Journal of Astronomical History and Heritage, 10(2), 148-150 (2007).

STEPHEN J. O'MEARA AND RING SPOKES BEFORE VOYAGER 1

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Abstract: I consider why Stephen J. O'Meara's visual observations of spokes in Saturn's B ring were not acted upon by planetary scientists before Voyager 1.

Keywords: O'Meara, Saturn, spokes, Voyager

1 INTRODUCTION

My paper "E.E. Barnard and the eclipse of Iapetus in 1889" appeared in the March 2007 issue of this journal (Bryan, 2007). In it I offered an interpretation of Barnard's observation of Iapetus as it emerged from the planet's shadow, crossed the sunlit gap between the planet and rings, entered the shadow of the C ring, and disappeared in the shadow of the B ring. I suggested that changes in the eclipsed satellite's visual magnitude agreed with modern optical depths at some places in the rings but disagreed at other places. If the inner rings in 1889 were identical to their condition today, what Barnard saw might be explained by a combination of shadows from the normal rings and shadows from transitory ring spokes. In support of this, I described historical and modern visual observations that found spoke-like objects in the A and C rings. However, spokes have not been observed by Voyager, Hubble Space Telescope, and Cassini in any location on the rings other than the B ring. Given the credibility of space-based observations, reliance on visual results is problematic. Yet these results are relevant and ought to be considered. In respect of this, I relied extensively on observations of spokes by Stephen J. O'Meara to interpret what some of Barnard's contemporaries saw in Saturn's rings around the time of the eclipse of Iapetus.

O'Meara's experience is interesting history. He was not the first to see spokes in the B ring, but he was the first to report them to planetary scientists in 1976 and to observe them systematically thereafter. Voyager 1 arrived at Saturn in 1980 and obtained credit for discovery of spokes. Why did O'Meara's pre-Voyager reports receive interest but nothing more? This paper corrects an error in my Barnard paper. It goes on to consider what happened when O'Meara, a skillful visual observer of Saturn, reported a completely unexpected result.

2 BARNARD AND O'MEARA

Barnard and O'Meara had the same problem. Both observed extraordinary events, but no other person saw what they saw. They made different decisions about what to do. Barnard was confident about his skill as a visual observer, but he did not see strange things at Saturn that others claimed, and he recoiled from criticism. Further, he could not repeat his observation of Iapetus. O'Meara was also confident of his skill as a visual observer. Unlike Barnard, he was able to repeat his observation. Barnard reported what he saw but deemphasized and finally ignored the strangest part of the eclipse. O'Meara reported B-ring spokes that exhibited non-Keplerian orbital motion. Responses from their respective audiences differed. Since Barnard's result conformed to what others already thought about Saturn's rings, there were few published reactions and none was critical. O'Meara's result was controversial because non-Keplerian orbital motion appeared to be inconsistent with particulate rings.

To consider how Barnard might have been received if he, too, had offered something radical, perhaps that he had seen the effect of an unknown and unseen ring interior to the C ring, I contrasted that hypothetical circumstance with what happened to O'Meara. I used a set of conditions that scientists historically relied on to evaluate the trustworthiness of testimony given by others about observations that scientists themselves did not make. The conditions, which prefer conservatism, passed Barnard's facts and failed O'Meara's. That is, the outcome implied that O'Meara's testimony represented more risk of error than did Barnard's. Yet nobody could have repeated what Barnard saw. By contrast, Voyager 1 successfully repeated O'Meara's observations. The point of this exercise was that conservatism is not always a reliable guide to recognizing strange reality.

3 AN ERROR

After publication of the Barnard paper, I learned from O'Meara about an error in my text. My statement that "... astronomers whom O'Meara consulted either did not know him or did not fully trust him." is incorrect (Bryan, 2007: 45). In fact, he was both known to and trusted by these astronomers. Valued friendships from that time, 30 years ago, continue today. He described the situation:

> ... as far as I know, the astronomers with whom I consulted did not have any trust issues with me personally. They knew I was a good observer; they knew that I believed in what I saw ... I had correctly identified 1/10-magnitude azimuthal (in four points) variations in Ring A visually over ... [a] period of weeks or months and ... my visual observations were confirmed with photometric observations with a 16-inch reflector at Oak Ridge (O'Meara, pers. comm., 2007).

O'Meara's congenial relationship with his professional colleagues raises the question of why that audience considered his spoke observations but did not pursue them.

4 WHO OR WHAT TO TRUST

The test of trustworthiness referred to in Section 2

relied on a set of considerations that date to the seventeenth century. Its conditions reveal what English scientists once thought about trust. Steven Shapin (1994: 211) identified seven 'prudential maxims of testimony' which I condensed into the test's five points. As Shapin ordered them, contributed testimony is trustworthy if it:

1. Conforms to what we know of the world.
2. Comes from several sources.
3. Is free of inconsistencies.
4. Is the account of an eyewitness.
5. Comes from a competent person.
6. Comes from a person whose manner inspires confidence.
7. Comes from a person who is honest and without agenda.

I do not wish to suggest that those who considered O'Meara's situation literally referred to seventeenth-century maxims. His acquaintances, being planetary scientists, certainly relied upon their extensive knowledge of Saturn and upon common sense to evaluate what he brought to them. In looking back upon events, O'Meara suggested that trust may not have been a factor in the outcome. That is, neither trust of him personally nor trust of his evidence influenced the outcome. He explained that everyone involved was most puzzled by his description of spokes. Uncertainty over what the observations might mean may have been so great that nothing was done. This explanation is both simple and plausible. It may be correct, but there is an alternative.

In carrying out research for the Barnard paper, I found that a majority of the planetary scientists whom I consulted were distrustful of visual results, especially when no independent confirmation existed. Multiple historical reports of spoke-like objects in the A and C rings were not persuasive and did not qualify as being independently confirmed. Similar objects have not been observed by spacecraft or with modern ground-based instruments. Nobody knows how the personal state of the observers affected what they saw or if what they saw was illusory. Finally, visual observation was abandoned by professionals long ago. All of this explains a general lack of enthusiasm among professsionals for visual results. Attitudes in the 1970s could not have been much different than they are today. O'Meara's audience consisted of planetary scientists. He presented them with a serious problem that required a decision. They decided to do nothing. Why was that? For their timeless common sense, the old maxims may provide clues about what his audience thought they could trust.

O'Meara was a collaborator and not an outside contributor as is anticipated by the maxims. However, in respect of the fact that he was an amateur among professionals, there is reason to consider him as an outsider. Four of the seven maxims purport to evaluate the person who testifies. This implies that if an audience has full confidence in the person, on the strength of this alone, they might be able to trust his or her evidence. The decision becomes especially difficult when the evidence offered by a trusted person has significant problems.

O'Meara had much in his favor. His audience knew him to be honest, competent, free of agenda, and to have seen spokes first-hand on several occasions. Further, and significantly, as described above, they had authenticated by photoelectric photometry his ability to see slight differences in the A ring's brightness. However, his evidence was very difficult to accept because it ran contrary to physics. Also, there was no independent confirmation.

5 EXPLAINING-AWAY SPOKES

As O'Meara (pers. comm., 2007) described it, the astronomers around him

> ... found the observations of spokes interesting but, based on the spokes['] defiance of Keplerian rotation, concluded that the atmosphere or conditions on the planet must have set up some sort of visual illusion -- making me see things that unfortunately were not.

His audience did not recognize the real issue. They characterized the problem as an irreconcilable conflict between a radical visual observation of the rings and the physics that govern the motion of bodies in the rings. Posed in this way, conservative scientists had no choice but to prefer physics over the observer and the evidence. Hindsight makes it possible to say that there was no irreconcilable conflict. However, at the time and in the middle of the problem, an indication of the right answer existed, but recognizing it required going beyond the obvious. On one hand, O'Meara was personally trusted. His ability was respected. His accuracy was proven. On the other hand, the existence of Keplerian orbital motion in Saturn's rings is undeniable. If there was no reasonable basis to object to either side of the dilemma, then there was no dilemma. Something else was wrong. That 'something' was a too-simple model of Saturn's rings. Since the audience knew that observations may sometimes correctly conflict with models, they had a basis to suspect the ring model. Either they did not do that, or, if they did, another factor outweighed this consideration.

O'Meara's audience distrusted the visual method. How can that be? They had verified, on their own terms, the accuracy of O'Meara's visual results in the A ring. I distinguish between the audience's perception of O'Meara and their perception of the method he used. The distinction is slight since the observations were a product of his vision and judgment. The audience's expectation was important. They anticipated variations in the A ring's brightness and employed O'Meara to detect those variations. When he found them, and his result conformed to photoelectric photometry of the ring, his skill with the visual method was evident. The audience did not anticipate spokes in the B ring. They expected that these objects did not exist. Spokes were unaccountable and physically implausible. What inducement did planetary scientists have to prefer the observations? Was there a weak link in the evidence for spokes? There was if the audience had the right predisposition. The observations came from a technique that planetary scientists did not use, prefer, understand, or probably trust. The clearest indication of their discomfort with how the evidence was obtained was that they invoked an optical illusion induced by an unknown cause to deceive their otherwise trusted and skilled observer. Instead of arranging for independent confirmation of O'Meara's strange B-ring observation, as they had done in the A ring, the audience allowed the matter to drop. As an

optical illusion, there was nothing to observe, so nothing to confirm. O'Meara remained a trusted figure because even the best visual observer may see an optical illusion. If such reasoning occurred, his evidence became untrustworthy by association with a distrusted technique.

6 CONCLUSION

Inaction that followed O'Meara's report of spokes in 1976 may have been caused by others' distrust of the visual method he used. This explanation may be correct even though his audience had verified his ability to produce scientifically-valid results for Saturn's rings.

Except in their dealings with O'Meara, the planetary scientists he consulted almost certainly had no other active involvement with visual observation. The consequence of the decision not to act was to postpone recognition of spokes until Voyager 1 arrived. Would his audience have responded differently if O'Meara had, instead of seeing spokes, measured them with an instrument and reduction process?

7 ACKNOWLEDGMENTS

I thank Steve O'Meara for sharing more details of his experience with spokes before Voyager 1. I also thank Wayne Orchiston for the opportunity to publish this short follow-up to my original paper.

8 REFERENCES

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CORRIGENDA

James Bryan noticed a misprint in his Barnard paper that was published in the previous issue of *JAH*[2]. On page 39, near the end of the first paragraph, the uncertainty of Barnard's estimated magnitudes is shown as ± 0.01 whereas it should be ± 0.1.