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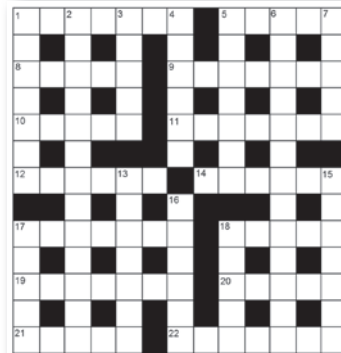
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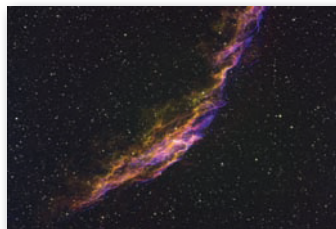
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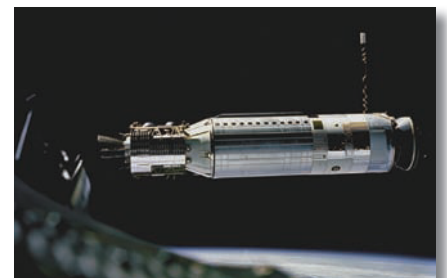
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On the Front Cover:

Stuart Heggie returns in this issue with a photograph of NGC 7380 in Cepheus. Stuart used an SBIG STL 11000 camera on an AP 155 EDF telescope at f/7. Exposures were 7 x 5 min luminance, 5 x 5 min in each of RGB, and 5 x 30 minutes in H α . NGC 7380 was discovered by Caroline Herschel on 1787 August 7, while being free from recording duties when her brother William was absent. Sir William Herschel included his sister's discovery in his catalogue.

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News Notes

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Vertical Structures Seen in Saturn's Rings

NASA's *Cassini* spacecraft has uncovered "towering vertical structures" in the planet's flat rings, according to the *Cassini* Imaging Central Laboratory for Operations (CICLOPS)/Space Science Institute in Boulder, Colorado. The images of the vertical structures were made possible as Saturn neared equinox. They are attributable to the gravitational effects of a small nearby moon.

The search for ring material extending well above and below Saturn's ring plane has been a major goal of the imaging team during *Cassini's* "Equinox Mission," the two-year period containing exact equinox — that moment when the Sun is seen directly overhead at noon at the planet's equator.

This novel illumination geometry occurs every half-Saturn year, or about every 15 Earth years. It lowers the Sun's angle to the ring plane and causes out-of-plane structures to cast long shadows across the rings' broad expanse, making them easy to detect.

The 8-kilometre-wide moon Daphnis orbits within the 42-kilometre-wide Keeler Gap in Saturn's outer A ring, and its gravitational pull perturbs the orbits of the particles forming the gap's edges. Scientists have estimated, from the lengths of the shadows, that wave heights from the perturbation reach enormous distances above Saturn's ring plane — as high as 1.5 kilometres — making these waves twice as high as previously known vertical ring structures, and as much as 150 times as high as the rings are thick. The main rings — named A, B, and C — are only about 10 metres thick.

The findings were presented in a paper authored by *Cassini* imaging scientists, and published June 2009 online in the *Astronomical Journal*.

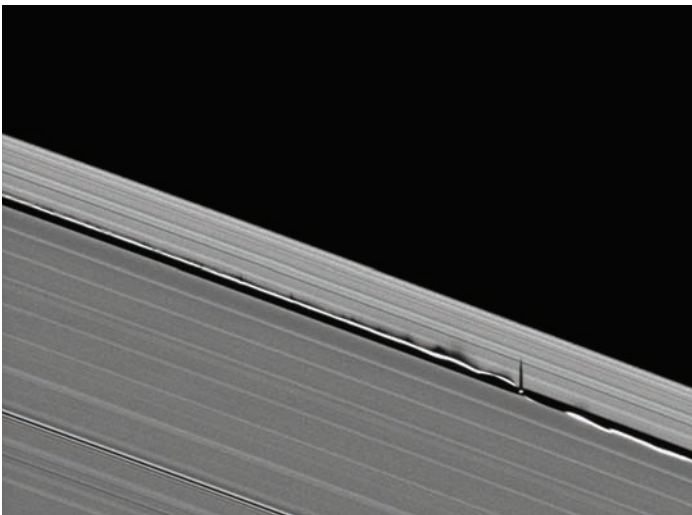


Figure 1 — Looming vertical structures, seen here for the first time and created by Saturn's moon Daphnis, rise above the planet's otherwise flat, thin disk of rings to cast long shadows in this *Cassini* image. Photo: CICLOPS/Space Science Institute, Boulder, Colo.

Journal

The *Journal* is a bi-monthly publication of The Royal Astronomical Society of Canada and is devoted to the advancement of astronomy and allied sciences. It contains articles on Canadian astronomers and current activities of the RASC and its Centres, research and review papers by professional and amateur astronomers, and articles of a historical, biographical, or educational nature of general interest to the astronomical community. All contributions are welcome, but the editors reserve the right to edit material prior to publication. Research papers are reviewed prior to publication, and professional astronomers with institutional affiliations are asked to pay publication charges of \$100 per page. Such charges are waived for RASC members who do not have access to professional funds as well as for solicited articles. Manuscripts and other submitted material may be in English or French, and should be sent to the Editor-in-Chief.

Editor-in-Chief

Jay Anderson
203 – 4920 Dundas St W
Toronto ON M9A 1B7, Canada
Internet: editor@rasc.ca
Web site: www.rasc.ca
Telephone: (416) 924-7973
Fax: (416) 924-2911

Associate Editor, Research

Douglas Hube
Internet: dhube@phys.ualberta.ca

Associate Editor, General

Michael Attas
Internet: attasm@aecl.ca

Assistant Editors

Michael Allen
Martin Beech
Dave Chapman
Ralph Chou
Dave Garner
Patrick Kelly

Editorial Assistant

Suzanne E. Moreau
Internet: semore@sympatico.ca

Production Manager

James Edgar
Internet: jamesedgar@sasktel.net

Contributing Editors

Geoff Gaherty (Through My Eyepiece)
Dave Garner (On Another Wavelength)
Bruce McCurdy (Orbital Oddities)
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Proofreaders

Ossama El Badawy
Margaret Brons
Angelika Hackett
Terry Leeder
Kim Leitch
Suzanne Moreau
Maureen Okun

Design/Production

Brian G. Segal, Redgull Incorporated

Advertising

James Edgar
Internet: jamesedgar@sasktel.net

Printing

Maritime Digital Colour

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The Royal Astronomical Society of Canada
203 – 4920 Dundas St W
Toronto ON M9A 1B7, Canada
Internet: nationaloffice@rasc.ca
Web site: www.rasc.ca
Telephone: (416) 924-7973
Fax: (416) 924-2911

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An RASC Catalogue of Meteorites

by R.A. Rosenfeld, RASC National Office (randall.rosenfeld@utoronto.ca)

ABSTRACT: This article briefly outlines the historical interest in meteoritics within the RASC, the vagaries of the vestigial collection associated with the RASC National Archives, and presents a catalogue of the current holdings.

Introduction

In the early evening of the second-last day of January 1868, a bolide dramatically detonated in the vicinity of Pultusk, Poland, raining down a shower of more than 100,000 meteorites (H5 ordinary chondrites) in an extensive strewn field (*JRASC* 85 [1991], 263-280; 91 [1997], 68-73). This was one of the largest such events recorded, and the news doubtless struck the ears, sparked the interest, and fired the imagination of at least several of the fathers of the RASC, or rather the Toronto Astronomical Club, founded towards the end of that year.¹ It is striking that the extraterrestrial origin of meteorites had been a broadly accepted and respectable scientific doctrine for only half a century, and that Ernst Chladni's (1756-1827) *On the Origin of the Object found by Pallas and Other Masses of Iron Similar to It, and on Some Natural Phenomena Occurring in Connection to It (Über der Ursprung der von Pallas Gefundenen und anderer ihr ähnlicher Eisenmassen, und Über Einige Damit in Verbindung stehende Naturerscheinungen)*, one of the starting points for modern meteoritics, had appeared just seven decades earlier (Marvin 2007). A convincing demonstration of the cometary origin of meteor streams was then very recent, the brilliant work of Giovanni Virginio Schiaparelli (1835-1910) (Schiaparelli 1867; DSB 12, 159-162; Buffoni *et al.*; Littmann 1998).

From the inception of the Society's publication programme, meteoritics was well represented. Between 1890 and 1931, there appeared in *JRASC* and its predecessors 133 notices of meteorite observations, reports of falls and finds, lectures, historical treatments, presentations of theory, and reviews. C.A. Chant, who played such a formative role in the RASC in the half-century beginning around 1900, was responsible for 10 of those contributions, and the well-known English meteoriticist, W.F. Denning (1848-1931; *JRASC* 84 [1990], 383-396; Meadows 2004; BEA, 1, 290-292),² a corresponding member of the RASC, was the author of 16 (Harper 1931, 64-66). The first annual ephemeris of the RASC, *The Canadian Astronomical Handbook for 1907 (1906)*, edited by Chant, contained a table of 81 "Meteoritic Showers" by Denning (1906, 74-75), 65 more than in the 2009 *Observer's Handbook*, its lineal descendant (2008, 258)³

In addition to Denning, the names of other eminent late 19th- and early 20th-century Commonwealth and American meteoriticists were inscribed on the roll of honorary RASC membership: Daniel Kirkwood (1814-1895), Sir George Darwin (1845-1912), W.H.S. Monck (1839-1915; like Denning, a corresponding member), and Simon Newcomb (1835-1909). The distinguished Soviet meteoriticist, I.S. Astapowitsch, published several articles in *JRASC* during the 1930s, as did the American meteoriticist, Lincoln Lapaz, in the 1950s, and Dorrit Hoffleit in the same period.

Canadian meteoritics can be said to have come of age in the 1940s-1960s with the rise of internationally recognized professionals such as Peter M. Millman (1906-1990; *JRASC* 85 [1991], 67-78), D.W.R. McKinley (1912-), C.S. Beals (1899-1979; *JRASC* 73 [1979], 325-332), and Ian Halliday (Schmadel 2003, 350). For 40 years (1933-1973), Peter Millman's *JRASC* column "Meteor News" brought reports of matters meteoritic worldwide to RASC members, eventually running to 132 issues. To the average Society member, two research programmes probably seemed especially promising: one, the Dominion Observatory's programme for the identification and investigation of Canadian impact craters,⁴ and the other, the Meteorite Observation and Recovery Project, or MORP (1970-1985), the prairie network of semi-automated meteor-camera field observatories (*JRASC* 52 [1958], 18-19; *JRASC* 72 [1978], 15-39; Bowden 2006, 382-383). Most members would have known of Millman and McKinley's cooperation with amateurs of the Society in the observing groups of the NRC Springhill Meteor Observatory (1957-1987) and the organized meteorite recovery teams out west. More amateurs had their own copies of McKinley's influential text *Meteor Science and Engineering* (1961) than could comfortably understand it, but through its pages they would have been introduced to the importance of Millman and Halliday's meteor spectrography and McKinley's radar observations. The Springhill veterans could boast of temporary interment in the relative luxury of the heated observing "coffins" designed by Millman!

A retrospective of meteoritic contributions to *JRASC* over the last three decades demonstrates that it still serves some of the needs of the community, with the names Beech, Brown, Connors, Dale, Herd, Hildebrand, Hube, Huziak, McCausland, McCurdy, Majden, Plotkin, Sarty, Spratt, and Tatum, among the contributors. While it cannot hope to compete with *ICARUS* or *Meteoritics and Planetary Science*, it does remain the sole serious Canadian *astronomical* journal that can accommodate meteoritics.⁵ And the RASC continues as a place where professional meteoriticists can call on their amateur colleagues for help in scientific endeavours, such as staffing meteorite field-recovery teams.

RASC Meteorite Collection

By any standards, the Society's collection is, and always has been, extremely modest. Compared to the major Canadian research collections, such as the University of Alberta's Meteorite Collection, the largest in Canada (www.museums.ualberta.ca/dig/search/meteors), or the Canadian National Meteorites Collection (*JRASC* 82 [1988], 24-30; Herd 2002), it is as an interplanetary dust particle to the impactor that created the Sudbury basin (N 46° 36', W 81° 11').

The history of the RASC collection is extraordinarily poorly documented for a meteorite collection. The evidence, such as it is, points to a consistently inconsistent plan of collection development, and a disquietingly inchoate approach to curation. Given the

problems of continuity, it is probably to the good that nothing more ambitious was pursued. That the RASC owned and owns any meteorites at all can probably be attributed to the venerable idea that astronomical institutions of any kind with non-meteorite collections of any sort are incomplete without a few bits of space rock. The idea can ultimately be traced to natural-philosophy cabinets of the 17th century, part of the learned matrix from which associations like the RASC arose. Some associated material survives, such as lantern slides of meteoritical interest (first mentioned in *JRASC* 4 [1910], A35), and a few stray publications, such as *A Chapter in the History of Meteorites* (Flight 1887), *Meteorites, Their Structure, Composition and Terrestrial Relations* (Farrington 1915), and *The Nininger Collection of Meteorites: A Catalog and a History* (Nininger 1950). Curiously enough, McKinley 1961 is not in the Archive's Rare Book Collection.

It is likely that specimens were acquired through mechanisms similar to the following:

Mr. A.F. Miller, on behalf of Mr. Joseph Townsend, of Dixie, presented to the Society a very beautiful specimen of meteoritic iron. Several years ago Mr. Townsend gave the Society a fragment broken off the same specimen. Mr. Miller has learned that the meteorite was kept for years in a collection of curios owned by the late Mr. Edward Terry, of Toronto [*JRASC* 1 (1907), 197].

Neither specimen forms part of the collection today, nor is there any record of how and when they may have been removed for "unofficial" study purposes. One suspects that over the years the RASC has unknowingly granted several similar "loans" to more than one budding amateur collector. Such has been the success of that "programme" that the earliest acquired specimen remaining in the collection is from the Bruderheim fall of 1960 (RASC M1.19600304).

Inattention has its price. Two years ago the collection had been so decimated that the Bruderheim stone was in poor company; the rest of the collection consisted of two low-class meteorwrongs (RASC Mwr1.19XX00XX, and RASC MWr2.196100XX).

The collection is in better shape today, thanks mainly to a generous and anonymous donation by a RASC member, who said that at the very least the Society "should have a collection of which a beginning amateur wouldn't be ashamed." As it stands, the donor's words are an apt characterization of the collection at present. It is fortuitous that the gift coincided with the Society's move to its new premises, for the Archives can now provide a much-improved measure of climate control, and stable heat and humidity conditions, to help check the processes of meteorite terrestrialization.

Catalogue

The catalogue fields consist of:

1. inventory number;
2. type and origin;
3. provenance;
4. dimensions;
5. weight;
6. form;
7. appearance;
8. state of preservation;
9. bibliography.

Given the limited size of the collection, a little more detail

can be supplied in the fields than is usually the case in catalogues. This is not to be taken as a sign of the relative importance of the specimens in the RASC collection; rather it attests to the opposite. It should also be noted that characterizations of the meteorites are referred to descriptions of the type specimens, or other properly analyzed specimens in the literature, for samples from none of the RASC specimens have been subject to extensive laboratory analysis. This catalogue has been prepared with the needs of the amateur uppermost, rather than the professional.

Meteorites

1. 1. RASC M1.19600304; 2. Bruderheim, L6 Chondrite, Bruderheim, Alberta (N 53° 54', W 112° 53'), witnessed fall 1969 March 4 ca. 08h 06m UT, ca. 303 kg; 3. Given to the RASC by the recovery team? (Documentation missing). Paper label: "STONY METEORITE FROM/ BRUDERHEIM, ALTA." Inventory number in black ink on white ink: "B-151"; 12.4×7.05×6.45 cm; 5. 750 g; 6. Irregular, with prominent ridge on one side, regmaglypts tend to be elongated (indicating flight orientation?); 7. Fusion crust > 99% intact; 8. Excellent state of preservation; 9. Not previously published(?); Grady, p. 118; IMCAEM www.encyclopedia-of-meteorites.com/meteorite.aspx?id=5156; MB 18 (1960), 1; MBDB <http://tin.er.usgs.gov/meteor/metbull.php?code=5156>

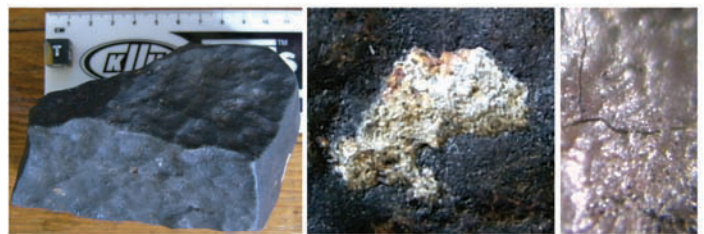


Figure 1 — Bulk appearance, exposed surface, and fusion crust on the RASC M1 meteorite.

2. 1. RASC M2.20090712; 2. Canyon Diablo, IAB coarse octahedrite, Meteor Crater, Arizona, (N 35° 3', W 111° 2'), found 1891, ca. 30 mt; 3. Anonymous gift 2009 July 12; 4. 3.52×2.39×1.22 cm; 5. 13.8 g; 6. Shrapnel, oriented; 8. Good state of preservation; some small rust spots common to these specimens; 9. Not previously published; Grady, pp. 128-129; IMCAEM www.encyclopedia-of-meteorites.com/meteorite.aspx?id=5257; MB 33 (1965), 1-2 (Fair Oaks, paired; Bloody Basin, paired); MB 37 (1966), 2 (Oildale, paired?); MB 54 (1976), 82-83 (Panamint Range, paired); MBDB <http://tin.er.usgs.gov/meteor/metbull.php?code=5257>

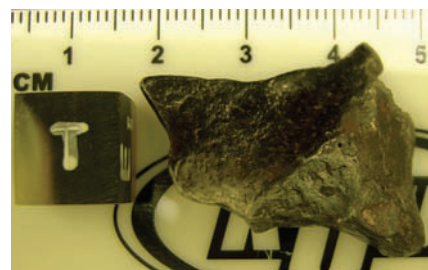


Figure 2 — The RASC M2 meteorite.

3. 1. RASC M3.20090712; 2. Sikhote-Alin, IIAB coarsest octahedrite, Sikhote-Alin, Russian Federation, (N 46° 9' 36", E 134° 39' 12"), witnessed fall 1947 February 12 ca. 00h 30m UT, ca. 23 mt; 3. Anonymous gift 2009 July 12; 4. 3.03×1.40×0.67 cm; 5. 7.7 g; 6. Shrapnel, oriented; 7. Lacquered?; 8. Excellent state of preservation; 9. Not previously published; Grady, pp. 462-463; IMCAEM www.encyclopedia-of-meteorites.com/meteorite.aspx?id=23593; MB n.a.; MBDB <http://tin.er.usgs.gov/meteor/metbull.php?code=23593>

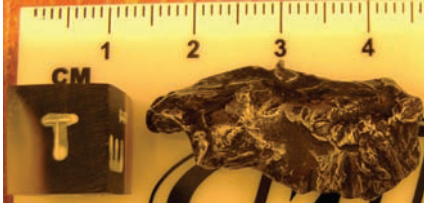


Figure 3 — The RASC M3 meteorite.

4. 1. RASC M4.20090712; 2. Gibeon, IVA fine octahedrite, Namibia (S 25° 30', E 18° 0'), found 1836, ca. 26 mt; 3. Anonymous gift 2009 July 12; 4. 2.28×0.62×0.94 cm; 5. 6.5 g; 6. Etched slice; 7. Fusion crust on longest side; 8. Fair state of preservation; some rust spots; 9. Not previously published; Grady, p.214; IMCAEM www.encyclopedia-of-meteorites.com/meteorite.aspx?id=10912; MB 36 (1966), 2 (Nico, paired); MBDB <http://tin.er.usgs.gov/meteor/metbull.php?code=10912>

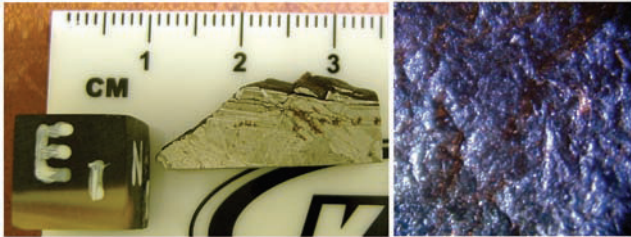


Figure 4 — The RASC M4 meteorite (left) and an enlargement (x30) of its fusion crust (right).

5. 1. RASC M5.20090712; 2. Gibeon; 3. Anonymous gift 2009 July 12; 4. 1.41×0.94×1.19 cm; 5. 4.8 g; 6. Etched slice; 8. Fair state of preservation; some rust spots; 9. Not previously published

6. 1. RASC M6.20090712; 2. Gibeon; 3. Anonymous gift 2009 July 12; 4. 1.05×0.72×0.33 cm; 5. 4.2 g; 6. Etched slice; 7. Traces of fusion crust(?); 8. Fair state of preservation; some rust spots; 9. Not previously published

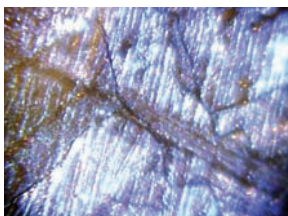


Figure 5 — The RASC M6 meteorite x30.

7. 1. RASC M7.20090712; 2. Gibeon; 3. Anonymous gift 2009 July 12; 5. 0.09 gr; 6. fragment; 9. Not previously published

8. 1. RASC M8.20090712; 2. Gold Basin, L4 Chondrite, Gold Basin, Arizona (N 35° 52' 30", W 114° 14' 0"), found 1995, ca. 61 kg; 3. Anonymous gift 2009 July 12; 4. 2.06×1.95×0.47 cm; 5. 2.6 g; 6. End cut, polished face; 7. Weathering rind (?); 8. Good state of preservation; 9. Not previously published; Grady, pp. 218-219; IMCAEM www.encyclopedia-of-meteorites.com/meteorite.aspx?id=10940; MB 82 (1998), 223; MBDB <http://tin.er.usgs.gov/meteor/metbull.php?code=10940>

9. 1. RASC M9.20090712; 2. Gold Basin; 3. Anonymous gift 2009 July 12; 4. 2×1.95×2.39 cm; 5. 2.4 g; 8. Good state of preservation; 9. Not previously published

Impactites

10. 1. RASC I1.20080920; 2. Tektite, Australasian Strewn Field; 3. Anonymous gift 2009 July 12; 4. 3.63×1.59 cm; 5. 17.2 g; 6. Elongated tear-drop splashform; orientated; 8. Excellent state of preservation; 9. Previously unpublished; McCall 51-54

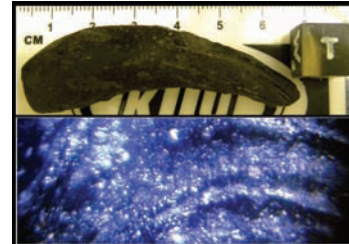


Figure 6 — The RASC I1 tektite (above) and an enlargement (x30) (below).

11. 1. RASC I2.20080920; 2. Tektite, Australasian Strewn Field; 3. Anonymous gift 2009 July 12; 4. 1.22×2.39×1.68 cm; 5. 15.3 g; 6. Pear-shaped splashform; orientated; 8. Excellent state of preservation; 9. Previously unpublished; McCall 51-54



Figure 7 — the RASC I2 tektite.

Meteorwrongs

12. 1. RASC MWr1.19XX00XX; 2. Ilmenite (FeTiO₃), possibly an Ontario find; 3. Unknown. Whoever added it to the collection was undoubtedly misled by its mild magnetism and "dark" colour; 4. 3.65×2.85×1.26cm; 5. 34.2 g; 9. Previously unpublished



Figure 8 — The RASC MWr1 meteorite.

13. 1. RASC MWr2.196100XX; 2. Partially melted crystalline silica; 3. Unknown. Paper label (on collection bag): “Bought from U. of Alberta for/\$28.in 1961. Identified Dec. 18th/ 1974 by J.A. Mandarino, Curator/ Dept. of Mineralogy R.O.M.” Note that Mandarino’s identification is not directly reported, nor does it survive in written form elsewhere in the RASC Archives. The implication is that Mandarino identified the specimen as a “meteorite,” but that may reflect the interpretation of his words by the writer of the label; 4. 6.5×5.3×2.87cm; 5. 83.2 g; 6. Loosely bound amorphous mass of fine grains in various stages of melt, ≈60% glass; probably post-industrial waste product; 8. The glass has a mildly green-coloured cast, covered with a glaze-like crazed skin; the less-fused portions of the mass are very friable; 9. Previously unpublished



Figure 9 — The RASC MWr2 meteorite.

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Abbreviations

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 DNSBS=The Dictionary of Nineteenth-Century British Scientists, ed. B. Lightman *et al.*, 4 vols, 2004, Thoemmes Continuum, Bristol
 DSB=Dictionary of Scientific Biography, ed. C.C. Gillispie *et al.*, 18 vols., 1970-1990, Scribner, New York
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End Notes

- ¹ The Pultusk meteor was famous, or rather infamous, as the best contender for the title “meteor in a hyperbolic (interstellar) orbit.” It, and the problems it posed, was well known to prominent RASC meteoricists like D.W.R. McKinley, who wisely expressed caution on the nature of its orbit, and the interstellar origin or not of its constituent parts (McKinley 1961, 163). Subsequent work has not favoured the reliability of Pultusk’s reputed hyperbolic orbit (*JRASC* 91 [1997], 68-73).
- ² Denning’s omission from the recent DNCBS is inexplicable. Martin Beech has written a life of Denning (<http://uregina.ca/~astro/DEN/Denning.html>).
- ³ Chant wisely chose Denning to compile the radiant tables, for he was the acknowledged expert in their discovery at that time (Denning 1899). Unfortunately, many of his showers are now considered illusory corollaries of his fixed radiant theory (Littmann 1998, 148-151; Jenniskens 2006).
- ⁴ For an updated list see www.unb.ca/passc/ImpactDatabase/NorthAmerica.html, maintained by the Planetary and Space Science Centre at the University of New Brunswick.
- ⁵ There are, of course, more consistently professional Canadian journals for geology and geochemistry that publish meteoritics.