of the nature of stars and nebulae. It was, in fact, a history of astrophysics. The description "popular" meant a non–technical non–mathematical treatment "to enable the ordinary reader to follow with intelligent interest the course of modern astronomy..... Astronomy is essentially a popular science. The general public has an indefeasible right of access to its lofty halls", Agnes wrote. However, her popularisation was not mere entertainment; her books, in Margaret Huggins words, "ministered to those who long to know, not to people who are too lazy to do more than go to scientific lectures to have their ears tickled"[12].

The book immediately brought Agnes Clerke to the notice of the astronomical community. She received the enthusiastic encouragement of established astronomers at home and abroad whom she could freely consult, Sir David Gill who met her when on a visit to England in 1887 was so impressed by her intellectual capability that he invited her to spend some time at the Royal Observatory at the Cape to gain some first hand experience of practical astronomy for her next book. She spent three months in South Africa in 1888 with the Gills and learned the art of night observing and made some spectroscopic observations which were later published in the Observatory magazine. Her second book, *The System of the Stars* (1890)[13], dealt with the contents and structure of the visible universe which, in the view of Agnes Clerke and of most astronomers at the time, were confined within the Milky Way Galaxy. The third of Agnes' major books was *Problems in Astrophysics* (1903)[14], a sort of sequel to her *History,* in which she brought the

story of the progress of astrophysics up to date and discussed unresolved questions and possible paths for further reserach. In 1905 she brought out a revised edition of *The System of the Stars* and also published a shorter book, *Modern Cosmogonies* [15], a historical account of the theories of the evolution of the universe. Her *History* went into four editions, the last in 1902.

The immense value of Agnes Clerke's astronomical books to this day is their extraordinary thoroughness. Her breadth of research, her capacity for assembling and collating material, were enormous. Each individual worker who contributed to the progress of astronomy was given "strictly and impartially his due". Being fluent in almost every European language she consulted only primary sources, often quite obscure ones: to quote Margaret Huggins again, "we are not humiliated by any attempt to make Great Britain the hub of the astronomical universe." The last editions of her works give the modern historian an accurate unbiassed picture of the state of astronomy and the preoccupations of astronomers in the early years of the 20th century.

These important works which made Agnes Clerke an authoritative figure in astronomy represent only part of her prodigious output. Shortly after settling in London she was engaged to contribute to the ninth edition of the Encyclopaedia Britannica. This famous edition took the form of monographs on important subjects signed by their authors, with shorter entries on minor topics. Agnes wrote major scholarly essays on the lives and work of Galileo, Laplace and Alexander von Humboldt, and also one on the Zodiac which was an account of ancient astronomies. At the beginning of the 20th century the new and revised 11th edition of the Encyclopaedia Britannica (published in 1911) was planned to provide an up–to–date picture of all branches of knowledge especially the rapidly developing sciences. Agnes Clerke contributed the main article on the history of astronomy and no fewer than 30 biographies of great astronomers – Hipparchus, Copernicus, Tycho Brahe etc. – as well as those already published in the earlier edition. It was a tragedy that she did not live to see this monumental work in print. Many of her articles – necessarily abridged – survived into later editions of the *Encyclopaedia Britannica:* she is still listed as a contributor in the 16th edition of 1961.

Another important project of a historical nature in which Agnes was involved was the *Dictionary of National Biography,* begun in 1882. The original dictionary appeared volume by volume in alphabetical order at the rate of one per quarter from 1885 to the death of Queen Victoria in 1901, The bulk of the work was done by a core of 100 regular contributors, among them Agnes Clerke who was responsible for the biographies of astronomers. A recent bibliographer has counted 165 entries over her initials[16]. This work, like that for the Edinburgh Review, involved relentless deadlines for years on end, Yet it did not deter her from undertaking other tasks such as regular contributions to the Observatory and countless articles for non–scientific magazines. She also found time to write a book on the Herschels[17] and another, in a lighter vein, on Homer which included her own translations of some passages from the original Greek.

4 Women in the scientific World

Britain, compared with countries on the Continent of Europe and the United States, was slow in admitting women to membership of professional scientific societies. The Royal Institution, founded in 1799 to teach useful science to the Public, was therefore a great boon to women like Margaret Huggins and Agnes Clerke. They attended the famous Friday evening discourses and the annual Christmas lectures where they could hear and see many of the great scientists of the day and keep themselves informed of developments in physics and chemistry. Among Agnes Clerke's various publications is an account of the low–temperature research carried out by the physicist Sir James Dewar at the Royal Institution where he lectured and performed demonstrations of the liquefaction of gases. Both Agnes Clerke and Margaret Huggins (jointly with her husband) were recipients of the Royal Institutions Actonian Prize for science writing.

In 1890 the British Astronomical Association was founded to cater for the interests of amateur astronomers who were dissatisfied with the situation at the Royal Astronomical Society where the fees were high and women were ineligible for Fellowship. Margaret Huggins and Agnes Clerke supported the new association and became two of four women elected to the 48–strong Council[19]. The Royal Astronomical Society, however, remained closed to them, though Agnes Clerke was allowed the use of its library. At the time of her visit to South Africa, David Gill had suggested that she should be made an honorary member of the Society in order that she might use the library as a right rather than as a favour[20]. Nothing came of this, or of other attempts

in 1886 and 1892 to have women admitted as Fellows. Eventually, in 1892, a concession was made to issue cards of admission to meetings "to such persons as it may be thought desirable to admit[21]"; Agnes Clerke and Margaret Huggins were thus enabled to attend meetings of the Royal Astronomical Society - in the role of spectators.

When Agnes Clerke's *Problems in Astrophysics* appeared in 1903 it was felt by her male associates in London that her membership of the Royal Astronomical Society could no longer be postponed. Accordingly she and Margaret Huggins were made honorary members in that year. In the entire history of the Society, founded in 1828, only three women had been so honoured - Caroline Herschel and Mary Somerville, elected in 1835 on the strength of their own achievements, and Anne Sheepshanks in 1862 as a benefactress of astronomy. In formally admitting Agnes and Margaret to membership the President of the Society drew attention to "the considerable resemblance between the claims of these ladies and those of our original honorary members. Lady Huggins has been associated with the work of her husband as Miss Caroline Herschel was associated with the work of her brother. The work of Miss Agnes Clerke is similar to that of Mrs Somerville, lying in the domain of scientific writing"[22]. To modern minds it seems a long overdue recognition of their worth: Margaret Huggins was then 55 and Agnes Clerke was over 60.

5 The last years

William Huggins' term as President of the Royal Society ended on St Andrew's Day (November 30), 1905. His wife was present to hear his closing address. She recorded: "Sir William has closed his five years of office brilliantly. This is the general verdict – a brilliant and memorable Presidency brilliantly brought to a close. I thank God fervently for the success and usefulness of the last five years, I had the responsibility of them; and I have been Sir William's sole Privy Counsellor, all through, I am aware that the RS has been good enough to do me honour. It recognises me as Sir William's faithful and sole and, I trust, pretty capable assistant." Margaret lost no time in providing a permanent memorial of her husband's Presidency in the form of a collection of the addresses delivered by him to the Society during his term of office[23].

In 1906 Agnes Clerke lost her much loved sister Ellen, who had also made a career in writing principally as a journalist on the Catholic weekly paper *The Tablet,* Agnes' own health deteriorated: she was so easily tired that she could work for only half–hour periods at a time, and while writing her *Problems in Astrophysics* she feared that she would not live to finish it. She died on January 20, 1907. She had laboured to the end; her last publication, an essay in the *Edinburgh Review* on Ernest Rutherford's work on radioactivity, appeared in the very month of her death. Her friend and companion in astronomy, Margaret Huggins, had the sad duty of writing obituary notices for the journals. At the request of their brother, the sole survivor of the Clerke family, she then wrote a personal memoir of Agnes and Ellen[24]. It is a charming and warm account of the two sisters whom she had known well and loved dearly.

Not long afterwards the time came when William and Margaret Huggins felt that they had contributed all they could to science. He was now 85; he had worked in his little observatory for well over fifty years, she for over thirty. The Royal Society arranged for the instruments which they had on loan to be given to the University Observatory, Cambridge, where H. F. Newall, newly created professor of Astrophysics, was ready to make use of them. It was fitting that the telescopes were dismantled and repacked under the supervision of Sir Howard Grubb who had made and installed them, and who had brought the two astronomers together so many years before. William and Margaret, in their retirement, collected and edited their scientific papers which were published in 1909 in a handsomely produced volume illustrated by Margaret's pen drawings[25].

William Huggins died the following year. Margaret moved to a small apartment in Chelsea and made plans to write the biography of her late husband. It was never completed; notes left among her papers were eventuaily used in a memoir privately printed in 1936[26]. She suffered a long and serious illness involving surgery and spells in hospital. She was able, however, to ensure that her scientific and artistic treasures were placed in good hands by donating them to Wellesley Womens College in the United States[27]. Margaret Huggins had always taken an interest in the cause of womens education and greatly admired the achievements of American women in the academic world. She was a particular friend of Sarah Whiting, Professor of Astronomy at Wellesley College whom she had got to know during the latter's period of study in Britain. The bequest to Wellesley College include some of the observing diaries from the Huggins Observatory at Tulse Hill[28]. Even as she packed and dispatched

her gift Margaret knew that she had not long to live; she died on March 24, 1915 at the age of 66.

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