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# THE SURPRISING HISTORY OF CLAIMS FOR LIFE ON THE SUN

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**Abstract:** Because astronomers are now convinced that it is impossible for life, especially intelligent life, to exist on the Sun and stars, it might be assumed that astronomers have always held this view. This paper shows that throughout most of the history of astronomy, some intellectuals, including a number of well-known astronomers, have advocated the existence of intelligent life on our Sun and thereby on stars. Among the more prominent figures discussed are Nicolas of Cusa, Giordano Bruno, William Whiston, Johann Bode, Roger Boscovich, William Herschel, Auguste Comte, Carl Gauss, Thomas Dick, John Herschel, and François Arago. One point in preparing this paper is to show differences between the astronomy of the past and that of the present.

**Keywords:** Sun, stars, extraterrestrial life, W. Herschel, J. Herschel

## 1 INTRODUCTION

This paper discusses one aspect of the history of the extraterrestrial life debate, in particular, the history of claims for life on the Sun and stars. So far as I know, no one has previously put together a systematic survey of this topic.

First, some background. Earlier in my career, I spent over a decade researching the history of ideas of extraterrestrial life in the period from antiquity to 1915. This project culminated in 1986 when Cambridge University Press published my 700-page book, *The Extraterrestrial Life Debate 1750–1900: The Idea of a Plurality of Worlds from Kant to Lowell*. In the course of this research, I was able to show that this debate, rather than being confined to the twentieth century, began in Greek antiquity and has continued to the present. This book also provides evidence that already by 1915, over one hundred and forty books, not counting works of science fiction, had been published on the issue of extraterrestrial life (Crowe, 1986: 646-657).

One of the most fascinating aspects of this history concerns claims for life on the Sun. What is especially striking about the history of claims for solarians is that it can serve as an indicator of the level of enthusiasm for extraterrestrials among earlier authors. It takes a particularly robust passion for populating celestial bodies to claim that intelligent beings live on our Sun. I have located about fifty authors who, before 1900, supported life on the Sun. Another surprising research result concerns the prominence of some of these authors arguing for solarians. A number of these authors can, of course, only be described as cranks or as intellectuals venturing far from their areas of competence, but other authors were among the most prominent scientists or intellectuals at the time when they championed life on the Sun. And many of these individuals showed great ingenuity in finding ways to claim life on the Sun even when they were aware of some of the many convincing reasons that we now have for believing that the Sun is not a location favorable for highly-complex organic beings.

## 2 THE MEDIEVAL PERIOD

Would authors from the Medieval Period be shocked to hear us discuss extraterrestrial life? In fact, many Medieval authors explored the question of 'a plurality of worlds', as the issue of extraterrestrial life was then called. One of the most important Christian authors, Albertus Magnus (d. 1280), remarked: "Since one of the most wondrous and noble questions about Nature is whether there is one world or many ... it seems desirable for us to inquire about it." (as translated by Dick in 1982: 23). And inquire he did, as did his leading pupil, Thomas Aquinas (ca. 1224–1274), both of whom argued against extraterrestrials. But not all Medieval Christian authors opposed extraterrestrials. In 1440, the philosopher, theologian and mathematician Nicholas of Cusa (Figure 1) published his famous work *Of Learned Ignorance* in which he not only advocated extraterrestrials, but also stated regarding the Sun:

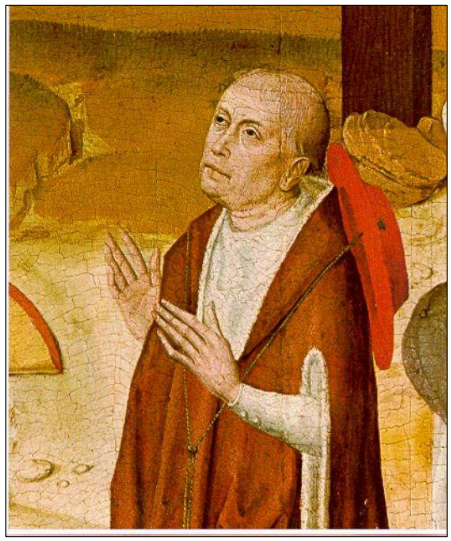

Figure 1: Nicholas of Cusa, 1401–1464 (Master of the Life of the Virgin, ca. 1480 (after https://commons.wikimedia/org/wiki/File:Nicholas_of_Cusa.jpg).

> It may be conjectured that in the area of the sun there exist solar beings, bright and enlightened intellectual denizens, and by nature more spiritual than such as may inhabit the moon—who are possibly lunatics—whilst those on earth are more gross and material. It may be supposed that those solar intelligences are highly actualized and little in potency, while the earth-denizens are much in potency and little in act, and the moon-dwellers betwixt and between. (Nicholas of Cusa, 1954: 116).

Persons learning about Cusa's advocacy of extraterrestrials and knowing that in 1600 the Catholic Inquisition burned Giordano Bruno at the stake may wonder

what fate befell Cusa. What happened is that eight years after the publication of his book, he was made a Cardinal. This should not be taken to imply that Cusa's advocacy of extraterrestrials secured him this recognition. Nor is there solid evidence that Bruno's punishment was because he advocated extraterrestrials. It seems far more probable that his harsh sentence was because he argued for various heresies, such as denying the divinity of Christ.

## 3 THE PERIOD FROM 1500 TO 1725

Cusa, by the way, was a major influence on Giordano Bruno (Figure 2), when in the last two decades of the sixteenth century Bruno championed extraterrestrials. In fact, Bruno was the first author to claim that stars were suns surrounded by inhabited planets. Moreover, his enthusiasm for extraterrestrials was such that in his cosmology, not only planets were inhabited but also the Sun and stars (Bruno, 1950: 306).

Figure 2: Statue of Giordano Bruno, 1548–1600, by Ettore Ferrari (1845–1929), after en.wikpedia.org/wiki/File/Giordano_Bruno_Campo_del_Fiori).

Let us jump ahead more than a century and a half to Isaac Newton (1642–1727), who in 1687 published his masterpiece, the *Mathematical Principles of Natural Philosophy*. Newton did not advocate solarians; in fact, in his book he presented information that one might suspect would have killed off any claims for solar inhabitants. Using his theory of gravitation, Newton showed that the weight of any terrestrial object would increase by more than a factor of 23 by being transported to the Sun. He also showed that although the Sun is vastly more massive than the Earth, its density is four times lower than Earth's, making further problems for any beings living on its surface (Newton, 1999: 811-815).

Of course, not everyone read Newton's *Principia*, containing such distressing news regarding extraterrestrials, but surely Newton's successor in the Lucasian Professorship at Cambridge University must have known of these passages. This was William Whiston (1667–1752), who repeatedly advocated extraterrestrials. As early as his *New Theory of the Earth* (1696), Whiston urged that other planets and planetary systems have inhabitants subject to moral trials (Jaki, 1978: 94). Two decades later, in his *Astronomical Principles of Religion*, Whiston extended his extraterrestrials by proposing denizens dwelling in the interiors of the Sun, planets and comets. Moreover, Whiston (1717: 92) posited "not wholly Incorporeal, but Invisible Beings …" living in planetary atmospheres. Whiston made provision for his solarians by supposing that the Sun has cavities beneath its surface where the solarians could live, shielded from the intense heat of the Sun's exterior surface. Whiston was anxious that all parts of creation be put to use, so he suggested that the planets, including the Earth, have inhabited cavities beneath their surface. In support of this suggestion, he was able to cite similar claims made by another famous Newtonian, Edmond Halley (Whiston, 1717: 94).

## 4 THE PERIOD FROM 1725 TO 1800

Let us move ahead now to the period between 1725 and 1760, during which four prominent intellectuals wrote in support of solarians. In 1748, Gowin Knight (1713–1772), an English scientist and the first Principal Librarian at the British Museum, published *An Attempt to Demonstrate, That All the Phenomena of Nature May Be Explained by Two Simple Active Principles, Attraction and Repulsion.* In that volume, Knight suggests that the Sun and stars may be sufficiently cool to accommodate life. In fact, he states:

> Their globes [i.e. those of the Sun and stars] are no longer frightful Gulphs of Fire, but inhabitable Worlds: Those Philosophers who thought them too hot for the Habitation of Salamanders, and those sublime Genii, who thought them to be Hells, will now perhaps be in Pain, lest the inhabitants should freeze with Cold. (Knight, 1748: 58).

Moving on to 1752 and German authors, we find that Johann Jakob Bodmer (1698–1783), a prominent German poet, published his epic poem *Der Noah*, an account of the deluge modeled to some extent on John Milton's *Paradise Lost*. Astronomy enters that poem not only through his adoption of Whiston's idea that a comet caused the deluge, but also through a telescope, which Bodmer bestows on one of Noah's fellow patriarchs. From that instrument and from the angel Raphael's revelations to Noah comes information that inhabited planets orbit stars, that the Sun itself is inhabited, and that at least one planet has been spared the ravages of sin. Bodmer describes his solarians in these verses (Schatzberg, 1973: 164):

> Not of human form, and not of terrestrial dust;
> But with their own beauty adorned from the stuff of light,
> Worthy of inexhaustible skill, with finer limbs,
> In accord with their location, to endure the sun's heat.

The year 1752 saw the publication of *Sources of Incredulity with Regard to Religion*, written by Duncan Forbes (1685–1747), Lord President of Scotland's Court of Session. In this book, Forbes questions the idea of a plurality of worlds. Nonetheless, moved

by the question of what purpose the heavenly bodies would serve if they are uninhabited, Forbes (1752: 2) suggests that

> … we cannot deem it impossible, that beings may have been made, fit to reside, to act, and to think, in the very centre, as well as on the surface of the sun.

The author with the most impressive scientific credentials who supported solarians in the 1750s was the famous Jesuit physicist Roger Boscovich (1711–1787), who in 1758 published his magnum opus, his *Philosophiae naturalis theoria*. In his explanation of fire as a fermentation in which a sulphurous substance must be present, he suggests that

> … in the sun itself, & in the stars ... there may exist bodies altogether lacking in such a [sulphurous] substance; & these may grow & live without the slightest injury of any kind to their organic structure. (Boscovich, 1966: 166).

Remarkable as his claim for life on the Sun and stars may be, Boscovich went even further in a suggestion based on his doctrine that matter ultimately consists not of hard, massy atoms but rather of point centers of force, which at certain distances exert repulsive and at other distances attractive forces. Drawing upon this hypothesis, Boscovich speculates about the interpenetrability of matter and proposes even that

> … there might be a large number of material & sensible universes existing in the same space, separated one from the other in such a way that one was perfectly independent of the other, & the one could never acquire any indication of the existence of the other. (Boscovich, 1966: 184).

By the 1770s, extraterrestrials had attained a level of acceptance, even among eminent astronomers, that probably exceeds what they now have. Among late eighteenth-century astronomers, few were more distinguished than Johann Elert Bode (1747–1826), who for over fifty years edited a leading German astronomical journal (*Astronomisches Jahrbuch*), and who, in 1786, became Director of the Berlin Observatory. Moreover, few authors from any nation advocated extraterrestrials with more frequency, fervor, or influence than Bode. His enthusiasm is evident in the fact that in 1776 he published a model of the Sun suitable for intelligent life. After attributing a protective layer to the Sun and inhabitants to its supposedly cool core, Bode described the Sun as

> … a dark planetary body which as our earth consists of land and water and exhibiting on its surface all the unevenness of mountains and valleys and also surrounded up to a certain height by a thick atmosphere. (Bode, 1776: 233).

Concerning solarians, he asks:

> Who would doubt their existence? The most wise author of the world assigns an insect lodging on a grain of sand and will certainly not permit ... the great ball of the sun to be empty of creatures and still less of rational inhabitants who are ready gratefully to praise the author of their life.
>
> Its fortunate inhabitants, say I, are illuminated by an unceasing light, the blinding brightness of which they view without injury and which, in accordance with the most wise design of the all-Good, communicates to them the necessary warmth by means of its thick atmosphere. (Bode, 1776: 246).

Next we come to Edward King (1735?–1807), who championed extraterrestrials in various books, including his *Morsels of Criticism Tending to View Some Few Passages in the Holy Scriptures, upon Philosophical Principles and an Enlarged View of Things* (King, 1800), which was a work of scriptural exegesis. King argues that the Septuagint translation of the Old Testament contains anticipations of some modern ideas, including the idea of a plurality of worlds. He presents this "Enlarged View of Things" in such a way as to have each star be the heaven for the resurrected inhabitants of its system of planets. After arguing that the solar rays are not themselves hot but produce heat only in interaction with material bodies, King urges his readers to join him in viewing

> … our sun, and all the other fixed stars, merely as so many mansions, and habitations of residence; merely as so many Islands (as it were) of Bliss, placed in the vast ocean of space. (King, 1800: 108).

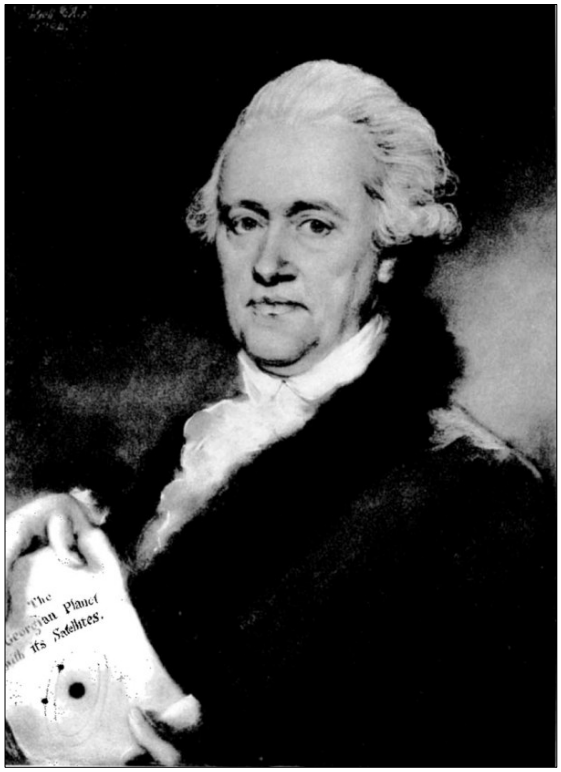


Figure 3: Sir William Herschel, 1738–1822 (after Dreyer, 1912, 1: frontispiece; courtesy: University of Notre Dame Library).

### 4.1 William Herschel

Many historians of astronomy view William Herschel (Figure 3) as the most important astronomer of the eighteenth and nineteenth centuries. Not only did he discover the planet Uranus, he also—and more importantly—was the pioneer of stellar and galactic astronomy. When he took up astronomy, only about one hundred nebulous objects were known. Using the giant telescopes he constructed, he discovered 2500 more, and made in addition numerous other discoveries. And his contributions to telescopic design and construction were legendary. He was also very interested in extraterrestrials. I have shown in my book that manuscripts from early in Herschel's career record his sighting a lunar forest (Crowe, 1986: 62–66). I have also suggested that a major reason why Herschel built some of his extraordinary telescopes may have been his determination to confirm his sighting of a forest and other evidences of lunar life.

Before discussing Herschel's view regarding life on the Sun, let us examine an incident reported in the 1787 issue of the *Gentleman's Magazine*. A certain Dr John Elliot was brought to trial in London for having come up behind a Miss Boydell and set fire to her cloak by firing a pair of pistols near it. Insanity was the plea made for Elliot, in support of which a Dr. Simmons recounted examples of Elliot's bizarre behavior, especially his having prepared a paper for submission to the Royal Society in which he maintained that the Sun is inhabited (see Manning, 1993).

This incident leads one to wonder what may have been the reaction among readers of the Royal Society's *Philosophical Transactions* when in 1795 and 1801 they encountered papers in which Herschel theorized that the Sun consists of a cool, solid, dark, spherical interior above which floats an opaque layer of clouds. In 1795, Herschel suggested that heat and light are carried by separate rays and that heat rays generate a rise in temperature only when in contact with special material (Herschel, 1795). In 1801, Herschel expanded the theory by proposing two exterior layers, the upper of which consists of the glowing matter, the lower being a reflecting shield that keeps the inner surface cool (Figure 4). As Herschel (1795: 63) states:

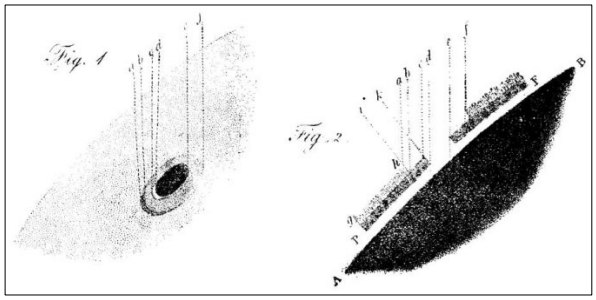


Figure 4: Diagram by William Herschel of his theory of the nature of sunspots (Herschel, 1801: Plate XVIII; courtesy: University of Notre Dame Library).

> The sun ... appears to be nothing else than a very eminent, large, and lucid planet, evidently the first, or in strictness of speaking, the only primary one of our system ... Its similarities to the other globes of the solar system ... leads us to suppose that it is most probably ... inhabited ... by beings whose organs are adapted to the peculiar circumstances of that vast globe.

Herschel contrasts his theory with that of "… fanciful poets …" who portray the Sun "… as a fit place for the punishment of the wicked …", urging that his claim rests "… upon astronomical principles." (ibid.). Herschel argues for his solarians by suggesting that terrestrial life flourishes in a variety of situation and by suggesting that terrestrials who deny life to the Sun have no more logic on their side than inhabitants of a planetary satellite who deny life to the primary around which they revolve. Such arguments seem to support E.S. Holden's statement (1881: 149) that Herschel's views on solar and lunar life "… rest more on a metaphysical than a scientific basis ..."

Holden's conclusion needs, however, to be qualified in one important way, which helps explain why the premier astronomer of that period adopted such a strange theory. Although as early as 1780 Herschel had considered a form of this solar model (Herschel, 1780: 2), he had between then and 1795 accumulated astronomical evidence that, when viewed in terms of his strong belief in the plurality of worlds doctrine, substantially increased the attractiveness of that model. In particular, during this period Herschel's stellar researches had led him to observe what he describes in his 1795 solar paper as "… very compressed clusters of stars." He goes on to argue that stars in such clusters will be too tightly packed to accommodate inhabited planets. This did not lead Herschel to abandon the region as a home for extraterrestrials; rather it led him to conclude that the stars themselves must be "… very capital, lucid, primary planets …" so structured as to allow habitation (Herschel, 1795: 69). Thus, Herschel had found a way to save these stars from being "… mere useless brilliant points." (ibid.: 71). That his solar theory was no passing fancy in his thought is shown by his having elaborated it further in his 1801 paper in which he refers to the Sun as "… a most magnificent habitable globe." (Herschel, 1801: 265) and by his 1814 description of stars as "… so many opaque, habitable, planetary globes." (Herschel, 1814: 263). However bizarre Herschel's solar theory may seem to us, there is good evidence that it persisted as the preferred theory of the Sun until the 1850s (Meadows, 1970: 6).

### 4.2 Other Eighteenth-Century Advocates of Solarians

Two scientists who immediately adopted it were Robert Harrington, M.D., and Thomas Thomson. In 1796, Harrington (1751–1837) published his *New System of Fire and Planetary Life. Shewing that the Sun and Planets Are Inhabited. and That They Enjoy the Same Temperament as Our Earth*, in which he claims that the two chief entities in nature are fire particles (which are mutually repulsive) and earth particles (which attract both air and fire particles). On the basis of this theory, he concludes that the Sun and planets

> … all enjoy the identical same fire, or light, or heat; the same temperature, and, I make no doubt, the same men, animals, vegetables, and minerals; the same atmosphere and water; in short, every thing the same. (Harrington, 1796: 50).

Harrington was on the fringe of British science, but Thomas Thomson, M.D. (1773–1852) was a leading Scottish chemist whose *System of Chemistry* contains in its 1804 edition an important exposition of Dalton's atomic theory. In that volume, Thomson also advocates Herschel's theory of the Sun without, however, mentioning solarians. In particular, Thomson (1804: 412) states that Herschel's observations indicate that

> … the sun is a solid opaque globe, similar to the earth and other planets, and surrounded by an atmosphere of great density and extent [in which] float two regions of clouds ...

Not only were some eighteenth-century scientists attracted to solarians, but so were a number of prominent poets, including the German, Friedrich Klopstock (1724–1803), and the American, Philip Freneau (1752–1832), who is known as the 'poet of the [American] Revolution.' Klopstock was widely regarded as one of the most gifted of eighteenth-century German poets, and no poet of such classic stature has devoted a larger portion of his poetry to extraterrestrial life themes. This is especially true of his most famous poem, *Der Messias* (1748–1773), in which he portrays the suffering, death, and resurrection of Christ within a Universe

abounding with extraterrestrials. For example, he portrays the Patriarchs as living on the Sun. Also, late in his life, Klopstock (1962: 171) published his poem "Die unbekannten Seelen" ("The Unknown Souls"), in which he makes a favorable reference to William Herschel's ideas about life on the Sun and stars.

Philip Freneau also published two essays in the *Monmouth Almanac* for 1795 supporting extraterrestrials. In one of these he not only attributes life to the Sun but also suggests that the Sun is "… peopled with beings of nature infinitely superior to any of those on the neighbouring planets." (Freneau, 1795: 7).

## 5 THE NINETEENTH CENTURY

A good way to begin the discussion of the nineteenth century is by mentioning the French poet Paul Gudin de la Brenellerie (1738–1812). In 1801 Gudin published a long didactic poem, *L'astronomie*, and in 1810 expanded it for a new edition, to which he appended a discourse on the doctrine of a plurality of worlds. Gudin (1810: 193) describes this doctrine as having

> … become so much the fashion that there is at present no person who, were he to arrive at the moon or Saturn, would feel less at home than in arriving at China or Mexico.

However, Gudin (ibid.) separates himself from this sentiment by stating his belief that

> … all the globes are populated, even suns and comets, but ... by beings very different from us; some [are] far above us, others much below our weak intelligence.

Gudin's volume was partly in the tradition of natural theology, which saw in nature a source for contemplating the power and beneficence of God.

Far more clearly in that tradition was a quite popular volume, *Harmonies de la nature*, published in 1815 by Jacques Henri Bernardin de Saint-Pierre (1737–1814). The ninth and final book of *Harmonies*, that devoted to astronomy, contains an enthusiastic endorsement, based on analogy and teleology, of life not only on all the planets, but also on the Moon, the Sun, and on comets. Regarding the planets, Bernardin de Saint-Pierre (1815, 3: 256) asserts that they ought to be inhabited because

> Nature has made nothing in vain, and what would be the use of desert globes? There must be vegetable products in them, because there is heat; there must be eyes, because there is light; and there must be intelligent beings, because intelligence is displayed in their formation.

This former Director of the Jardin des Plantes was not scientifically uninformed; he draws heavily on Herschel's writings, for example, in support of life on the Sun. But his approach frequently leads him beyond the boundaries of science, as in his suggestion that the Sun "… should be the receptacle of the earth's inhabitants in a future stage of existence ..." (ibid.: 234). The extravagant character of some of his techniques for salvaging the habitability of planets is illustrated by his bestowal upon Uranus of "… an immense atmosphere …" (ibid.: 307), and

> … an animal of the reindeer kind, feeding on moss and combining in itself the advantages of the fleece of sheep, the milk of the cow, the strength of the horse, and the lightness of the stag. (ibid.: 310).

As this suggests, ideas of extraterrestrials were frequently linked with religion. A striking example of this is the multivolume commentary on the Bible published by a leading Methodist theologian, Adam Clarke (1762?–1832). The magnitude of this publication is suggested by the fact that it weighs 35 pounds, whereas the extent of its attention to astronomy is indicated by the fact that before reaching Genesis 1:2, we find an elaborate table of data on the planets and satellites. By Genesis 1:16 Clarke (1837, 1: 34) informs us that

> Dr. Herschel's discoveries, by means of his immensely magnifying telescopes, have, by the general consent of philosophers, added a new habitable world to our system, which is the SUN.

### 5.1 Thomas Dick

The Scottish astronomer and religious writer Thomas Dick (Figure 5), whose observatory was at Dundee, was one of the most enthusiastic advocates of extraterrestrials during the first half of the nineteenth century. The boldest of his presentations appeared in his 1837

Figure 5: Thomas Dick, 1774–1857 (engraving from Hogg, 1850; courtesy: en.wikipedia.org/ wiki/ File:Dick_Thomas_portrait %2Bsignature.jpg).

book, *Celestial Scenery*. In this volume, Dick provides a population table (see Table 1 here) for all known objects in our Solar System except the Sun (Dick, 1838: 305). The way Dick arrived at this table was to determine that the average population per square mile in England was 280 people. Then Dick, for purposes of calculation, assumed that no oceans occurred on these bodies. Then he multiplied the surface area in square miles of each body by 280 to derive the object's population. In this way he determined that every planet and asteroid in the Solar System, except Vesta, had a greater population than the Earth. Even the rings of Saturn had larger populations. What about the Sun? Dick's omission of a population figure for the Sun does not indicate that he doubted solarians; in fact, after citing William Herschel on their behalf, he warned:

> … it would be presumptuous in man to affirm that the Creator has not placed innumerable orders of sentient and intelligent beings ... throughout the expansive regions of the sun. (Dick, 1838: 242).

Table 1: Thomas Dick's population table for our Solar System (after Dick, 1838: 105).

| | Square Miles. | Population. | Solid Contents. |
|---|---|---|---|
| Mercury | 32,000,000 | 8,960,000,000 | 17,157,324,800 |
| Venus | 191,134,944 | 53,500,000,000 | 248,475,427,200 |
| Mars | 55,417,824 | 15,500,000,000 | 38,792,000,000 |
| Vesta | 229,000 | 64,000,000 | 10,035,000 |
| Juno | 6,380,000 | 1,786,000,000 | 1,515,250,000 |
| Ceres | 8,285,580 | 2,319,962,400 | 2,242,630,320 |
| Pallas | 14,000,000 | 4,000,000,000 | 4,900,000,000 |
| Jupiter | 24,884,000,000 | 6,967,520,000,000 | 368,283,200,000,000 |
| Saturn | 19,600,000,000 | 5,488,000,000,000 | 261,326,800,000,000 |
| Outer ring of Saturn. | 9,058,803,600 | | |
| Inner ring | 19,791,561,636 | 8,141,963,826,080 | 1,442,518,261,800 |
| Edges of the rings | 228,077,000 | | |
| Uranus | 3,848,460,000 | 1,077,568,800,000 | 22,437,804,620,000 |
| The Moon | 15,000,000 | 4,200,000,000 | 5,455,000,000 |
| Satellites of Jupiter | 95,000,000 | 26,673,000,000 | 45,693,970,126 |
| Satellites of Saturn | 197,920,800 | 55,417,824,000 | 98,960,400,000 |
| Satellites of Uranus | 169,646,400 | 47,500 992,000 | 84,823,200,000 |
| Amount | 78,195,916,784 | 21,894,974,404,480 | 654,038,348,119,246 |

Moreover, Dick all but carried out the calculation by noting that the surface area of the Sun was thirty-one times the combined surface area of all other Solar System objects.

### 5.2 John Herschel

William Herschel had one offspring, his son John (Figure 6), who graduated with many honors from Cambridge University and who during the decade after his

Figure 6: Sir John Herschel, 1792–1871 (by Edward Alfred Chalon, after http://en.wikipedia.org/wiki/File:John_Herschel100.jpg).

his father's death in 1822 emerged as the leading British astronomer, in fact, as arguably the leading scientist in Britain. In 1833, John Herschel published his *Treatise on Astronomy*, which his contemporaries viewed as the most authoritative presentation of astronomy published in English. In 1849, John published a far longer and even more highly-regarded presentation, his *Outlines of Astronomy*. By 1833, when John published his *Treatise*, William Herschel's claims concerning the Sun and its inhabitants had become increasingly problematic, as his son no doubt realized. It is true that John was well aware of the problems raised by physics and chemistry for the Sun. In his *Treatise and Outlines*, he laments, regarding the Sun, that

> … the great mystery … [is] to conceive how so enormous a conflagration (if such it be) can be kept up. Every discovery in chemical science here leaves us completely at a loss, or rather, seems to remove farther the prospect of probable explanation. If conjecture might be hazarded, we should look rather to the known possibility of the generation of heat by friction, or its excitement by the electric charge … for the origin of solar radiation. (Herschel, 1833: #337; 1850: #400).

Such puzzlement, however, did not prevent him, in both his *Treatise* and *Outlines*, from endorsing his father's doctrine that the Sun has a large solid nucleus, which becomes visible through the 'openings' (sunspots) in its exterior layer or 'luminous ocean'. John also champions a layer of clouds separating this 'luminous ocean' from the solid interior, finding evidence for it in the appearances at the edges of sunspots. Although admitting the extraordinarily high temperature of the Sun's exterior and also that

> … the most intensely ignited solids appear only as black spots on the disk of the sun when held between it and the eye … [and] it follows, that the body of the sun, however dark it may appear when seen through its spots, may, nevertheless, be in a state of most intense

> ignition. It does not, however, follow of necessity that it must be so. The contrary is at least physically possible. A perfectly reflective canopy would effectually defend it from the radiation of the luminous regions above its atmosphere, and no heat would be conducted downwards through a gaseous medium increasing rapidly in density. That the penumbral clouds are highly reflective, the fact of their visibility in such a situation can leave no doubt. (Herschel, 1833: #334; 1850: #396).

John Herschel does not directly discuss solar inhabitants in his *Treatise* and *Outlines*, being content with having supplied these provisions for their existence, of which David Brewster and others availed themselves later in the century.

That the source of this passage lay not only in filial fondness for his father's ideas, some of which John did not accept, but also in his own solicitude for solarians is suggested by John Herschel's theory of James Nasmyth's solar 'willow-leaves'. To see this matter in context, it is important to understand that in general Herschel was known for the soberness of his thought. Nonetheless, he did have his speculative moments; in fact, in a lecture delivered in late 1861 and subsequently twice published, he puts forth a solar speculation that went beyond even those of his father. Around 1860, James Nasmyth, a respected astronomer with one of the best telescopes of the period, reported that he had observed the surface of the Sun to be covered with numerous objects shaped like willow leaves. These were intensely luminous objects of immense size and in constant motion. In his 1861 lecture, Herschel not only accepts this observation, which by the mid-1860s had been shown to be erroneous, but goes beyond it to argue for the solidity of the willow leaves and to state that they are "… evidently the immediate sources of the solar light and heat ..." Then he adds the remarkable claim that

> … we cannot refuse to regard them as organisms of some peculiar and amazing kind; and though it would be too daring to speak of such organization as partaking of the nature of life, yet we do know that vital action is competent to develop both heat, light, and electricity. (Herschel, 1871: 84).

Two considerations help explain how the premier British astronomer of that period could make such a fantastic assertion. The first, which is supported by the materials presented above, is that the younger Herschel had inherited not only his father's instruments and abilities, but also his father's fondness for extraterrestrials. The second factor is the openness of Herschel's astronomical contemporaries to pluralist claims. An excellent example of this is Admiral William H. Smyth (1788–1865), whose *Cycle of Celestial Objects* (1844) won a gold medal from the Royal Astronomical Society. In that book Smyth (1844: 92), without directly advocating William Herschel's theory of life on the Sun, responds to Thomas Young's objection that solarians could not overcome the Sun's gravitation by:

> … the mysterious WORD which formed the Laplander and the Negro, the condor and the whale, the mosquito and the elephant, for the several portions of one and a small globe, is surely not to be limited to the fashioning of creatures of our constitution or conception. The inhabitants of every world will be formed of the material suited to that world, and also for that world; and it matters little whether they are six inches high, as in Lilliput, or as tall as [Voltaire's] inhabitants of Sirius ... whether they crawl like beetles, or leap fifty yards high.

### 5.3 Carl Friedrich Gauss

It is of course true that solarians were championed by some authors who knew essentially no astronomy or mathematics. Such a claim cannot, however, be made against Carl Friedrich Gauss (Figure 7), who is ranked as the most brilliant mathematician of the nineteenth century and possibly of all time. Moreover, Gauss by profession was Professor of Astronomy at the University of Göttingen and Director of its Observatory. We know Gauss' views regarding extraterrestrials partly from his writings, but also from other sources, for example, records kept by his Göttingen colleague, Rudolf Wagner (1805–1864), of conversations with the great mathematician. Wagner's records show that Gauss had adopted the doctrine that after death our souls take on new material forms on other cosmic bodies, including even the Sun. That Gauss held such an extreme idea is also evidenced in the biography of Gauss written immediately after his death by Baron Wolfgang Sartorius von Waltershausen (1809–1876). This intimate friend revealed that Gauss

Figure 7: Carl Friedrich Gauss, 1777–1855 (1887 oil painting by G. Biermann copied from an 1840 painting by Christian Albrecht Jensen; courtesy: https://commons.wikimedia.org/wiki/File:Carl_Friedrich_Gauss.jpg).

> … held order and conscious life on the Sun and planets to be very probable and occasionally called attention to the action of gravity on the surface of heavenly bodies as bearing preeminently on this question. Considering the universal nature of matter, there could exist on the sun with its 28-fold greater gravity only very tiny creatures ... whereas our bodies would be crushed ... (Sartorius, 1966: 73).

### 5.4 Auguste Comte

The degree to which various intellectuals uncritically accepted life on the Sun, despite the availability of scientific information that went against such belief, suggests that what was needed was an author who would stress the importance of empirical information, of a scientific approach, and would set aside from such discussions philosophical and religious issues. The French philosopher Auguste Comte (Figure 8), known as the founder of positivism, might seem the ideal person for this task. And, indeed, we do find Comte in a number of his writings stressing the importance of a scientific, positivistic methodology and simultaneously criticizing a religious approach. Moreover, we find him

Figure 8: Auguste Comte, 1798–1857 (after Comte, 1858: Frontispiece; scan courtesy: Eric Chaim Kline Bookseller).

Figure 9: Sir David Brewster, 1781–1868 (engraved by W. Holl from a painting by Sir H. Raeburn, R.A.; U.S. National Library of Medicine).

discussing the Sun in a book he published in 1851. In that volume, Comte (1968: 24) excoriates those who see astronomy as allied with religion,

> … as if the famous verse 'The Heavens declare the glory of God' had preserved its meaning. It is however certain that all true science is in radical and necessary opposition to all theology …

Moreover, he adds that for those familiar with the true philosophy of astronomy,

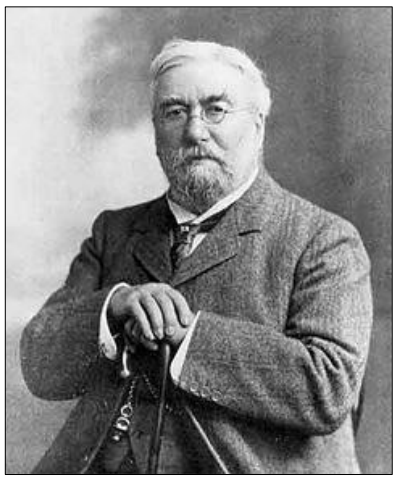

Figure 10: J. Norman Lockyer, 1836–1920 (after *Proceedings of the Royal Society,* 1909).

> … the heavens declare no other glory than that of Hipparchus, of Kepler, of Newton, and of all those who have cooperated in the establishment of laws. (ibid.).

In particular, Comte maintains that what shows the unacceptability of theology is the realization that the Earth, rather than being the center of the Universe, is only a secondary body circling the Sun,

> … of which the inhabitants have entirely as much reason to claim a monopoly of the solar system which is itself almost imperceptible in the universe. (Comte, 1968: 130).

What this, and Comte's repeated unqualified endorsements of extraterrestrials, indicates is that the programs advocated by some philosophers may not be an indication of their practice.

### 5.5 Second Half of the Nineteenth Century

The debate over life on the Sun continued into the second half of the nineteenth century. The slowness with which ideas change is dramatically indicated by the fact that life on the Sun was championed in the late 1850s and in the 1860s by a number of American, Belgian, British, French, and German authors. Some supporters of solarians came from the fringes of science (Schimko, 1856: 30-32; Read, 1860: 155), but in other cases prominent scientists advocated this idea.

For example, in 1854, the prolific Scottish physicist, Sir David Brewster (Figure 9), responded to an attack on extraterrestrials by publishing his *More Worlds Than One; The Creed of the Philosopher and the Hope of the Christian*, in which he endorses life on the Sun; in fact, he populates it with "… the highest orders of intelligence." (Brewster, 1870: 102). Moreover, in 1867 the English chemist Dr Thomas Lamb Phipson (1833–1908) asserted that the Sun "… must indeed be a region of eternal life and perfect happiness …" (Phipson, 1867: 3, 65). Shortly thereafter, the English astrophysicist and founder of the journal *Nature*, J. Norman Lockyer (Figure 10), in his *Elements of Astronomy* presented solar life as a possibility (Lockyer, 1870: 69). Also in the 1860s, Mungo Ponton (1802–1880), a pioneer of photography and a founder of the Bank of Scotland, championed both William Herschel's theory of a cool, habitable core for the Sun and John Herschel's view that Nasmyth's 'willow-leaves' consist of giant organisms (Ponton, 1866, 243, 262-266). In an 1859 address to the Belgian Academy, Jean Baptiste Joseph Liagre (Figure 11), an astronomer and mathematician, concluded his discussion of the Sun by stating that it ought no longer be seen

> … as a devouring furnace and destroyer, but as the most imposing of the planetary globes … [as a] majestic abode where the perfection of organized beings ought to be ... in harmony with the magnificence of the habitation. (Liagre, 1859: 413).

In France, the Director of the Paris Observatory was François Arago (Figure 12), who for twenty-three years delighted the population of Paris with his astronomical lectures. These were published shortly after his death as his *Astronomie populaire*, and included a section that focused on the question: "Is the Sun inhabited?" He answers:

> ... I know nothing. But if one asked me whether the sun can be inhabited by beings organized in a manner analogous to those which populate our globe, I would not hesitate to make an affirmative response. The existence

> in the sun of a central dark nucleus enveloped in an opaque atmosphere, far from the luminous atmosphere, offers nothing in opposition to such a conception. (Arago, 1854-1857, 2: 181).

Arago then describes William Herschel's model of the Sun, mentioning as an aside Dr Elliot, whose already-tarnished reputation was further darkened by Arago erroneously reporting that Elliot had killed Miss Boydell. Arago (1854-1857, 2: 182) dryly adds: "The conceptions of a madman are today almost generally adopted." In 1862, Camille Flammarion (Figure 13), an immensely widely read astronomical author, published the first of the perhaps fifty editions of his *Pluralité des mondes habités*, in which he endorses life on the Sun (Flammarion, 1862: 81-85). Most energetic on behalf of solarians was Fernand Coyteux (1800 –?), who in 1866 published a massive book arguing for life on the Sun, thereby creating a controversy in a learned society in Poitiers, France (Crowe, 1986: 369).

In 1858, astronomers acquired a new tool, which helped them immensely, but probably had a bad effect on solarians. This was spectroscopy, which allowed astronomers eventually to determine the chemical composition and temperatures of various heavenly bodies (e.g. see Hearnshaw, 2010). Moreover, various critiques of claims for life on the Moon and planets began to carry more weight, until by century's end, extraterrestrials had been banished from most planets, with the exception of Mars, on which in 1877 sightings of canals had been reported. Claims for life on the Sun had by this time diminished, although a few hearty souls continued to champion solarians. For example, in 1894, Sir Edwin Arnold (1832–1904), a journalist, published an essay attacking astronomers for rashly and foolishly denying life to the Moon and planets and for failing to see that "… there may be creatures on the sun which thrive upon incandescent hydrogen ..." (Arnold, 1894: 407-408). Advocacy of solarians continued in Germany; for example, in 1880 William Preyer (1841–1897) published a book in which he claims that the Sun itself may be a

> … glowing organism whose breath may perhaps be shining iron vapor, whose blood may be flowing metal, and whose food may perhaps be meteorites. (Preyer, 1880: 60).

And Carl Goetze (1896) published an entire book arguing for life on the Sun.

## 6 CONCLUSION

Solarians are gone. Moreover, their departure was far more than a local event. When our Sun lost its inhabitants, so did every star in the Universe. This raises a question that I fear I can answer only partially. The question is: "When and by whom were the solarians slaughtered?" I can answer a parallel question: "When and by whom were the Martians destroyed?" They were dispatched as the result of a successful campaign carried out against the Martians and their canals by various astronomers in the period from 1877 to 1915. Regarding the solarians, on the other hand, I know of no comparable campaign launched against them. Nor was their departure caused by a direct attack. It is true that Newton, as we have seen, made serious problems for them. Moreover, Thomas Young (1845: 399) in the first decade of the nineteenth century reminded his fellow scientists of these problems, as did François

Figure 11: Jean Baptiste Joseph Liagre, 1815–1891 (http://wiki.arts.kuleuven.be/wiki.images/1/11/Liagre.jpg).

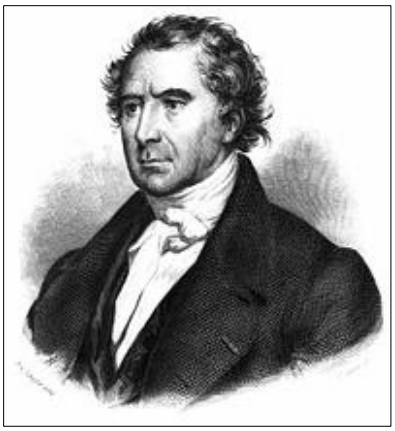

Figure 12: Francois Arago, 1786–1853 (en.wikipedia.org/wiki/Francois_Arago).


Figure 13: Camille Flammarion, 1842–1925 (en.wikipedia.org/wiki/Camille_Flam-marion).

Plisson in 1847 (Crowe, 1986: 168, 248-249). But what above all drove the solarians from the Sun was the progress of physical astronomy and physics. As more and more was learned about the Sun and stars, it became not just difficult, but impossible, to assume the existence of solarians. Although in the early decades of the nineteenth century, many saw solar life as plausible, by the last decades of the nineteenth century, it seemed impossible. For example, in 1870 the British astronomer and populariser, Richard Proctor, published his *Other Worlds than Ours*. In this volume, although Proctor supported life on the planets, he labeled life on the Sun as "… too bizarre [for] consideration." (Proctor, 1870: 20). Some castles crumble as a result of rapid and direct attack; others fall vacant and over decades become uninhabitable. The latter fate befell the Sun and stars.

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