Chapter 3

Ever Watchful.

Time and space cannot be given in a short work such as this to a full discussion of all the topics that Denning wrote about. We shall try, however, to offer a flavour of his diverse writings and scientific contributions. As we noted in Chapter 1 Denning had an insatiable appetite for observing and it is abundantly clear that his interests were highly catholic.

The role of the amateur:
An important factor in distinguishing an amateur astronomer from the mere dilettante is that the amateur follows some form of research program. This was certainly Denning's view. He did, however, stress the importance of setting time aside for teaching, and bringing new observers into astronomy. Writing[1] in *Telescopic Work for Starlight Evenings*, Denning explained "it is the duty of all of us to encourage a laudable interest in the science." These comments were qualified, however, by the warning that "the utility of an observer constituting himself a showman, and sacrificing many valuable hours which might be spent in useful observations, may be seriously questioned." Although he proffered this warning, Denning clearly saw educational development as an important part of an astronomical societie's mandate. In this respect, Denning was fully supportive of the suggestion[2] that the Liverpool Astronomical Society "institute periodical examinations in astronomy, and that the Council should be empowered to grant certificates of competency." As early as 1883, Denning had written[3] to the journal *Nature* on this very issue. There he wrote "It seems a thing to be deplored that in this country there is no establishment where astronomy is made a special subject for teaching, and where those who early evince a taste in this direction may be educated in conformity with inclination."

Denning was an impassioned astronomer and he continually encouraged the enrollment of new members to the field. He firmly believed that the scientific study of the heavens was not just a noble pastime, but an essential one. To this end he was often critical of the casual observer. He was to write[4], for example, "seeing an object is not observing it. The mere view counts for nothing from a scientific stand-point, though it may doubtless afford some satisfaction to the person observing it. A practical astronomer, with his own credit at stake and the interest of the science at heart, will require something more." Denning clearly wanted to see purpose and resolve in amateur astronomy. In an almost contradictory way, however, Denning also expressed other ideas on how to best set about observing. In 1883, for example, he wrote[3] "the fault with amateurs seems to be that they are devoid of organization, and generally of proper education to the work in hand. ... it seems desirable to make some attempt to organize the labours of amateurs in directions suitable to their means and inclinations, and to utilize such results for the benefit of astronomy." These comments were written some ten years after the demise (circa 1872) of the Observing Astronomical Society, and seven years before the formation (in 1890) of the British Astronomical Association.

In 1897 Denning was again to write[5] to *Nature* on the subject of Organized or Sectional Work in Astronomy. This time he responded to an article written by S. C. Chandler on the successes that "organized" observations had brought to variable star research. Denning reasoned "in some other departments of observation, there does not appear to exist the same necessity for organized effort. In fact, I think that it can be shown from results - the best of all tests - that it has been a comparative failure as far as affects the progress of astronomy." To this he added "a little reflection will prove that all the best work has been accomplished by individual and independent effort. A good man will persevere in his labours, just the same, whether he belongs to any combination or not; and it is really much better for such a person to be isolated, so that he may perform the work of his choice in his own way." Denning did temper these arguments slightly by suggesting that "beginners sectional work is often most beneficial, as it affords them a useful preliminary training." In these writings we find the essential Denning. To Denning it is the act of observing that is all important, indeed, it is "the best test of all."

Denning was a dedicated and life-long promoter of amateur astronomy. His ambition was to encourage well organized observational work, and to foster a sound, and wide ranging astronomical education. He was driven in his outlook by the confident Victorian belief that method, discipline, and application would bring a continued stream of new discoveries. In his seventieth year (1918) Denning still held to these ideals, and writing[6] in the *Journal of the Royal Astronomical Society of Canada* he argued, "it may be taken as certain that the amateur will never be out of the running. So long as there remains a new comet to be found, a temporary [nova] or variable star to be discovered, a new or old planetary feature to be investigated or other important work to be accomplished, he may be expected to take his share. ... [the amateur] is a sort of free-lance in astronomy, and his more or less vigilant examination and watching of the heavens must necessarily result in discovery." Denning's sentiments are as true today as they were in his time, and indeed, the dedicated amateur can still make important contributions to astronomy.

Astronomers, science, and telescopes:
In parallel to his strong views on what amateur astronomers as a whole should be doing, Denning also expected a great deal from the individual observer. He noted[7] "virtually the observer himself constitutes the most important part of his telescope: it is useless having a glass of great capacity at one end of the tube, and a man of small capacity at the other." To this end, Denning argued that serious amateur astronomers should continually strive to improve their observing skills. He also suggested that "every amateur should practise drawing," and, habitually exercise their sight. On this later issue he remarked[8], "I invariable use the right eye on the markings of planets and the left on the minute stars and satellites. Practise has given each eye a superiority over the other in the special work to which it has been devoted." There is unfortunately no evidence to support Denning's claim that the eye can be 'trained' in the manner he described. It does seem, however, that Denning had very good eyesight. That this was so is evidenced by one of Denning's early contributions[9] published in the *Monthly Notices of the Royal astronomical Society*, where he recorded the fact that he had been able to visually resolve the Jovian satellites Ganymede and Callisto. Denning also commented in the same short note that he could distinguish 13 stars in the Pleiades, and had on occasion seen Jupiter in full sunshine. Such impressive accounts of eye sensitivity are rare but not unheard of.

In his *Telescopic Work for Starlight Evenings* Denning claimed[10] that "a distinguishing trait among astronomers has been their keenness of vision, which in many cases they have retained to an advanced age." Such sweeping and unsubstantiated claims reflect an interesting side of Denning's character. While he was typically quite reserved in what he would claim from a set of observations, he occasionally made gross generalizations on the basis of personal beliefs, and/or dubious statistics. An example of the later case is exemplified in his comment[11] "night air is generally thought to be pernicious to health; but the longevity of astronomers is certainly opposed to this idea." In an attempt to substantiate this claim Denning published two articles[12], one in 1897 the other in 1917, which listed a whole host of astronomers who had lived to the age of 80, and beyond. From these he concluded, "astronomical pursuits were conducive to longevity." The promotion of such ideas on the basis of poor statistical testing highlights Denning's occasional lack of scientific subjectivity. One notes, however, that Denning lived to his 83rd year.

In spite of the fact that Denning received no formal scientific training, he was an enthusiastic promoter of scientific study. He saw the advancement of knowledge as a necessary and noble occupation. On this subject he was to write[13] in prosaic tones, "the progress of science may be compared to the ceaseless running of a stream. It continues its course uninterruptedly through the years. ... occasionally there is a slackening of velocity and a lowering of the waters but it ever goes on to its goal. So the advance of scientific discovery is maintained through the ages. There may occur comparative lulls and temporary abatements but there is never absolute inactivity." Here, if ever there was one, is a genuine belief in scientific *plus ultra*.

Denning held strong opinions as to the manner in which observations should be collected. Indeed, Denning believed that the astronomer had an ethical responsibility to seek out the truth, and to report only those facts that were unambiguously observed. In some sense, we can summerize that

it was a strict observational ethic, a perceived quest for the truth, and a belief in the noble pursuit of science that drove Denning to make his studies. Indeed, his commitment to the pursuit of science was sufficiently strong that he followed a celibate and impoverished life-style because of it.

Although Denning laid great stress on how an astronomer should set about collecting observations, he also expressed strong views on the type of telescopes that should be used in astronomical research. These opinions, on occasion, brought him into conflict with the ideas of other astronomers. In particular, Denning was critical of the employment of large telescopes in planetary studies. This is quite an extraordinary viewpoint from a modern perspective. Once again, we find Denning's essential views expressed in *Telescopic Work for Starlight Evenings*. There he writes[14] "we must judge of large glasses [telescopes] by their revelations; their capacity must be estimated by results. The fruit of their employment is rarely prolific to the extent anticipated, because the observers have been defeated in their efforts by impediments which inseparably attend the use of such huge constructions." These views are consistent with Denning's belief that new discoveries, and insight should automatically follow upon the application of a sound observing program and the investment of observing time. Denning most often used a 10-inch reflecting telescope for his planetary work, and he believed that this was about the optimum size. Going to larger telescope sizes, he believed, would only be a hindrance. To the modern astronomer it seems somewhat remarkable to find Denning writing[15], for example, that "with my 10-inch in a sadly deteriorated state I have obtained views of the Moon, Venus and Jupiter that could hardly be surpassed. The moderate reflections from a tarnished mirror evidently improves the image of a bright object by eliminating the glare and allowing the fainter details to be seen." Denning was not alone in such views, and in particular the argument over telescope size (i.e., aperture dimensions) became an important issue in the debate over Martian markings[16].

Denning made regular studies of Martian features in his early observing career, and was particularly interested in determining the planets rotation period. Using observations collected between 1869 and 1884, he found[17] a Martian rotation rate of 24 hours 37.372 minutes (this period is very close to the accepted modern day value of 24 hours 37.44 minutes). Denning was not drawn into the debate concerning the 'meaning' of Martian canals, but he did report seeing them, and he did occasionally note surface changes. Denning's feelings as to the origin of the canals was that they were of a natural, rather than artificial origin. As to the observation of planetary details, however, the essential point that Denning, and many other prominent observers raised was that planetary markings, such as the Martian canals, which were prominent in small aperture telescopes were not apparent to observers who used larger apertures (to Denning this meant apertures greater than about 15-inches). In the case of Mars this was clearly a crucial point, and observers such as Percival Lowell would insist, for example, that only small aperture telescopes should be used to study surface features. Lowell believed that large telescopes did not show intricate surface features because they suffered from a "fine imperceptible blurring."[16] Likewise, Denning argued that the observer using a large aperture telescope would only see images that would "be blazing disks, affected by incessant moulding and flaring and nearly devoid of reliable markings." While Lowell was guilty of trying to force the observations to fit his theories on Martian canal origins, Denning simply reported what he saw. It is now known that what the early observers failed to appreciate (but see Denning's comments on Saturn below) was that at the threshold of eye-resolution physiological effects will 'flavour' what is apparently perceived. In essence the debate was not due to the fact that large aperture telescopes did not resolve planetary surface features, but rather that they did not resolve the surface features that several prominent astronomers wanted to see.

Comets and Nebulae:
Denning dedicated a considerable amount of his telescope time to searching for comets. He is accredited with the discovery of four comets: comets 1881V, 1890 VI, 1892 II, and 1894 I, and he was pre-empted by a matter of hours in the discovery of comet 1891 I.

In chapter 1 we commented that Denning was awarded Bronze Comet Medals by the Astronomical Society of the Pacific for his discoveries of 1890, 1892, and 1894, and that he

was the first Director of the British Astronomical Associations Comet section between 1891 and 1893. Even though his official involvement with the Comet section ceased in 1893, Denning continued to be interested in comets, and cometary searching. Indeed, he wrote long-running columns on cometary matters for the *Observatory* magazine and the popular journal *Knowledge*.

Denning's views on comet-seeking afford a clear example of his belief that systematic and applied work would inevitably provide successful results. As early as 1882, he was to write[18] "success in this, as in other departments of research, depends, in a very large measure, upon the energy with which it is pursued. To an observer who devotes himself closely to it, and avails himself of every chance presented, there is an encouraging prospect of success." It is interesting (and probably a little unfair of us) to note, however, that in his first book, published in 1872, Denning had commented[19] "comets are not interesting objects in telescopes."

Some measure of how much time Denning dedicated to cometary sweeping, can be gained from a calculation he presented[20] in 1894. At that time he commented that in 596 hours of comet-sweeping he had discovered five comets. This averages to some 119 hours of searching per comet. Although Denning continually tried to promote cometary studies among English amateur astronomers he found that they did not easily turn to the subject. As late as 1922, Denning can be found complaining in the journal *Nature* "it is remarkable that English astronomers appear hitherto to have taken little interest in cometary work, and that very few comets have been discovered from this country. ... there are a great number of telescopic observers in the United Kingdom who have the means and the time at their disposal to accomplish valuable work in this department if they would only engage in it in an earnest manner."[21] These are clearly the words of a frustrated organizer.

When Denning outlined the role of the Cometary section in the June 1891 issue of the *Journal of the British Astronomical Association*, he commented that besides searching for comets its main aims were to discover new nebulae and record telescopic meteors. A knowledge of diffuse nebulae is of interest to the would-be comet-searcher since they can be confused with a new comet. Denning referred to nebulae on one occasion[22] as "the bane of the comet-seeker."

Denning discovered several 'unmarked' nebulae during his cometary searches, but he devoted only a little time to the discussion of these objects. The term nebula was not well defined in Denning's time, and objects such as galaxies, globular clusters, galactic clusters and diffuse interstellar clouds were included under the nebula umbrella. One contentious issue concerning the nebulae at that time was their apparent variability. Denning made a few comments on the supposed variability recorded in the nuclear region of the spiral galaxy in Andromeda[23]. While the variability that had been ascribed to the nebula (M31) had been based on photographic observations, Denning showed typical disregard for such 'hi-tech' results, and commented that from his experiences, the supposed variability was probably due to "atmospheric disturbances." In this case Denning was correct, but instrumental techniques would soon outstrip the human observer in both sensitivity and versatility.

The Planets:
Before he elected to abstain from telescopic work circa 1906, Denning devoted a large fraction of his observing time to the study of the planets. He directed most of his attention to the planet Jupiter, and indeed, his publications on this planet run second only to his works on meteors. Denning's chief reason for studying the planets was to determine rotation rates. In order to determine rotation rates an observer has to make repeated transit observations of distinctive surface features. Clearly, in order to perform this work the planet under investigation must show either long-lived atmospheric features, or several prominent surface markings. For planets such as Jupiter, Saturn and Mars many 'features' are generally available, for Venus and Mercury, however, the situation is more difficult.

Of the two inner planets Mercury is the more difficult to observe. The reason for this is that Mercury is never far from the Sun when viewed from the Earth. Denning, however, noted[24] in 1900 that he had observed Mercury with his un-aided eye on no less than 102 occasions between February 1868 and December 1899. In addition to his naked-eye sightings of the planet, Denning also reported a few telescopic observations of

Mercury[25]. In his *Telescopic Work for Starlight Evenings*, Denning commented[26] that he had "occasionally seen Mercury, about two or three hours after rising, with outlines of extreme sharpness."

Of all the planets Jupiter held special prominence for Denning. He began observing this planet in the early 1880s, and wrote[27] of it in impassioned tones,

"Beyond the sphere of Mars, in distant skies,
Revolves the mighty magnitude of Jove,
With kingly state, the rival of the Sun."

The greater bulk of Denning's work on Jupiter was concerned with recording transit times of atmospheric features. Denning, along with many other members of the astronomical community, was drawn to the study of Jupiter in 1878 when what is now known as the Great Red Spot came into striking prominence. Not only did Denning record transit times for this feature, he also made detailed sketches of the planet's appearance. In addition to his transit studies of the Great Red Spot, Denning also undertook an extensive literature survey in an attempt to trace historical reports of its appearance. He reasoned[28] on the basis of his survey, published in 1899, that the "great red spot of recent years may be identical with the large spot discovered on Jupiter in 1664 by Robert Hooke."

Soon after the 1878 upsurge of interest in the Great Red Spot it was found that its equatorial rotation rate varied. Denning studied these variations on numerous occasions, and as late as 1920 (some 14 years after he has ceased planetary observing himself) he collected the available published data, and demonstrated that its equatorial rotation rate had been slowing down between 1899 and 1919. Between 1878 and 1898 the spots rotation period had been speeding up. In contrast to his complaints (noted above) that British observers had not shown enough interest in cometary searching, Denning was to praise the planetary observers. He wrote, "my abstention from planetary work has been practically enforced, but amid the regret caused thereby, I feel great satisfaction in the fact that others are pursuing it with much ability and energy."[29]

American astronomer Asaph Hall first recorded[30] the appearance of a distinctive white spot on Saturn on the night of December 7th, 1876. Several further claims for other Saturian spots were reported in ensuing years, but Denning warned that great care should be exercised in such studies. He commented "perhaps there is no object upon which it is easier to exercise the imagination than upon Saturn. And there is probably no orb in reference to which more errors in detail have been made."[31] Interestingly, Denning continued "many of the abnormal results reported in recent years, and due to small instruments, may be safely dismissed, for they are not only doubtful but, when all the conditions are considered, ridiculous, and palpably the outcome of unconscious suggestions of the imagination." These comments show that Denning clearly appreciated that physiological effects could be very important when making planetary observation. They also reflect a change in Denning's attitude concerning the type of instruments that should be used in planetary studies. As we discussed above Denning, like Lowell had suggested that only small aperture telescopes should be used for planetary work. That Denning had changed his mind concerning the "capacity" of large telescopes is further exemplified by his comments[6] printed in the *Journal of the Royal Astronomical Society of Canada* in 1918. There he explained, "more than a generation ago there was an animated discussion as to the relative merits of large and small telescopes in dealing with detail on bright planets, and I argued that, judging from published observations and drawings, the great instruments previously in use could be regarded as possessing very little, if any, superiority.... But better instruments have undoubtedly been constructed in later years and there seems no reason to doubt that the great refractors of the present day are decidedly more effective in studies of planetary markings than smaller instruments." We see here a different Denning. Throughout the stationary radiant debate, for example, Denning had refused to review his methods, and had steadfastly stuck to his beliefs - no matter how much at odds they were with canonical wisdom. When it concerned telescopes, however, we find Denning to be an observer who can appreciate advancements in optics, and construction methods.

Nova:

By their very nature the appearance of nova and supernova cannot be predicted, and their

discovery must rely on serendipitous circumstances[32]. When Denning wrote his *Telescopic Work for Starlight Evenings* the mechanisms underlying nova and supernova formation were completely unknown. Denning knew, however, that these "new or temporary stars" required an "exceptional explanation", and he even questioned their classification as simple variable stars. Denning commented[33] in *Telescopic Work* that he had "frequently, while watching for meteors, reviewed the different constellations in the hope of picking up a new object, but have never succeeded in doing so." Thirty years after writing those words Denning was to finally succeed in his wishes.

In a remarkable three year period between 1918 and 1920, Denning was witness to the discovery of two nova. While his priority of discovery for the nova of June 1918 was not to be established, Denning was certainly one of the first independent observers to describe the phenomenon. He wrote[34] of its discovery "on commencing a watch for meteors on June 8th, I immediately observed a new star of considerable brilliancy had made its appearance in the western border of Aquila." That the nova was "immediately obvious" bears testament to Denning's intimate knowledge of the constellations. He observed the nova for three hours that June night, and made comparative estimates of its brightness.

Nova Cygni was first observed by Denning on the night of August 20th, 1920. Again, he had set out to begin a meteor watch but had immediately noticed a new magnitude 3.5 star in Cygnus[35]. Upon realizing that a 'new star' had appeared Denning sent a telegram to the Royal Observatory, at Greenwich. An extended visual and photographic study of the nova was initiated at that observatory and a light curve was published[36] by W. J. Luyten in November of that year. Denning received a great deal of correspondence concerning Nova Cygni, and he wrote to his niece (Christine Gravely) on September 26th that, "the new star brought me about 100 letters extra, and the event seems to be regarded as a very important one in the astronomical world."[37]

That Denning had received so many extra letters because of this one phenomena underscores the fact that he was still the focus for a great deal of correspondence. It is an unfortunate fact that only the smallest fraction of this correspondence seems to have survived to the present day.

Wasps, birds, and natural history:
Denning's inquiring gaze was not always directed skyward and it would seem that he was a keen natural historian. As we first saw in chapter 1, the young Denning nurtured an early interest in natural history, and it is reasonably clear that he continued this interest throughout his life. Most of what we know on Denning's studies in this area is contained in the few surviving letters to his niece[37], and in a handful of published articles in *Nature* and the *Observatory* magazine.

Virtually nothing is known of Denning's early studies in natural history, and it is not until circa 1912 that we find clear evidence of dedicated research. At this time Denning would have been 64 years old. The details of his studies first became evident in 1916, at which time Denning was drawn into a debate concerning the scarcity of wasps. The question of wasp scarcity had been raised[38] by H. V. Davis in the October 12th issue of *Nature*. In the October 14th issue of *Nature*, Denning responded[39] to the issue and wrote,

"I may say that in this district ordinary wasps have been decidedly scarce this year... I make a point of cultivating these insects, as they are extremely interesting to watch, and destroy myriads of flies every summer. There were six embryo nests in my garden in May last, but only one (Vespa vulgaris) managed to withstand the vicissitudes of the inclement weather. This nest was a weak one, for when I dug it out on September 20 it consisted of four layers of cells, the top one alone being for small working wasps (1000 cells), while the others were exclusively for queens and drones (1250 cells). This proportion is quite exceptional according to my own observation, for I have commonly found the smaller cells greatly in excess of the others..."

Denning continued in his letter that wasps were not as aggressive as commonly supposed, and that they "display remarkable industry and activity." To this he added that "on a bright summer day in 1913 I carefully watched the entrance of a wasp's nest in my garden, and concluded that the insects brought home at least 2000 flies." Clearly Denning had made some careful observations of hive activity. He wrote

again[40] on wasp studies to *Nature* in 1920. In this second communique we find that Denning had been "observing wasps during the past eight years" i.e., since 1912. In this second letter Denning presented a table of his observations of hive activity for the summers of 1915 and 1918.

It is clear from his writings that Denning was disheartened by the common practice of destroying wasp nests, and he wrote, "Man often misapprehends the benefits from certain forms of animate nature. Birds are destroyed and noxious insects enabled to multiply. Efforts are ever being made to exterminate the wasp, and hordes of pestiferous flies naturally become the bane of our summers."[40] Such sentiments would suggest that Denning was concerned for the conservation of nature, and that he appreciated the dangers of blindly meddling with ecological systems.

Denning's ornithological interests are evident from a letter he wrote[41] to the *Observatory* magazine in May of 1915. Writing on the *Birds that Pass in the Night*, Denning suggested that an appropriately experienced astronomer might study the passage of birds, and thereby gain some useful knowledge on nocturnal bird behaviour, and migration. From his own experience Denning explained "the nightjar at certain times of the year is often in evidence; but the bird which, more prominently than any other, makes its presence known is the redwing, for every spring and autumn, during many weeks, droves of these fugitive nocturnal itinerants may be heard passing above almost incessantly."

During the closing years of his life Denning only rarely left the confines of his home. This isolation, although self imposed, did cause him some regrets. He still made some observations, however, and in a letter to his niece dated November 25th, 1919 (the day of his 71st birthday) he commented[37] "I have to observe from my garden but one needs to go farther afield, although it is quite astonishing what one can see of bird life even in a limited place like the surroundings by houses." Just over a year later he was again to write to his niece that "I hear few birds in this locality just at present except the Robin and we have them singing every day - I like their song better than that of any other British bird." Interestingly, in this same letter Denning comments that he has been thinking that he would "like to cultivate bees" and that he intends to enquire about the cost of hives. It is not known if he followed through on this desire.

Very little is known of Denning's early interests in natural history. The material that has survived all dates from the later part of his life, and we can only guess at what he observed in his younger days. That he was involved in such studies is certain, however, and consistent with his strong belief in self education and personal improvement.

Meteorology:

Not only was Denning an astronomer and natural historian, he was also an avid meteorologist. Indeed, the first national society that Denning ever joined was that of the Royal Meteorological Society (RMS). He became a Fellow of the RMS in 1872 (the same year that he tried, albeit un-successfully, to become a Fellow of the Royal Astronomical Society[42]), and he became a regular contributor to the *Quarterly Journal of the RMS* and the *Meteorological Magazine*.

Denning submitted many notes on rainfall and local weather conditions to the meteorological journals. Most of these accounts were mundane, and matter-of-fact, but sometimes he would find more rare phenomena to write about. Denning was fortunate to observe several uncommon events during his meteor watches and, for example, he was to report the sighting of lunar rainbows, and paraselene on several occasions[43]. He also witnessed several spectacular auroral displays.

In relation to the aurora, Denning was to comment[44] in 1885 that he believed "scarcely a very clear night passes but that there may be traced, with a critical eye, some feeble traces of aurora." This is one example where Denning was clearly mistaken, and it is indeed only on rare occasions that an observer as far south as Bristol will witness an auroral display[45]. That Denning believed such displays occurred daily may be testament to an early case of confusion due to City light pollution.

One question that has often preoccupied meteor astronomers is that which asks if meteor showers can produce noticeable effects on the Earth's weather. It has been suggested, for example, that the residual 'dust' from ablated meteors may seed rain clouds, and produce rain storms. It has also been suggested that meteor activity might

initiate periodic cold spells[46]. Interested in this later subject, Denning attempted[47] a statistical study of periodic cold spells in 1915. He drew reference to a work published by Professor Erman, who had argued, in 1839, that periodical cold spells occurred in May and February each year because of the passage of "falling stars between us and the sun." Denning concluded that there was statistical evidence to support Erman's claim for a periodic cold spell in February. He also suggested that there was evidence for the occurrence of several other periodic cold spells spaced about a month apart. In light of this apparent discovery Denning questioned, "is there a meteoric swarm with a periodic time of about 30.5 days, and sufficiently distended to occupy about six days in passing the sun, revolving around that luminary at little inclination, but with necessary density to moderate the solar rays to an appreciable degree? Possibly the corona might have afforded evidence during past total eclipses on the sun. This is a mere suggestion on imperfect data, but the matter may be worth further enquiry."[47] It is now clear that no meteoroid stream could possibly be dense enough to produce the effect that Denning was suggesting. It is also clear, in the light of more refined analysis, that such periodic cold spells do not, in fact, occur. That Denning could entertain the idea that a meteoroid stream might have a period of 30.5 days is also interesting. Such a meteoroid stream is quite impossible, and this underscores Denning's complete disregard for theoretical constraints. As with the stationary radiants, Denning was only concerned with what he believed he saw. As far as Denning was concerned his analysis suggested a 30.5 day periodicity, and that, in spite of any theoretical counter argument, was the period that the postulated meteoroid stream must have.