The Meteoritical Bulletin:

Categorization of Finds and Falls

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by

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Background:

Meteorites have long been divided into two categories, **falls** and **finds**. If any part of the event leading to the delivery of a meteorite to Earth was witnessed, either by humans or their devices (cameras, radar, etc.), it is traditionally called a fall. All other meteorites are traditionally called finds.

The Meteorite Nomenclature Committee (NomCom), which publishes *The Meteoritical Bulletin* on behalf of the Meteoritical Society, is mainly responsible for the oversight of meteorite names, but also documents their classifications and whether they were falls or finds. To date, 410 meteorite falls have been announced in the *Bulletin* since its inception in 1957 (adding to the 716 previously known falls); tens of thousands of finds have also been published. Note that a meteorite's classification and fall status, as listed in the *Bulletin*, are not intended to be "official," as is the meteorite's name. Instead, they represent consensus findings of the diverse group of scientists who serve on NomCom at the time of the meteorite's approval, and are simply initial determinations of these properties.

The rules of meteorite nomenclature are somewhat different for falls and finds. All isolated meteorites are given unique names, regardless of whether they are falls or finds. But in regions where meteorite finds can be made in large numbers, numbering or lettering systems are frequently used to name them. In so-called dense collection areas (DCAs), mostly located in the world's deserts, numbered sequences of finds may reach into the thousands, like the sequence Dhofar 001 to Dhofar 1982 in Oman. However, meteorite falls are given unique place-names, even when they occur within the boundaries of a DCA; for example, a 1998 observed fall within the Roosevelt County DCA in New Mexico, USA, was named Portales Valley. Only in rare cases where two meteorite falls occur in the same place are they given the similar names, such as Wethersfield (1971) and Wethersfield (1982).

The Problem:

The NomCom has found that categorization of a meteorite as a fall or find is not always straightforward. For a meteorite to be announced as a fall, two simple conditions need to be met:

1. A fall event has been documented

2. The recovered meteorite has been connected to the fall event

Both of these conditions are subject to considerable uncertainty. For condition 1, accounts of meteorite fall events that are submitted to NomCom vary widely in quality, ranging from those that are so well documented that an orbit may be determined for the original meteoroid, to highly questionable stories with low credibility. For condition 2, some meteorites are actually witnessed hitting the ground or penetrating a roof, providing direct evidence to connect them to a fall event. However, in most reported recoveries, the meteorite was found some time after the witnessed event, ranging from hours to many years, and thus circumstantial evidence must be presented to connect the meteorite to the event. Not surprisingly, the strength of this evidence varies widely. Moreover, the credibility of the human witnesses to meteorite fall events and recoveries varies widely.

The philosophy of NomCom has long been to publish all information relevant to a reported meteorite fall event, regardless of whether the meteorite was categorized as a fall. When there has been uncertainty as to whether circumstantial evidence was strong enough to support a claim that a meteorite was an observed fall, the committee has preferred to take a conservative approach. Such meteorites have been published as finds, with enough information to allow interested researchers to reach their own conclusions about whether the meteorite was really an observed fall. For example, the Valencia (*Bulletin* 82, http://www.lpi.usra.edu/meteor/index.php?code=24147), Mount Moroto (*Bulletin* 99, http://www.lpi.usra.edu/meteor/index.php?code=52858), Benešov (a) and (b) (*Bulletin* 100, http://www.lpi.usra.edu/meteor/index.php?code=54854), and Mreïra (Bulletin 102, http://www.lpi.usra.edu/meteor/index.php?code=57653) meteorites were all published as finds, although the text contains information on the circumstances of possible fall events.

In recent years, there has been increased pressure to accept meteorites as observed falls, even on relatively weak evidence regarding one of both conditions listed above. Part of this pressure is due to the rapid growth of meteorite commercialism, and the fact that a meteorite's market price or collectability can be affected by whether it is announced as a fall or a find. Part of the pressure comes from increased awareness of meteorites in less-developed parts of the world, where people are now becoming eager to report witnessed falls, but do not have the means to afford the technology or the population to support a news media needed to thoroughly document fall events. And part of the pressure comes from finders, who do not want meteorites that they think were observed falls to get "undesirable" DCA numbers instead of unique names (which can also affect market prices and collectability). However, the NomCom never considers factors like meteorite prices in making decisions about the name, fall status or classification of submitted specimens, nor does it apply different standards of evidence in evaluating falls from different parts of the world.

A better system is needed, in which the NomCom can express its varying level of confidence as to whether a given meteorite was actually an observed fall. This system needs to replace the binary system of categorizing meteorites as either falls or finds, to better reflect the reality of uneven strength of evidence for falls. The system should also help users of meteorite data to identify finds that are suspected of being observed falls, but for which the evidence is weak.

The New Categorization System for Falls and Finds:

In December, 2014, the NomCom adopted a new system for categorizing falls and finds. Instead of a binary system, the new one has five categories, which can be arranged in order of confidence that a meteorite is an observed fall.

The top two categories will comprise meteorites that NomCom determines to be **falls**, and are subject to the nomenclatural rules for falls:

> A "*Confirmed fall*" is a meteorite determined to be a fall beyond reasonable doubt. There was a well-documented fall event, witnessed either visually or with instruments, and collection occurred soon after the event. Physical evidence is consistent with a fresh fall, or, when collection did not occur immediately, convincingly points to a fall at the time of the event.
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> A "*Probable fall*" is a meteorite found to be a fall by the weight of the evidence, but there remains some degree of doubt. There were observations of an event considered likely to have produced meteorites, but there remains some doubt about whether the collected meteorite is related to the event, or about the nature of the event itself.

The bottom three categories will comprise meteorites that NomCom determines to be **finds**, and are subject to the nomenclatural rules for finds, including application of DCA numbering sequences.

> A "*Find, possible fall*" is a meteorite that was submitted with information that may connect it to a fall event, but the evidence was found to be insufficient to accept this claim. There was an observation that seems consistent with a fall event, but there is significant doubt, either about whether the meteorite is connected to the event or about the observations of the event itself.
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> A "*Find, doubtful fall*" is also a meteorite submitted with information that may connect it to a fall event, but there is a high degree of doubt about whether the meteorite is connected to the event or about the observations of the event itself.
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> A "*Find*" is a meteorite for which no evidence, or no credible evidence, was submitted concerning the fall circumstances.

Implementation

For all new meteorite submissions suspected of being falls, the submitter will be asked to select from one of the categories listed above. If the submitter does not wish to choose, the Editor will make a tentative categorization. The proposed category will be considered by the NomCom at the time of voting on the submission, and evaluated against the evidence presented by the submitter. The NomCom will decide on a category following a discussion and vote.

Published categorizations of meteorites may be changed if new evidence is presented; for example, if radiogenic nuclides are determined for a meteorite accepted as a "Find, possible fall" and the data demonstrate a connection to a witnessed fall event, the NomCom could revote and

change the categorization to probable or confirmed fall. Such changes will be announced in *The Meteoritical Bulletin* and *The Meteoritical Bulletin Database*. The impetus for changing the category may come from the original submitter or any member of the meteoritical community (in the same manner in which corrections are currently accepted).