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The discreditation of mineral species

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The following statement was endorsed by the Commission on New Minerals and Mineral Names, IMA, which has jurisdiction concerning the subject matter and of which the author is the voting member for the United States.

Introduction

Most mineral species, once described, remain valid, and additional studies serve to enhance our knowledge of the species, their crystal structures, solid solution relations, stabilities, phase relations, etc. However, not all original descriptions are correct. Some were based on incorrect data, some on incorrect interpretations, and still others on insufficient data, mixtures of data sets, or mixtures of minerals. In some cases the errors can be rectified, new data can be obtained, and the mineral redefined; approval of the redefinition, if needed, can be obtained, and a correction can be published in the literature. However, some such attempts to redefine a mineral, as well as attempts to restudy older minerals, result in the conclusion that the description of the substance as a unique mineral is invalid, and this finding requires formal discreditation of the mineral.

A discreditation does not necessarily imply that the original work was not good or was incorrectly done. Many such discreditations are the result of the application of new technologies to substances not formerly recognized as mixtures, or to the chemical analysis of elements very difficult to determine in earlier times. In many cases the original work was as good as could be done at the time; indeed, in many cases the work was excellent, and thus some historical perspective is needed in evaluating and criticizing sources or causes of error.

The literature is replete with mineral discreditations, ranging in quality from the very careful and formal to the truly careless and casual; indeed, some are done cavalierly and some are even incorrect, requiring subsequent correction and revalidation of the mineral. This paper provides guidelines for the proper discreditation of a mineral species. It should be emphasized at the outset that all discreditations require the approval of the IMA Commission on New Minerals and New Mineral Names (CNMMN). Just as a mineral name requires formal international certification before birth and publication, so too does it need a death certificate and a proper burial in the literature. Many of the notes below refer equally to the redefinition or revalidation of mineral species.

The literature

It is very important that the original description be obtained and read in full; reference to abstracts or compendia is insufficient and is fraught with potential for further error. If the description was written in a language in which the investigator is not competent, a translation must be obtained, preferably from a person familiar with scientific writing and the protocols of presenting technical data. After obtaining the translation, counsel from mineralogists in the country where the mineral was described might be sought regarding unclear sections of the text, incomplete locality designations, and other complications. It is imperative that the original description not only be read, but be understood fully, before discreditation is undertaken. If the original description was in an obscure journal, it is useful to repeat publication of at least the original critical data in the discreditation paper.

Type specimens

It is imperative that the type material (the same material used in the original description), if it still exists, be utilized in the discreditation of a mineral species. This matter is of paramount importance and cannot be overstated. The general and specific definitions of type specimens were given by Dunn and Mandarino (1987), and the discussion paper by Embrey and Hey (1970) has useful insights and gives much perspective. The methods utilized in a search for type specimens should be part and parcel of the training of a mineralogist, but this training is seldom offered currently, so a few guidelines are offered here.

If the senior author of the original description resided in a nation with a national museum, the curator of that museum is the most likely person to be of assistance. Such individuals can usually be identified by that nation's representative on the IMA Commission on Museums (CM), and that representative, in turn, can be identified by the seeker's national representative on the CM. If there is no such museum in the host nation, recourse can be had to the curators of regional museums. Additionally, very large research-oriented museums, such as the British Museum (Natural History) and the Smithsonian Institution, have extensive collections that contain many hundreds of type specimens.

If such museum endeavors are unsuccessful, inquiry might be made of the institution where the senior scientist was employed at the time the original work was done. Postmortem memorials in the journals in which the scientist commonly published (usually a society-published

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journal in his home country) may be informative sometimes as to the places he worked and disposition of his collections. Interim studies of the mineral, subsequent to its original description, may offer some guidance as to the disposition and location of the original type specimens. If the mineral comes from a famous locality (Tsumeb, Långban, Crestmore, Franklin, etc.) the mineralogists specializing in the mineralogy of such deposits are usually well informed and might be of assistance.

If all these efforts fail, it may well be that there is no type material. The preservation of type mineral specimens, clearly marked or designated as such, is a relatively recent development in mineralogy; for a vast number of the older mineral species no type specimens exist. Some specimens in old collections are marked "original material" or "original stuff," sometimes in the handwriting of the author, but such material and handwriting need careful physical and historical evaluation by local curators before they can be identified positively as what now is called type material. If type material cannot be obtained, it may not be possible to be certain about what material was described, and formal discreditation therefore may be impossible.

There are, however, instances where clear, unambiguous type specimens cannot be found, yet much authentic material from the type locality exists in systematic collections. Although an uncommon happenstance, discreditation is sometimes still possible, but usually a number of specimens would have to be studied, and a higher standard of proofs would have to be met in argument, such that all possible weaknesses in the presentation are straightforwardly addressed. If one cannot locate holotype or cotype material, that fact should be stated, together with a description of the attempts made to find it. If one has other specimens that might be a satisfactory match for the species in question, one should state why they are adequate and describe them fully, together with any supporting documentation. Lastly, they should be identified by means of accession numbers or other identifiers for future reference and preserved in a national museum. By these procedures, the discreditation itself could be reexamined in the future, if need be. A very few discreditations are found to be in error, and revalidation then requires the use of the same specimen.

It is important to remember that once one has obtained type material and discredited the species (or failed to), the specimen is still the type material. It will be kept by repositories in perpetuity as a type specimen, so that it can be restudied if needed. If, at the conclusion of the discreditation study, the type specimen is deposited in a different collection than that from which it was obtained, this information and the new catalogue number or numbers should be published in the paper.

Having obtained all the type specimens, it is necessary to ascertain mineralogically that they are indeed the type material, and that they correspond to the original description. Regardless of the quality of the documentation, cataloguing, numbering, and labels with the specimen, and disregarding the often very considerable effort expended, if the extant material does not match the original physical description, such that it can be clearly identified as the original material, then all may be for naught. Mislabeled specimens abound in the best of collections (Bentley et al., 1986), and type specimens, like any other specimens, are subject to this problem (Dunn, 1978). When the documentation described above does corroborate and support all observations and supports the integrity of the type material, those facts should be clearly noted in the paper. One should also be cautious concerning fake specimens (Dunn et al., 1981); although an uncommon occurrence, type specimens have been faked.

The above-described methodology represents cases wherein the written descriptions were done reasonably well. However, some descriptions in the literature were poorly done, a few horribly so, making it very difficult in some instances to ascertain the nature of the mineral described. Nickel and Mandarino (1987) noted:

> If a type specimen exists and if the original description, though faulty, represents a reasonable approximation to material on the specimen, the mineral is to be defined by reference to the type material rather than to the original description. This means that errors in the original description cannot be held to discredit a mineral unless the original description was so grossly inaccurate that, in the words of J.D. Dana, "a recognition of the mineral by means of it is impossible."

Most such cases result in redefinitions of species rather than discreditations.

Discreditation

In many cases the true identity of the material is initially established by the investigator on nontype specimens, and this result then prompts the search for type material so as to permit a formal discreditation. When the type specimen is obtained, a few simple tests may serve to confirm earlier findings and provide conclusive proofs. Indeed, in some instances, much more effort is expended in obtaining type material than in its examination and definition.

However, it is best to define the type specimen as well as possible, and to describe it as completely as possible. The use of modern techniques commonly provides the opportunity to describe the specimen in more detail than was originally possible, and this information should be added. If the discreditation is successful, this study might well be the last time the specimen is ever intensively examined. The comprehensiveness of the effort will vary from investigator to investigator, but certain criteria should be met in all cases. First, the physical appearance of the specimen should be redescribed, and its agreement with the original description noted, thereby convincing the reader that this is the original material.

Certain parts of the discreditation procedure are critical; most species are defined on the basis of one or more prime discriminatory factors that serve to give the species unique status. Commonly, the discriminating property

will be the chemical composition or crystallographic symmetry. In such cases, that property must be explicitly examined, which is to say, for example, that a species based on a chemical distinction must be reanalyzed chemically, and one based on a symmetry distinction must have its symmetry reexamined. These factors are paramount, but other aspects should also be investigated. In cases of mixtures, if any component of the mineral has solid-solution relations known or possible, or indicated by the initial description, they should be examined. Every attempt should be made to identify all components of mixtures. It is not sufficient to show that the mineral is not what it was purported to be; it is also required that a clear new definition of the mineral or minerals present be given. If the "mineral" being discredited is a synthetic compound, that too should be addressed.

Rarely, a mineral being discredited will be found to consist of a mixture of a known mineral and a new mineral as yet undescribed. By tradition, in such cases the old mineral name commonly is applied to the new mineral that is a part of the original specimen (Nickel and Mandarino, 1987). This tradition may be set aside, with the concurrence of the CNMMN, if a misnomer or other confusion would result.

It is useful to attempt to ascertain the errors in the original description; they may be single or multiple, simple or complex. The new investigator may be the person best qualified to provide an interpretation of the original study. Much can be learned by such an attempt and, in addition, it lends much weight and credence to the discreditation. The reinterpretation of faulty analyses, or of analyses of mixtures, is often possible and should be done. Recalculations of analyses, both of isochemical mixtures and of minerals with different chemical elements, can often be done and should be. Subtle or gross distinctions in symmetry, missed in the earlier study, should be pointed out and clarified, as well as errors in the measurement of optical and physical data.

In describing such errors, it is a professional courtesy to our predecessors to do so sympathetically, with a considerate eye on what was possible at the time and keeping the original investigator's best intentions in mind. If the original investigator is living, advice and counsel may be sought; in any case, the rules of the CNMMN require that the original investigator, if living, be consulted.

Occasionally, a mineral, although invalid, will be reported a second or third time from other localities. In such instances, it is advisable to attempt to acquire such specimens and reexamine them. In almost all such cases the second or subsequent description will be based upon erroneous information in the initial study, and the examination of type material will commonly reveal the sources of error in the secondary descriptions. These other occurrences should be critically discussed; most are trivial and contain little or no data, but inasmuch as the subject will likely not be revisited by one as close to the problem as the current investigator, it is wise to clear up all loose ends.

Upon completion of the study, the results should be submitted to the Commission on New Minerals and Mineral Names, as indicated by Nickel and Mandarino (1987). After consideration and subsequent voting by the Commission, the results and all comments of voting members will be sent to the senior author of the discreditation. Such comments commonly contain insights that assist substantially in the preparation of the paper to be published.

If formally approved, the discreditation can and must be published. It is best to publish a discreditation as a separate paper so as to have a distinct focus and to ensure that the work is captured by all abstracters and authors of subsequent compendia. If the discreditation is part of a larger study and is best published as such, the discreditation should at least be clearly indicated in the title of the paper and noted as a separate paragraph of the abstract.

Structure of presentation

Each study is a unique one, with unique problems, and subject to the effects of insights, work style, and the writing habits of the individual scientist. Nonetheless, the extreme unevenness and sparseness of many published discreditations prompts the following suggested outline as a guide:

1. A statement of the problem and citation of all of the relevant literature.
2. The integrity of the type specimen or specimens and descriptions.
3. The correct definition of the mineral being discredited.
4. Discussion of the errors in the original work.
5. Conclusion and statement of CNMMN approval.

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