

# The life and times of E. M. Antoniadi, 1870–1944

## Part 1: An astronomer in the making

Richard McKim

This paper reviews the life and achievements of this most famous Greek observer, a past Director of the BAA Mars Section, the author of standard works on planetary science, and one of the greatest amateur astronomers of the twentieth century.

‘... un homme de culture, lettré érudit, historien, linguiste.’

*Audouin Dollfus<sup>1</sup>*

### Introduction

Eugène Michael Antoniadi was one of the most famous of all planetary astronomers. Greek by birth but later a naturalised Frenchman, Antoniadi became well-known through his artistic, high-resolution and above all *accurate* drawings of planetary features. His observations with the Great Meudon refractor enabled him to demonstrate the illusory character of the Martian ‘canal’ system of Schiaparelli and Lowell. He was able to suggest the true character of some of the surface features of Mars, and has left us with standard works on the planets Mars and Mercury. He wrote widely in French, British, American, Belgian and German astronomical journals, his interests ranging from the jovian satellites to deep sky objects and Egyptian astronomy. He demonstrated skills in archaeology and architecture. He made a major contribution to the development of planetary astronomy as a *science*, and by his own example demonstrated the quality of observational work that others might hope to emulate. Today, his name is commemorated by the scale of astronomical ‘seeing’ he devised, by a crater on the farside of the Moon and by a crater on Mars, to the northwest of *Syrtis Major*.

This paper reviews Antoniadi’s life and work, and in

attempting to uncover something of his personality focuses as much upon his opinions as upon the observations themselves. It is not exhaustive. For Antoniadi’s published work I have concentrated upon his planetary studies, especially his martian ones; the unpublished material consists of observations and letters in the BAA and RAS archives, and in the archives of the Juvisy and Lowell observatories and Vanderbilt University, USA.

1992 marked the 100th anniversary of the formation of the BAA Mars Section, 1993 marks the 100th anniversary of Antoniadi’s appointment as Flammarion’s assistant at Juvisy, and 1994 will mark the 50th anniversary of Antoniadi’s death. As almost nothing has been written about his life it is hoped that this paper will fill a gap in the literature.

### Early life, 1870–1893

Eugène Michael Antoniadi (he was christened Eugenios Mihail Andoniadis) was born in the Tatavla quarter of Constantinople (the present-day Kurtuluş quarter of Istanbul), Turkey, on 1870 March 1, the son of Michel Antoniadi and Photini Alexiou.<sup>2</sup> Figure 1 shows him as a boy.<sup>3</sup> Both parents were Greek, the name Antoniadi being quite common amongst Istanbul-born Greeks. We know little about his background, early life and education, but Walter Maunder later wrote of him as ‘an architect by training and an astronomer by genius’.<sup>4</sup> By 1888 Antoniadi had already achieved a high standard of astronomical drawing, observing with a 3-inch (75-mm) refractor (with useful powers as high as  $\times 300$ ),<sup>5</sup> both in Constantinople and on the island of Prinkipo in the Marmara Sea. The Société Astronomique de France (SAF) had been founded in 1887, and Antoniadi was a member from 1891. In the words of one obituarist ‘... his notes and drawings of sunspots, Jupiter, Saturn and Mars attracted immediate attention ... revealing as they did an observer endowed with an unusually acute and sensitive vision, and a gifted draughtsman.’<sup>6</sup> His astronomical records dated from 1887.<sup>7</sup>

In 1890, hearing of the formation of the BAA, he became one of its original members, having already



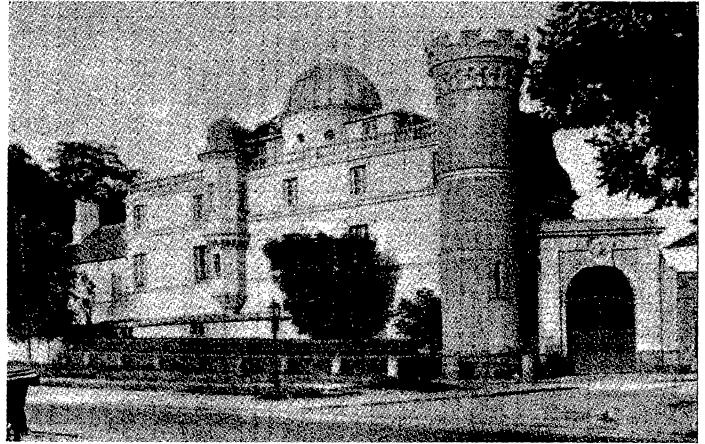
Figure 1. Antoniadi as a boy (RAS Add MS 91/2/29). Copyright Royal Astronomical Society Library.

## Antoniadi, Part 1



**Figure 2.** Antoniadi aged 23. Taken in Istanbul shortly before his departure in 1893 (RAS Add MS 91/2/9). Copyright Royal Astronomical Society Library.

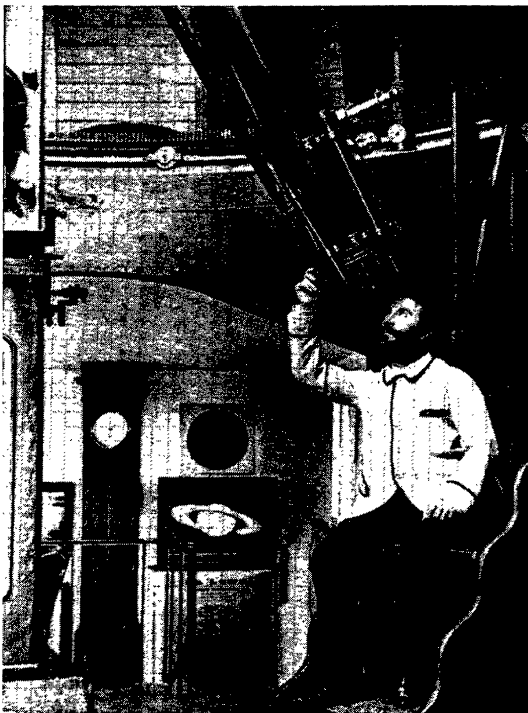
published papers in English in the *Journal of the Liverpool Astronomical Society*. In 1892, now equipped with a 4 $\frac{1}{4}$ -inch (108-mm) refractor by Mailhat, Antoniadi joined the BAA Mars Section, four of his drawings being reproduced in the first Mars *Memoir*.<sup>8</sup> Antoniadi also contributed to the Solar and Jupiter Sections.



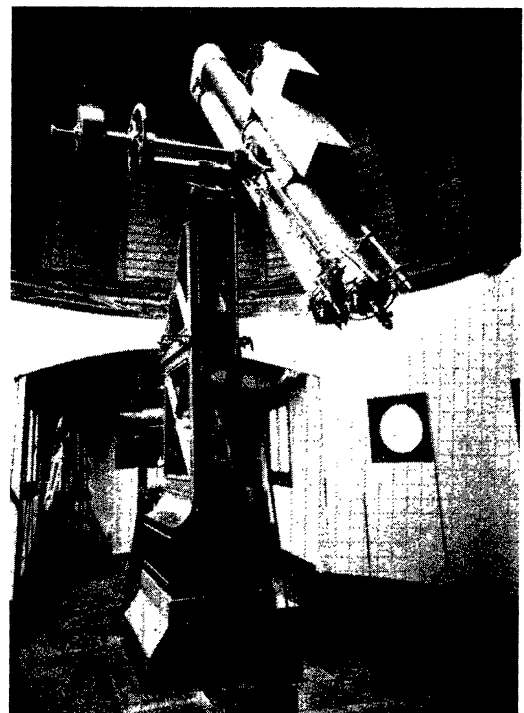
**Figure 3.** The Juvisy Observatory, from an old postcard. (Documentation Observatoire de Juvisy.)

## Juvisy

In 1893 Antoniadi, then aged 23, travelled to France and worked at the observatory of Juvisy, near Paris. The portrait in Figure 2 was taken shortly before he left Constantinople.<sup>9</sup> Juvisy (Figure 3) was the private observatory of the French writer and populariser of astronomy, Camille Flammarion, who had received the house and grounds as a gift from a generous well-wisher.<sup>10</sup> Flammarion (Figure 4) was already famous, having founded the magazine *l'Astronomie* in 1882,<sup>11</sup> and later the SAF (its *Bulletin* was also known, confusingly, as *l'Astronomie*). He quickly recognised the potential of the young Antoniadi, and probably invited him to come to France to work for him.<sup>12</sup>



**Figure 4.** Camille Flammarion with his telescope at Juvisy. (Documentation Observatoire de Juvisy.)



**Figure 5.** Flammarion's 9 $\frac{1}{4}$ -inch (240-mm) refracting telescope. (Documentation Observatoire de Juvisy.)

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Juvisy was becoming a cultural centre, and many famous personalities, such as the composer Saint-Saëns and the astronomer Percival Lowell visited Camille and Sylvie Flammarion there. No doubt Antoniadi found Flammarion inspiring to work for, as they both shared a particular interest in the planet Mars, which they followed with a fine 240-mm Bardou refractor (Figure 5). Antoniadi worked tremendously hard, an early achievement being a series of drawings of a complete rotation of Jupiter.<sup>13</sup> His contributions to the *SAF Bulletin* mushroomed in 1894, and he was elected to its Council. Flammarion paid Antoniadi and other assistants (such as F. Quénesset) a salary for their work: in 1896 Antoniadi received 300 francs per month. As Antoniadi's contract of employment (Appendix 1) shows,<sup>14</sup> Flammarion expected a good deal for this very modest sum. Also, Antoniadi did not live at Juvisy, but in Paris.<sup>15</sup> He addressed Flammarion respectfully as 'My dear Master' in their correspondence. In the 1890s the BAA annual subscription was only half a guinea, but the RAS subscription of two guineas was quite a considerable sum in those days. Nevertheless, Antoniadi was elected a Fellow on 1899 February 10, the *Monthly Notices* listing him as 'Astronome, Observatoire de Juvisy, Seine-et-Oise, France.'

### Norway, 1896

The BAA's first eclipse expedition took place in 1896, with 58 members and friends sailing to Norway to observe from Vadsø. Antoniadi was sent as emissary from Juvisy, and joined the ship to sail from Tilbury.<sup>16</sup> Although totality on August 8 was clouded out, an account was published in the *Memoirs*. Antoniadi wrote: 'The gorgeous purple colouring of the sky during totality was of an indescribable beauty, contrasting most admirably with the grand yellow gaps near the horizon. I could not see the edge of the Moon's shadow either coming on or going off. Not the slightest trace of it was seen on the overcast sky, the mountain scenery, or the still waters of the Varanger Fjord.'<sup>17</sup> Antoniadi's beautiful watercolours of the scenery are preserved at Juvisy.

Although the eclipse was not a success from an astronomical viewpoint, it brought many members together, and later that year, when the Directorship of the Mars Section fell vacant the Council looked to the youthful Greek emigré, whom many of them had met aboard the *Norse King*, to be the next Director.

### The BAA Mars Section: planetary work in the 1890s

As we have seen, in 1896 Antoniadi was invited by Council to succeed B. E. Cammell as Mars Section Director: the SAF still had no Sectional network, but observational notes were often grouped together in its *Bulletin*. Not until 1939 did de Vaucouleurs and Fournier start the Commission de la Planète Mars, of which Antoniadi was Président d'Honneur.

Antoniadi's first BAA Mars *Memoir* appeared in 1898.<sup>18</sup> The main contributors were Captain (later Major) P. B. Molesworth in Ceylon (Sri Lanka), Walter Gale in Sydney, together with the Rev. T. E. R. Phillips, Stanley Williams and H. F. Griffiths in England, although Antoniadi himself contributed the greatest number of drawings (53). He had obviously given a lot of thought to his first Report, so that the later ones fitted the pattern with little further change. It reads as a highly analytical work, much more so than the *Memoirs* produced by the other Sections at this epoch. Detailed footnotes placing new observations in their historical context demonstrate that Antoniadi, benefiting from Flammarion's extensive library, was very well-read. Correctly accrediting past authorities with their discoveries was very important to Antoniadi throughout his life.

We might note at this point that Antoniadi was a gifted linguist, for in addition to his knowledge of the classical languages he wrote (and doubtless spoke) perfect English and French. The following comment, on a postcard to Phillips, may amuse: 'Reading the 'New York Herald' after Gibbon gives me nausea. The Americans are seriously damaging your splendid language.'<sup>19</sup>

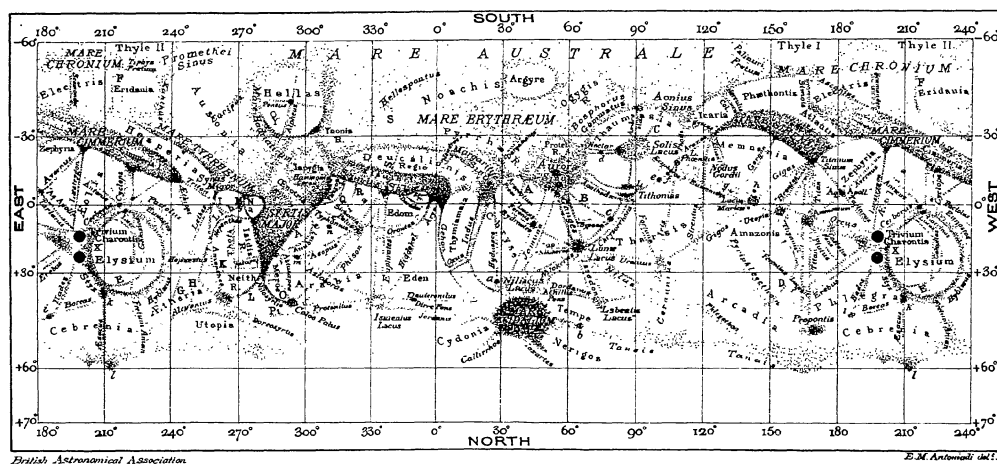


Figure 6. BAA Mars map, 1896, drawn by Antoniadi (see text for description).

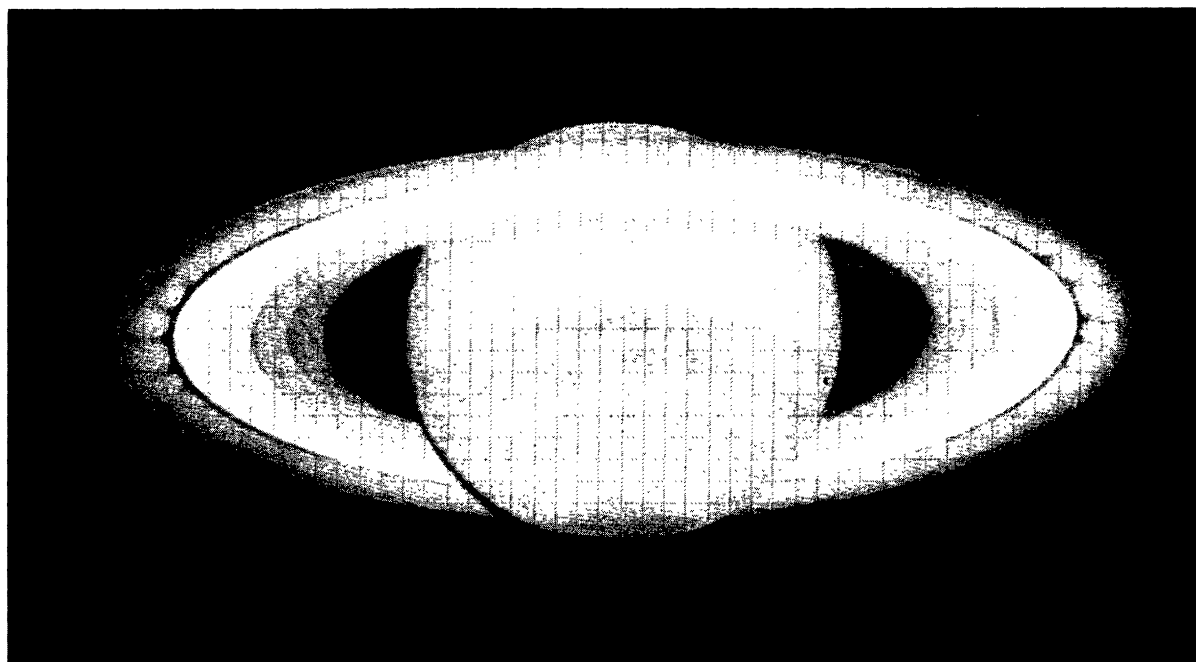
*Antoniadi, Part 1*

At this time, Percival Lowell's ideas were becoming well-known. Douglass (at Flagstaff) and Pickering were also drawing linear features, and some observers such as the obscure Austrian amateur 'Leo Brenner' (a pseudonym for Spiridion Gopcevic)<sup>20</sup> drew even more canals than the Flagstaff group. Many of the BAA members, including Antoniadi himself were certainly influenced by Schiaparelli in their early drawing styles. Thus the maria have rather hard edges and the canals are more often represented as hard rather than as soft features on the chart accompanying the Report<sup>21</sup> (Figure 6). But right from his first Report we see Antoniadi's critical mind at work. Section 7 deals with 'The Canals': 'The Director's experience . . . is that the canals are very difficult objects, visible only by rare glimpses, and had it not been for Prof. Schiaparelli's wonderful discoveries, and the fore-knowledge that 'the canals are there,' he would have missed three-quarters at least of those seen now . . . The Juvisy drawings fully corroborate Capt. Molesworth's and Mr Meares' statements on the broadish and diffused appearance of the linear markings (which is a corollary of their indistinctness), for out of some 55 of these streaks seen in 1894 and 1896, only the *Laestrygon* was found, during both oppositions, as an exceedingly fine black line. In justice, however, to the unrivalled Milan drawings, it should not be forgotten that the imperfect seeing of a narrow black line gives the appearance of a more or less diffused dusky band.'<sup>18</sup> Although Antoniadi recognised observers by their ability to see the canals he was already questioning their form and nature. When C. Roberts produced highly stylised drawings, Antoniadi was quick to criticise him for representing 'the most daedalian canal network ever devised.'<sup>18</sup>

In later years Antoniadi would discover that the geometrical nature of the Lowellian network was an illusion, the result of the eye straining to see myriads of unresolvable details, or giving illusory hard edges to the intersections of half-tones of different intensity. In Antoniadi's *Memoirs* for 1898–99<sup>22</sup> and 1900–01<sup>23</sup> we see him further attacking the canal question, and developing the foregoing ideas. Molesworth, Phillips and Williams also wrote about their work in the BAA and RAS publications.<sup>24, 25</sup>

Antoniadi's Directorship of the Section brought him into contact with many amateurs and professionals. He corresponded with Cerulli in Italy (one of the first to suggest the illusory nature of the *canali*), Schiaparelli (soon to retire from active observational work), Lowell at Flagstaff (whom he must have met at Juvisy) and Barnard at Yerkes. Some English amateurs like Phillips were to become lifelong friends. Excellent modern accounts of the canal controversy have been given by Hoyt<sup>26</sup> and Sheehan<sup>27</sup>, while Ryves<sup>28</sup> and Alexander<sup>29</sup> have given important summaries of the early work of the Section elsewhere.

It was during the 1890s at Juvisy that Antoniadi became involved in a controversy concerning the structure of the rings of Saturn. In 1896 June two independent reports appeared in the *BAA Journal*,<sup>30</sup> one by Roberts and one by Antoniadi. Both commented on ring A, Roberts seeing Encke's division and the other commenting that: 'instead of the Encke division, ring A shows (just now) some enormous white spots separated by dusky intervals. This ring appears broken (as it were) into fragments.' One of Antoniadi's beautiful drawings is given here (figure 7). Griffiths and J. S. Townshend were also able to see the features;<sup>31</sup> Alex-



**Figure 7.** Saturn, 1896 April 18d 23h 30m, drawn by Antoniadi at Juvisy (240-mm OG,  $\times 300$ ). Note the ring subdivisions, radial details in ring A, and the white patches in the equatorial zone. Reproduction from volume 1 (1896) of Antoniadi's notebook. (Documentation Observatoire de Juvisy.)

ander has told the story in more detail.<sup>32</sup> Some later observers drew similar radial markings on the rings,<sup>33,34</sup> and *Voyager* detected the famous ‘spokes’ upon the B ring. Antoniadi also did important work on Jupiter, witnessing the evolution of the South Tropical Disturbance and its interaction with the Great Red Spot.<sup>36</sup> He found time to criticise Lowell’s drawings of Venus,<sup>37</sup> and during a visit to England observed the Leonids from Blackheath in the company of Dr Crommelin.<sup>38</sup>

### The Great Paris Exhibition, 1900

In 1900 there was the Great Exhibition in Paris, and it included an astronomical component. Antoniadi wrote to RAS Secretary W. H. Wesley to secure the latter’s help: ‘We are gathering all sorts of celestial photographs . . . They will be either exhibited, or projected as lantern slides in lectures to be delivered in the Exhibition grounds.’<sup>39</sup> Antoniadi exhibited a painting of Jupiter 12 feet (3.7 metres) in diameter. By May 1900 he was working in Paris with the great refractor of the Exhibition. In the *Journal* for 1954 April, H. C. King described the telescope: ‘During its brief existence the 49-inch Paris refractor was the largest refractor in the world . . . To avoid the expense of a large dome and equatorial mounting . . . Deloncle instructed Gautier to build a fixed-tube instrument fed by a siderostat. . . . When the lights were out and the visitors abed, E. Antoniadi of the Juvisy Observatory used the telescope to examine certain more prominent nebulae. His drawings . . . are reproduced in the *Bulletin* of the Société Astronomique de France for 1900.’<sup>40</sup>

The initial observations of the heavens with the great telescope were hampered by the discovery that the tube was one metre too long (!), so that: ‘. . . M. Loewy was forced to get down the tube in order to realise the quality of the image. It is difficult to imagine an astronomical session more comical.’<sup>41</sup> Antoniadi drew a cartoon for Flammarion’s benefit (Figure 8). Walter and Annie Maunder were shown over the telescope by Antoniadi; ‘. . . privately we came to the conclusion that it won’t do much good’,<sup>42</sup> wrote Annie after the visit. Antoniadi observed Mars with the 49-inch OG, ‘. . . but to no purpose. Mars was a far better object in a 3-inch than in the 49-inch!’<sup>43</sup> Years later he reminded Barnard that they had once walked with Flammarion through

the tube of the great refractor.<sup>44</sup>

### Character, Marriage, Nationality

Antoniadi’s contract (Appendix 1) required him to keep a notebook for Flammarion, and four volumes of his drawings (1896–1902) are preserved to this day at Juvisy. A few of his exquisite drawings have appeared in the *SAF Bulletin*.<sup>45</sup> These documents are annotated in French and not Greek, so they are the *copies* that Antoniadi made (retrospectively and annually) for Flammarion; the originals must have remained in Antoniadi’s own notebooks (which left Juvisy with their originator), of which more in Part 2.<sup>46</sup>

In 1902 Antoniadi resigned from Flammarion’s staff and from the SAF. Publicly, Antoniadi said that having resigned his appointment he would be able to give more time to the work of the Mars Section.<sup>47</sup> Privately, the situation was rather different. Flammarion and Antoniadi both had strong personalities and they must have clashed on more than one occasion. Some aspects of this appear in letters, for example when Antoniadi wrote to Wesley, concerning a paper by himself (but also signed by Flammarion) on the photographic ‘auréole’ surrounding Nova Persei which he himself had discovered: ‘. . . M. Flammarion wedding his name to mine . . . merely as director of the Juvisy Observatory. (He does not know anything about photography himself, as he was asking me recently if I was developing my plates ‘with hyposulphite of soda’ [i.e., photographic fixer]. Also, it was not possible to make him believe at first that the ‘nebulousity’ photographed by me round the star was not real.)’<sup>48</sup> In fairness to Flammarion, the reader will see that he was quite free to publish Antoniadi’s observations under the terms of the contract (Appendix 1). Indeed, he was still doing so in the 1920s!

Annie Maunder sometimes mentions Antoniadi in her correspondence at this time. It appears that Antoniadi’s health was rather delicate, though Annie felt he worried too much. Referring in 1900 August to an observational dispute between Antoniadi and Stanley Williams, which had nearly led to his resignation, she noted to Molesworth: ‘Poor M. Antoniadi. He is a first-class observer, but I think he has imbibed in Paris a little of the French touchiness.’<sup>49</sup> On 1900 December 13 she wrote: ‘. . . M. Antoniadi has decided to become an Englishman. He is at present staying with Mr Chatwood [FRAS] near Manchester. He says he could not stand M. Flammarion any longer.’<sup>50</sup> Indeed, Antoniadi wrote that he was ‘very thankful’ to have left Flammarion’s staff.<sup>51</sup> Although he no longer worked with the great Frenchman after 1902, he often admired (and sometimes publicly defended) Flammarion’s writings.

Antoniadi did not stay in England long. On 1902 June 9 he married Katherine Sevastupulo, the daughter of Theodore Sevastupulo.<sup>52</sup> Like Eugène, Katherine had Greek parents, and had been born in Turkey. She too became a BAA member. Antoniadi’s marriage seemed to improve him considerably, Annie Maunder



Figure 8. Antoniadi’s cartoon of M. Loewy attempting to observe with the Great Paris Refractor (see text). (Fonds Camille Flammarion de l’observatoire de Juvisy-sur-Orge (France).)

## Antoniadi, Part 1

noted with satisfaction. Again, to Molesworth, 1903 February 6, she wrote: 'He seems stronger and less sensitive, and with a much keener sense of humour. He hopes to come and live in England some time – and how he does hate the French!'<sup>53</sup> He later changed his mind about the French, for Eugène Antoniadi never became an Englishman; instead, in 1928 both he and Katherine became naturalised French citizens!<sup>1</sup> Indeed, Dollfus has written that Antoniadi was a 'grand admirateur de la culture française'. The Antoniadis settled for many years at 74, Rue Jouffroy, Paris. Antoniadi's elder brother Dorotheos married in 1903; apart from a single reference in a letter<sup>54</sup> I can find no mention of any other members of the family.

Antoniadi's early opinions about the French have a bearing upon what he wrote to Wesley in 1901: 'I was exceedingly gratified last year with the courteous and encouraging reception I have met at the RAS Meeting, so that I have decided to bequeath to the Society by 15 vols. of astronomical observations and drawings (including some 2000 drawings of the heavenly bodies), all written in Greek . . .' He added that he would be very happy: 'to leave them in English hands after my death.'<sup>54</sup> The Society accepted Antoniadi's offer with thanks, but as we shall see later his wishes were thwarted by events on the world stage.

I do not know whether Antoniadi ever pursued a salaried profession after he left Flammarion. We know that he trained as an architect, but with the exception of his St Sophia book (see later) he does not appear to have put this training to use. He later wrote a number of other books, but the income from these must have been small. Furthermore, he received no salary for his later observational work with the Great Meudon Refractor.<sup>55</sup> I do not think he worked as an artist, for I know of no well-known works by him. Writing to B. M. Peek he refers to a portrait painted by him of Lord Byron and to a drawing of Newstead Abbey,<sup>56</sup> but I can find no other references to his non-astronomical drawing. Most probably he had private means, as he must have come from an affluent background: he was already highly educated in languages and sciences by the time he travelled to France. In the 1931 Paris Census,<sup>57</sup> Antoniadi gave his occupation as 'astronome', and Katherine (now spelt *Catherine*) as 'astronome, publiciste'.

### Interregnum: The Mosque of St Sophia

In 1904, Antoniadi obtained the unique permission of the Sultan Abdul Hamid Khan II to draw and (for the first time) photograph the interior of the Mosque of St Sophia, in his native city, Constantinople. The mosque, constructed by Constantine in AD 347 and rebuilt later, is considered to be one of the most beautiful buildings in the world. Antoniadi secured 1008 negatives, and as many sketches of the great basilica, over a period of 4½ months.<sup>58</sup> Many of these sketches were later redrawn and included, together with many watercolours, in a

magnificent three-volume book about the great mosque, the only one he wrote in the Greek language (*Atlas of the Mosque of St Sophia*, 1907).<sup>59</sup> It was his first book, and had little astronomical content apart from notes on the orientation of the building and on Byzantine clocks.<sup>58</sup> Antoniadi put a tremendous effort into this work, confessing to Wesley that: 'The Sta Sophia labour was quite formidable . . . Thank God everything is now being finished.'<sup>58</sup> We may note that Antoniadi paid a Paris printer about 12,000 francs for the plates of this book,<sup>60</sup> which appeared in a limited edition. The Sultan, who had dissolved the first Turkish Parliament in 1878 after only one year, was deposed in 1909 and constitutional rule restored. Today, St Sophia is a museum.

By the time Antoniadi had taken up his astronomical writing again he was convinced that his view of the martian 'canals' was the correct one, but he needed the final, indisputable piece of observational proof. As we shall see, this was not long in coming. (*To be continued*)

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### Notes and References

- 1 Dollfus, A., *Eugène Antoniadi et les observations planétaires*, in Proceedings of IAU Colloquium 98, Paris, 1987 June 20–24.
- 2 I am indebted to Mr Haldun Menali, a BAA member resident in Istanbul, for searching for Antoniadi's birth certificate. Unfortunately, the records of the Ecumenical Patriarchate do not predate 1900. A Greek encyclopaedia consulted by Mr Menali gave the district of Antoniadi's birth. Antoniadi's parents' names and his dates of birth and death are given on his death certificate, a copy of which I obtained from the Bureau des Mairies, Paris.
- 3 RAS Add MS 91/2/9. This portrait is undated; probably Antoniadi sent this and the one in Figure 3 to his friend W. H. Wesley, longtime RAS Secretary.
- 4 Maunder, E. W., *Journal of the Transactions of the Victoria Institute*, **44**, 85 (1912), quoted by Burnett, J., *J. Brit. Astron. Assoc.*, **89**, 136 (1979).
- 5 E. M. Antoniadi to C. Flammarion, 1889 August 5. (Fonds Camille Flammarion de l'observatoire de Juvisy-sur-Orge (France).)
- 6 Ryves, P. M., *J. Brit. Astron. Assoc.*, **55**, 163 (1945).
- 7 E. M. Antoniadi to F. W. Dyson, 1901 November 15. RAS Letters, 1901.
- 8 Maunder, E. W., *Mem. Brit. Astron. Assoc.*, **2** (6) (1895).
- 9 RAS Add MS 91/2/29. Taken in 1893 August at Photographie Phébus, Grand Rue de Pera, No. 301, Constantinople.
- 10 Porthouse, W., *English Mechanic*, 1915 November 5; Duplay, A., *Bull. Soc. Astron. France*, **89**, 405 (1975); Pecker, J.-C., and Pernet, J., *ibid.*, **101**, 331 (1987). By the publication in 1892 of his monumental work *La Planète Mars et ses conditions d'habitabilité* (Gauthier-Villars, 1892), Flammarion became a leading authority on the Red Planet. He was also interested in psychic experiences, and published a book *Les Forces Naturelles Inconnues* (Paris, 1907). It included an eye-witness account by Antoniadi of a seance Flammarion had arranged with the celebrated medium Eusapia Palladino, in 1897. Antoniadi considered that she was a fraud.
- 11 The earlier *l'Astronomie* ran from 1882 to 1894 only; I refer to it here by this name to avoid confusion with the SAF *Bulletin*.
- 12 M. Jacques Pernet, curator of the Juvisy observatory tells me that the archives do not settle this question, as they contain few copies of Flammarion's outgoing letters.
- 13 *l'Astronomie*, **12**, 453 (1893).
- 14 This is perhaps not the definitive contract, because it is not signed by Antoniadi. It is probably, however, an accurate copy. (Fonds Camille Flammarion de l'observatoire de Juvisy-sur-Orge (France).)
- 15 In 1896 Antoniadi lived at 6 Avenue de Péreire; by 1900, 21 Avenue de Messine.

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- 16 A commercial set of 3 × 3-inch glass slides was produced, together with an eclipse album; for references to these and for some reproductions see: Marriot, R. A., *J. Brit. Astron. Assoc.*, **101**, 162, (1991). A photograph of Antoniadi aboard the *Norse King* is given in *ibid.*, 195 and in *Mem. Brit. Astron. Assoc.*, **42** (1), Plate 15 (1990).
- 17 *Mem. Brit. Astron. Assoc.*, **6** (1) (1896).
- 18 *Mem. Brit. Astron. Assoc.*, **6** (3) (1898).
- 19 E. M. Antoniadi to T. E. R. Phillips, 1932 May 18. BAA Archives, T. E. R. Phillips papers.
- 20 Ashbrook, J., *Sky & Telesc.*, **56**, 515 (1978).
- 21 Note that early in his career Antoniadi had already perfected his 'stippling' technique for representing astronomical objects, for better reproduction of half-tones.
- 22 *Mem. Brit. Astron. Assoc.*, **9** (1) (1901).
- 23 *Mem. Brit. Astron. Assoc.*, **11** (3) (1903).
- 24 Molesworth, P. B., *Mon. Not. R. Astron. Soc.*, **65**, 825 (1905).
- 25 Phillips, T. E. R., *Mon. Not. R. Astron. Soc.*, **60**, 41 (1899) and *ibid.*, **64**, 39 (1904).
- 26 Hoyt, W. G., *Lowell and Mars*, Arizona University Press, 1976.
- 27 Sheehan, William, *Planets and Perception*, Arizona University Press, 1988.
- 28 Ryves, P. M., *Mem. Brit. Astron. Assoc.*, **36** (2), 86 (1948).
- 29 Alexander, A. F. O'D., in Davidson, M. (editor), *Astronomy for Everyman*, Dent, 1953.
- 30 *J. Brit. Astron. Assoc.*, **6** (7), 337 and 339 (1896).
- 31 Green, N. E., *J. Brit. Astron. Assoc.*, **7**, 236 (1897).
- 32 Alexander, A. F. O'D., *The Planet Saturn*, Faber, 1962.
- 33 Antoniadi published a fine 1899 Saturn drawing showing the radial markings in *Mon. Not. R. Astron. Soc.*, **60**, Plate 12 (1899).
- 34 The radial markings were best seen by G. Fournier in his observations with the telescope at the observatories of R. Jarry-Desloges (see the latter's *Observations des Surfaces Planétaires*, volumes 1–10, 1907–1946). Alexander, *op. cit.*, gives some further details.
- 35 Beatty, J. Kelly, O'Leary, B., and Chaikin, A. (editors), *The New Solar System*, Cambridge University Press, 1981.
- 36 For his drawings and diagrams of the South Tropical Disturbance see, for example: *Splendour of the Heavens*, eds. Phillips, T. E. R., and Steavenson, W. H., Hutchinson, 1923, volume 1, pp. 334, 346. Antoniadi was the first to foresee the effect the STropD would have upon the motion of the GRS.
- 37 Antoniadi, E. M., *Mon. Not. R. Astron. Soc.*, **58**, 313 (1898).
- 38 Antoniadi, E. M., and Crommelin, A. D. C., *Mon. Not. R. Astron. Soc.*, **61**, 91 (1900).
- 39 E. M. Antoniadi to W. H. Wesley, 1899 October 27, RAS Letters, 1899.
- 40 King, H. C., *J. Brit. Astron. Assoc.*, **64**, 210 (1954).
- 41 (Translation) E. M. Antoniadi to C. Flammarion, 1900 May 1. (Fonds Camille Flammarion de l'observatoire de Juvisy-sur-Orge (France).)
- 42 A. S. D. Maunder to P. B. Molesworth, 1900 August 31; RAS MSS Molesworth papers.
- 43 Antoniadi, E. M., *J. Brit. Astron. Assoc.*, **12**, 387 (1902).
- 44 E. M. Antoniadi to E. E. Barnard; 1909 December 11; Vanderbilt University Archives.
- 45 Coloured drawings of Mars and Jupiter for 1896 featured on the covers of *Bull. Soc. Astron. France*, **92**, 1978 July–August and **94**, 1980 March.
- 46 Antoniadi destroyed his original notebooks: see part 2.
- 47 Antonaidi, E. M., *J. Brit. Astron. Assoc.*, **12**, 388 (1902).
- 48 E. M. Antoniadi to W. H. Wesley, 1901 November 15. RAS Letters, 1901.
- 49 A. S. D. Maunder to P. B. Molesworth, 1900 August 31; RAS MSS Molesworth papers.
- 50 A. S. D. Maunder to P. B. Molesworth, 1900 December 13; RAS MSS Molesworth papers.
- 51 E. M. Antoniadi to W. F. Denning, 1902 September 30; BAA Autograph Letters collection. Antoniadi has absented himself 'for three months in the East'. He may have married in Istanbul.
- 52 *J. Brit. Astron. Assoc.*, **12**, 341 (1902).
- 53 A. S. D. Maunder to P. B. Molesworth, 1903 February 6; RAS MSS Molesworth papers.
- 54 E. M. Antoniadi to W. H. Wesley, 1901 November 4. RAS Letters, 1901. This letter tells us that Antoniadi already had sketches of St Sophia.
- 55 A. Dollfus to R. J. McKim, 1992 March 31.
- 56 E. M. Antoniadi to B. M. Peek, 1940 February 28, quoted by courtesy of Mr Brian Peek.
- 57 From details kindly provided by M. J.-M. Jenn, conservateur en Chef des Archives, Région d'Ile-de-France, Paris.
- 58 E. M. Antoniadi to W. H. Wesley, 1906 March 15; RAS Letters, 1906.
- 59 Antoniadi, E. M., *Atlas of the Mosque of St Sophia*, Maraşlı Library, Constantinople, 1907. Overall, these three volumes contain some 800 pages, 750 drawings and 100 plates.
- 60 E. M. Antoniadi to Mme Sylvie Flammarion, 1909 July 6. (Fonds Camille Flammarion de l'observatoire de Juvisy-sur-Orge, France.)

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## Appendix 1

**Antoniadi's Contract of Employment at the Flammarion Observatory, Juvisy (English translation by J. N. Brown)**

*Between the undersigned:*

M. C. Flammarion, Director of the Juvisy Observatory and living at that address,  
and M. Eugène Antoniadi, Astronomer, resident at 6 Avenue Péreire, Paris

has been agreed, as follows:

M. Eugène Antoniadi, desirous of devoting himself to the practice of Astronomy at the Juvisy Observatory, as Assistant Astronomer, from 1st November next.

He will devote himself to astronomical observations and work, following the programme which will be mapped out for him by M. Flammarion.

The duration of the hours of duty at the Observatory will be 8 hours per day, apart from one day a week off at the discretion of M. Antoniadi and official holidays: 1st January, Easter Monday, 14th July, All Saints Day and Christmas.

When the sky allows, observations will have to occupy the first four hours of darkness, that is to say from 7 to 11 p.m. from 1st October to 31st March, from 8 p.m. to Midnight in April and September and from 9 p.m. to 1 a.m. from 1st May to 31st August.

In the event that planetary positions or other observations require it, these hours may be replaced.

The day following these nights of observing, office work will be carried out from 1 p.m. to 5 p.m.

When no observations have taken place the previous evening, office work will be done from 8 a.m. to midday and from 1 p.m. to 5 p.m.

For his part M. Flammarion undertakes to pay M. Antoniadi a salary of 300 francs per month from 1st November next.

M. Antoniadi must keep an exercise book of his observations on a daily basis and copy them out into a register from which it is intended to select drawings for publication and to act as a record in the archives of Juvisy Observatory.

The work will be published by M. Flammarion; nonetheless M. Antoniadi may send articles abroad on his observations.

For the year beginning 1st November next, the observations will have as their special aim a Catalogue of Double Stars, delineation of orbits and the Astronomical Almanac for 1897.

M. Antoniadi will be able to take a fortnight's holiday per year, on a date which will be fixed by mutual agreement between M. Flammarion and him. His wages will continue to be paid during the holidays.

The present contract is valid for one year, unless M. Antoniadi withdraws his labour for a fortnight, other than for illness, which would render it null and void by definition. It will be able to be renewed in October 1896, according to the whim of both parties.

If M. Antoniadi were to have thirty days absence during the year through illness or otherwise, he would forfeit his right to fifteen days' holiday previously mentioned.

Copy at Juvisy 27 October 1895

*J. Br. Astron. Assoc.* **103**, 4, 1993