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## HISTORICAL PUBLICATIONS ON METEORITES (1867-1934) IN THE «*MISCELLANEA D'ACHIARDI*» (DIPARTIMENTO DI SCIENZE DELLA TERRA, UNIVERSITY OF PISA, ITALY)

**Abstract** - The author presents the catalogue of publications on meteorites in the «*Miscellanea D'Achiardi*», a miscellaneous collection of more than 9200 titles collected by the Pisa University's mineralogists Antonio and Giovanni D'Achiardi in the second half of the nineteenth century and early twentieth century, and currently maintained in the library of the Pisa University's Dipartimento di Scienze della Terra. The documents on meteorites are of great historical and scientific value and amounts to 148 documents (reprints of journal articles, museum catalogues and booklets) published in between 1869 and 1934, with 80 of them dating before 1900.

**Key words** - Antonio D'Achiardi, Giovanni D'Achiardi, meteorites, historical publications.

**Riassunto** - *Pubblicazioni storiche sulle meteoriti (1867-1934) nella «Miscellanea D'Achiardi» (Dipartimento di Scienze della Terra, Università di Pisa, Italia).* Viene presentato il catalogo del repertorio bibliografico sulle meteoriti presente nella «*Miscellanea D'Achiardi*» (attualmente custodita presso la biblioteca del Dipartimento di Scienze della Terra, Università di Pisa). Si tratta di materiale di grande valore scientifico e storico, costituito da 148 documenti tra ristampe di articoli in riviste, cataloghi di musei e piccole opere indipendenti, pubblicate tra il 1869 e il 1934, e che fu raccolto dai mineralogisti pisani Antonio e Giovanni D'Achiardi attraverso omaggi e scambi con i maggiori studiosi di meteoriti della fine dell'ottocento - inizio del novecento.

**Parole chiave** - Antonio D'Achiardi, Giovanni D'Achiardi, meteoriti, pubblicazioni storiche.

### INTRODUCTION

Antonio D'Achiardi (Pisa 1839-1902) and his son Giovanni (Pisa 1872 - Fauglia 1944) were among the most eminent representatives of the Pisa University's scientific school in the period from the Unification of Italy to the World War II. Both scientists devoted their activity mostly to research and teaching in the fields of mineralogy, mineral deposits and petrography, nonetheless they also contributed with significant and original studies on palaeontology, mining archaeology and thermal waters. A detailed biography of both scientists accompanied by a complete list of their scientific production can be found in Arcangeli (1903; for A. D'Achiardi) and Bonatti (1946; for G. D'Achiardi). A. and G. D'Achiardi gathered a huge miscellaneous collection («*Miscellanea D'Achiardi*») of scientific printed material amounting to more than 9200 documents (mainly reprints of scientific papers, booklets,

museum catalogues, newspaper articles and other printed material) dated from 1858 to 1938, and covering various fields of the geological sciences. The «*Miscellanea D'Achiardi*» is currently maintained in the library of the Dipartimento di Scienze della Terra, University of Pisa. The D'Achiardi's were both attracted by the relatively new field of meteoritics, though they were not directly involved in meteorite research. In particular A. D'Achiardi, who also worked for the former Pisa University's Museo di Mineralogia from 1860 to 1903, acquired a number of meteorite specimens, including some of great scientific relevance, which are currently maintained at the Pisa University's Museo di Storia Naturale (Perchiazzi *et al.*, 2004). In the thirties, G. D'Achiardi was tutor of several thesis dissertations on meteoritics, and some of them are kept in the miscellany. The interest of both scientists for meteorite studies is attested by the large number (148) of documents on meteorites present in the miscellany (Fig. 1). The aim of this work is to preserve, publicize, and make available this historical and rare scientific material to the public interested in meteorites and meteorite sciences. A CD-Rom containing digital reproductions of the front covers of all the reprints and all the plates enclosed in them (pdf file format) is available upon request from the author.

### HIGHLIGHTS OF THE CATALOGUE

The documents in the «*Miscellanea D'Achiardi*» dealing with meteorites date from 1869 to 1934, and 80 of them were published before 1900. Most of the works are written in German (82) and English (51) and lesser in Italian (12), Spanish (2) and French (1) (Fig. 2). The high number of papers written in German, including many published before 1900, attests to the high reputation of the German and Austrian schools in the field of meteorite science during the late nineteenth century; this was mainly due to the activity of some outstanding scientists such as Gerhard vom Rath (1830-1888, University of Bonn), Gustav Tschermak (1836-1927, University of Vienna), Emil Cohen (1842-1905, University of Greifswald), Friedrich Berwerth (1850-1918, University of Vienna), Aristides Brezina (1848-1909, University of Vienna), Friedrich Rinne (1863-1933, University of Lipsia), and many others. Other prominent meteorite scientists from the United States and the United Kingdom, contemporary with

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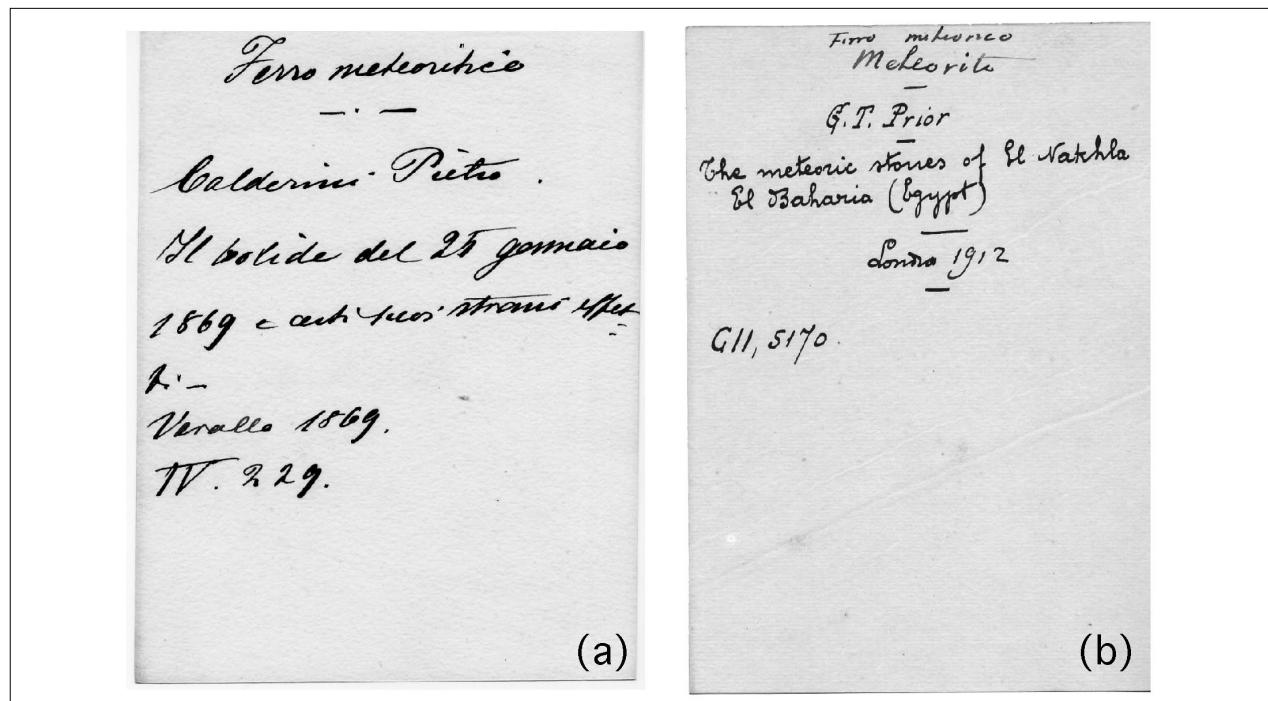


Fig. 1 - Two index-cards of the «*Miscellanea D'Achiardi*» personally handwritten by Antonio (a) and Giovanni (b) D'Achiardi.

the D'Achiardi's, and whose works are well represented in the miscellany were George P. Merrill (1854-1929, Smithsonian Institution), Lazarus Fletcher (1854-1921, British Museum), George F. Kunz (1856-1932), George T. Prior (1862-1936, British Museum), Leonard J. Spencer (1870-1959, British Museum) and Charles Palache (1895-1952, Harvard University).

Most papers on meteorite sciences in the miscellany address morphological, petrographic and chemical characterizations of meteorites. In many cases they are the very first reports of new falls or finds. A total of 117 different meteorites are described (plus 7 pseudo-meteorites), and 31 of them were observed falls occurred in the period during which the reprints were collected. Many papers enclose plates with beautiful reproductions of hand-made drawings or photographies of meteorites and their microscopic textures (Figs. 3 and 4). In the following, I highlight the contents of a few of the most interesting papers which were selected on the basis of their scientific and historical value:

- Document #242 in the miscellany: this is the 1886 edition of the twelve guides/catalogues published by Lazarus Fletcher from 1881 to 1914 and all entitled «*An introduction to the study of meteorites with a list of the meteorites represented in the collection*». Fletcher, who was keeper of the British Museum's (Natural History) mineral and meteorite collections since 1880, introduced a new type of catalogue to promote the public interest in meteorite sciences. Indeed, besides the list of meteorites kept in the

British Museum, these guides include a history of the collection and a short but very clear appraisal of the current knowledge about the history, structure, chemistry and origin of meteorites. In addition, the telluric irons and the pseudo-meteorites known at the time and the meteorite casts exhibited in the museum were listed in the appendices.

- Document #315: this is the first description of the Carroll County (Eagle Station) and Catorze (Charcas) meteorites (Kunz, 1887). Both meteorites are interesting as they demonstrate the use of meteoric iron as a precious source of this metal by peoples of varying ages. According to the author, the Carroll County (Kentucky) pallasite (found in 1880 and later officially renamed Eagle Station; Grady 2000) was the source material of the iron artifacts found in the Turner Mounds. The Turner Mounds are a group of burial mounds constructed by the Hopewell Indians (500 B.C. to A.D. 500) in the Little Miami Valley, Ohio. At the beginning of the nineteenth century, earrings, ornaments and other artifacts made of meteoric (pallasitic) iron were found on the altars of some of these mounds. The Catorze iron meteorite, described in the same paper, is also interesting for its ethnological value. This iron meteorite (later paired with Descubridora, Agua Blanca, Catorze and Charcas meteorites; Grady, 2000) is a IIIAB medium octahedrite found in 1885 near Catorze (San Luis Potosí, Mexico). The ethnological interest of this iron resides in the fact that it was certainly worked long before its find-

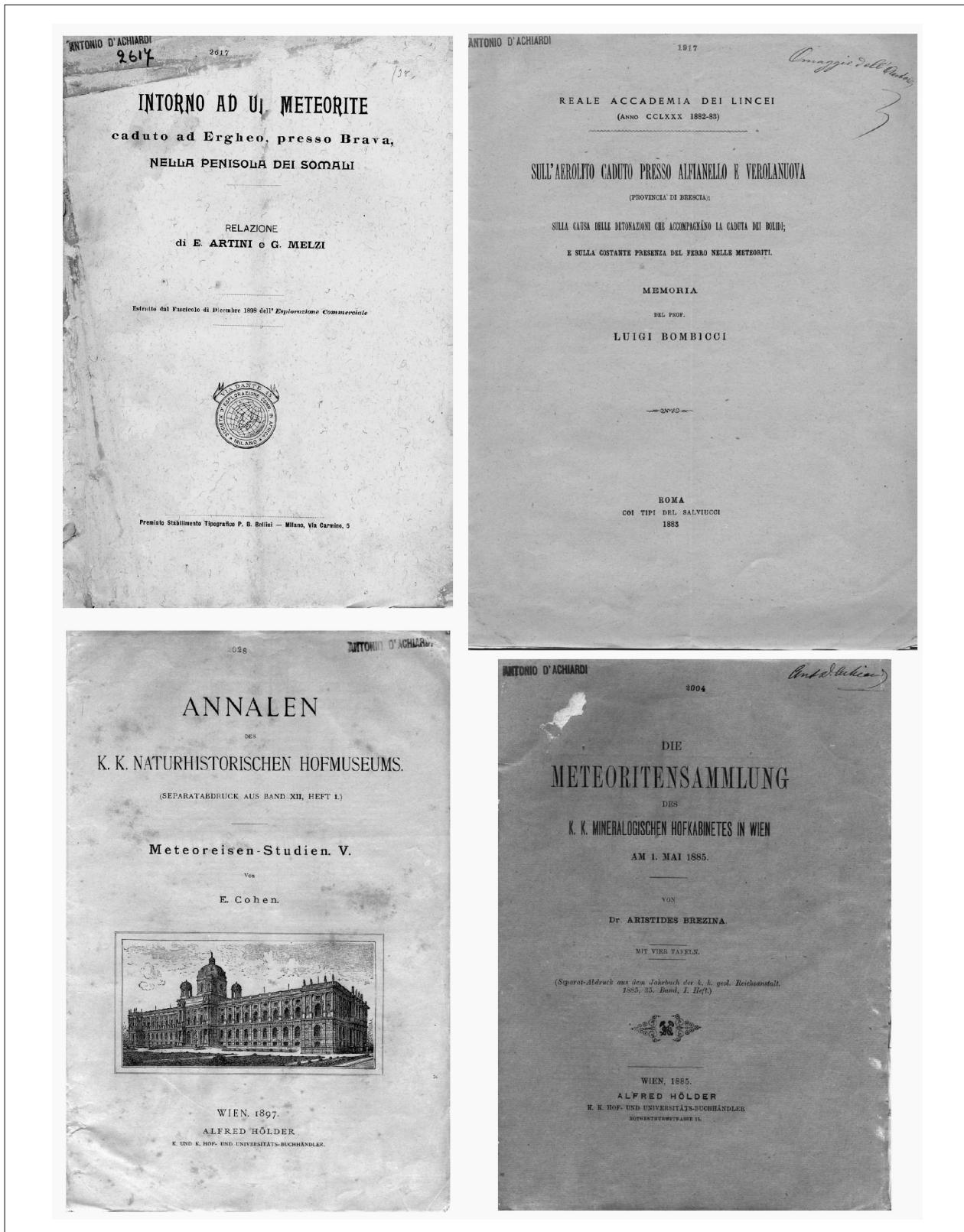


Fig. 2 - Front covers of four nineteenth century reprints in the «Miscellanea D'Achiardi».

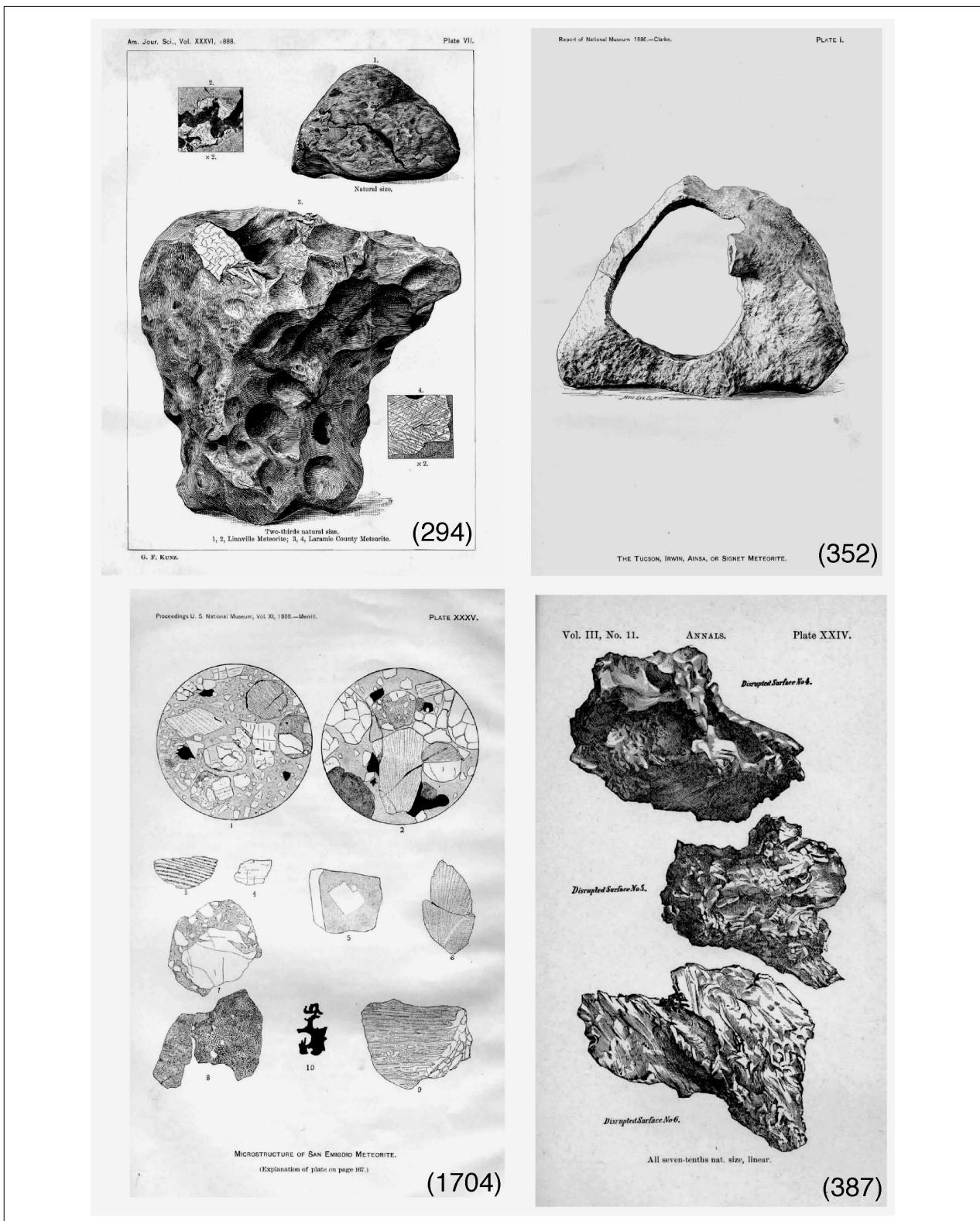


Fig. 3 - Selected plates with hand-drawings of individual meteorites and microscopic textures of meteorites from nineteenth century reprints in the «*Miscellanea D'Achiardi*». The plates report the catalogue number of the reprints they are enclosed in.

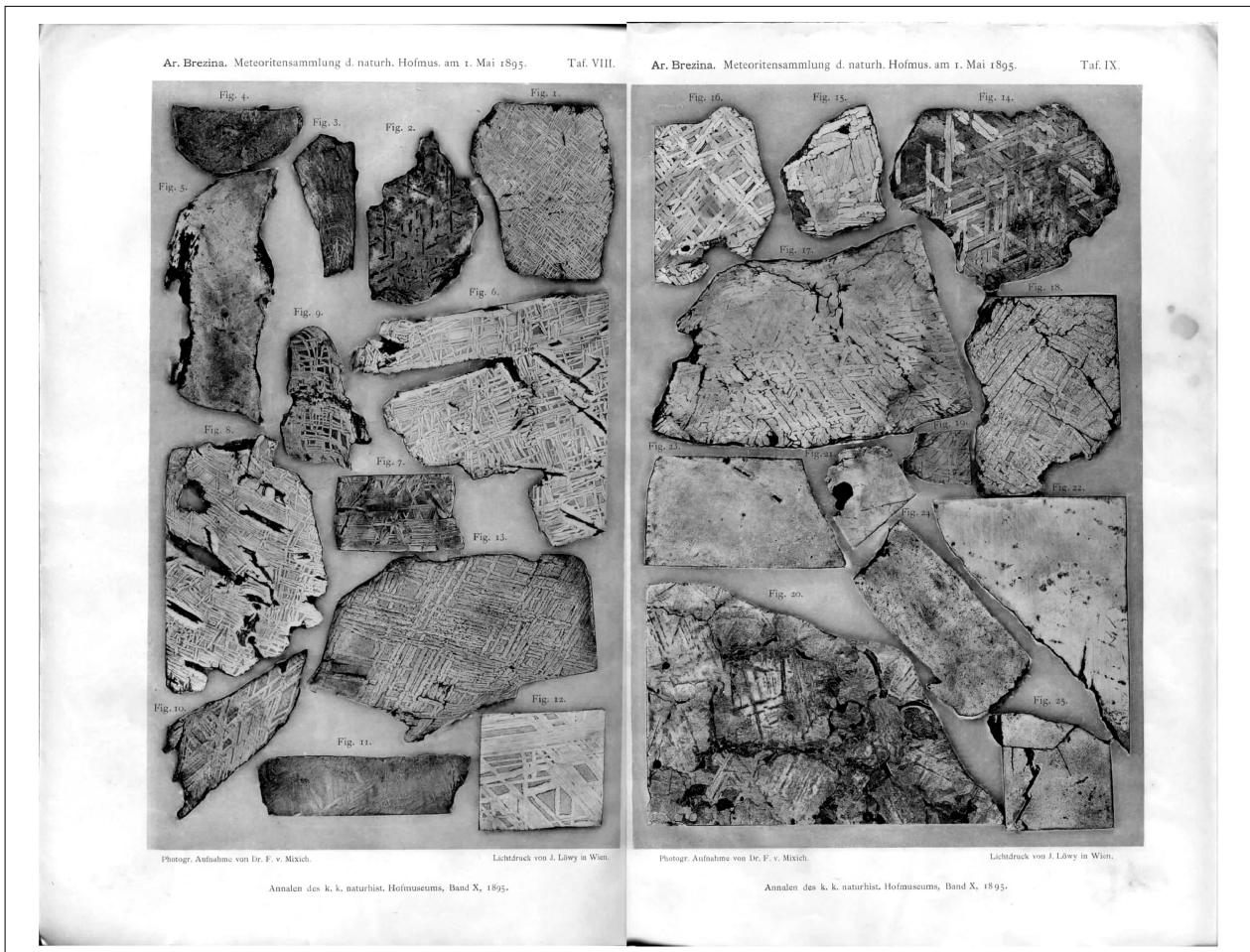


Fig. 4 - Plate portraying a selection of slices of iron meteorites slices on display at the Kaiserlich-Königliches Naturhistorisches Hofmuseum in Vienna in the nineteenth century. From Brezina (1896) (catalogue number 2024).

ing, as proved by the chisel of native copper found wedged in a fissure of it and used in the attempt of obtaining fragments from it.

- Document #1917 (Fig. 2): first description of the Alfianello meteorite fall (Bombicci 1883). The Alfianello (Brescia, Italy) L6 chondrite fell on February 16, 1883 at about 14:45 p.m. in a clover field. Some peasants saw a fireball crossing the sky from NNE to SSW and shortly after a strong explosion was heard. The meteorite did not break up but penetrated for about 1.5 m in the soft ground as single mass. Luigi Bombicci, mineralogy professor at the Bologna University reported that immediately after the fall, the stone was crushed and fragmented by the peasants. Nonetheless, he could ascertain that the shape of the meteorite was roughly conical, with rounded depressions and protuberances, and that its weight was approximately 200 kg (that is, the largest meteorite to date found in Italy). Bombicci then gives a detailed description of the petrography, mineralogy and chemistry of the Alfianello meteorite

samples in his possession and finally discusses two problems in meteorite science which were much debated at his times (1) the origin of the detonations accompanying meteorite falls, and (2) the abundance of metallic iron in the majority of meteorites in comparison with terrestrial rocks. According to Bombicci, the detonations were due to the ignition of hydrogen-oxygen explosive gas mixtures around the meteoroid during its heating through the atmosphere. The oxygen should be provided by the ambient atmosphere, while the hydrogen could be either liberated by the meteorite itself, or derived from the dissociation of the aqueous vapour in contact with the hot surface of the meteoric mass. Concerning the constant occurrence of metallic iron in meteorites, Bombicci taught that the Earth, by virtue of its strong magnetic field, operated a selection on the meteoric masses wandering in the solar system, having a preference for those containing metal iron.

- Documents #2025, 2026, 2028, 2619, 2618, 2627, 2626, 2760: these papers are the parts II, III, V, VI,

- VII, VIII, IX and X, respectively, of the *Meteoreisen-Studien* published by Emil Cohen (Fig. 2). The whole series is composed of 11 parts and was published from 1891 to 1900 on the Annalen des K.K. Naturhistorischen Hofmuseums in Wien. The *Meteoreisen-Studien* is a systematic investigation of the irons maintained in the meteorite collection of the Naturhistorisches Hofmuseum in Vienna, at the time the most important in the world. In the whole series the author reports on the structure, mineral phases and bulk chemistry of more than 60 iron meteorites, plus 6 iron pseudo-meteorites.
- Document #2617: this is the first description of the Ergheo stone meteorite (Artini & Melzi, 1898; Fig. 2). The Ergheo (Brava, Somalia) L5 chondrite came in possession of the Italian explorer captain Ugo Ferrandi during his residence in Brava in April 1894. Cap. Ferrandi came to know of the circumstances of the fall from a local shepherd, Schek Baba. According to his report, the stone fell in July 1889 in a locality close to Ergheo (west of Brava) during a rain shower. During the storm, a thunderbolt struck the ground producing a hole about 1.5 m deep, at the bottom of which the still warm (according to the shepherd report) «thunderstone» was found. The paper, illustrated with beautiful plates of phototypes made in the famous Max Jaffé Laboratory in Vienna, continues with a detailed morphological and petrographic description of the meteorite, followed by a chemical analysis by G. Boeris. The Ergheo chondrite was successively fragmented in several pieces that were distributed to the major collection of meteorites in the world.
  - Document #3334: it is first description of the Casas Grandes iron meteorite (Tassin 1902). This IIIAB medium octahedrite was recognized in 1867 but the strange circumstances of the find were known in 1873 and reported for the first time in this paper: some Mexican mountaineers during the excavation of the pre-Hispanic (Chichimeca Civilization) ruins of the Montezuma Casas Grandes (Chihuahua, Mexico), penetrated into a large room in the center of which was a kind of tomb. There they found a large iron mass (weighing more than 1500 kg) carefully wrapped in a kind of coarse linen much like the mummies found in the ancient tombs of the same locality. The Casas Grandes iron meteorite was presented to the Smithsonian Institute of Washington in 1876, where it is still maintained.
  - Document #3685: first description of the Peramiho eucrite (Berwerth 1903). This meteorite fell on October 24, 1899 close to the Benedictine Mission of Peramiho (district of Songea, German East-Africa, modern Tanzania). A single stone, weighing 165 g, was found by local people and given to the Superior of the Mission. The stone is a typical cone-shaped oriented meteorite showing thin, glossy black, primary and secondary fusion crusts. The author describes in great detail the stone as an eucrite breccia with shock-induced, black, melt veinlets. The eucrite clasts were described as having doloritic or ophitic texture and made of anorthitic plagioclase, clino- and orthopyroxene, magnetite (most likely chromite or ilmenite) and magnetic iron sulfide (*Magnetkies*). This paper is a good example of the accuracy in the morphological, petrographic, mineralogical and bulk chemical characterizations of meteorites attainable during the early twentieth century, with the sole use of the polarizing microscope and classic wet chemical analyses.
  - Document #5170: it is the description of the El Nakhla el Baharia achondrite (Prior, 1912). This very famous meteorite (later renamed Nakhla; Grady, 2000) fell on June 28, 1911 close to the village of El Nakhla el Baharia, about 28 miles east of Alexandria, Egypt. About 40 stones fell, with a total weight of about 10 kg, after the explosion of a single large mass approaching the earth from the northwest along a track inclined to horizontal about 30°. In this paper the author reports on the morphology, petrography and bulk chemistry of two samples presented to the British Museum by the Egyptian Government. Prior describes the meteorite as a chondrule- and metallic iron-free holocrystalline aggregate of diopside (~85 wt %) and Fe-rich olivine (~15 wt %) plus minor oligoclase, augite and magnetite. Prior also recognized the similarity of this rock with the achondrites belonging to the the angrite class. About seventy years after the fall of the Nakhla meteorite, it was proposed that the group of SNC achondrites (so called after the historical meteorites of the group: Shergotty, Nakhla and Chassigny) were samples of the planet Mars. In the miscellany is also kept the paper (#2011) reporting the first chemical analyses of Shergotty (India, fall, 1865 August 25), accurately performed by E. Lumpe in 1871.
- The high number (20) of museum catalogues of meteorites in the miscellany, reflects the large growth of meteorite collections in the world occurred during the late nineteenth century, after a long period of almost complete lack of interest in meteorites (Burke, 1986). Indeed, various editions of meteorite catalogues of the major European and U.S. collections can be found in the miscellany: the British Museum (Natural History), the Naturhistorisches Hofmuseum in Vienna, the U.S. National Museum in Washington, the Peabody Museum of Yale College, the Museum of the Königlichen Friedrich-Wilhelms-Universität in Berlin, the Mineralogy Museum of the Bonn University, the Mineralogical Museum of Harvard University in Boston. The publication and the diffusion of these catalogues greatly enhanced the exchanges of meteorite specimens between museums. This, in turn, stimulated the quantification of the exchange value of meteorite specimens. Indeed, three papers by Wülfing (1894, 1899) and Foote (1913) dealing with this argument can be found in the miscellany.
- A rare paper by Brezina (1889), published on the Monatsblatt der Numismatischen Gesellschaft in Wien, dealing with the representation of meteorites in ancient coins, is one of the most interesting documents in the miscellany, particularly for people interested in the his-

tory of meteoritics and mythology. Aristides Brezina collected hundreds of ancient Phoenician, Greek and Roman coins representing Baetys (sacred stones, some of meteoric origin) worshipped in ancient temples of Greece and Asia Minor. The most famous of these Baetys represented on coins (some of them illustrated in the paper) are: the Omphalos of Delphi, the Stone of Emesa, the Stone of Aphrodite of Paphos, the Artemis of Ephesos, the Stone of Astarte, the Stone of Athena, the Simulacrum of Artemis Pergia and the Stone of Apollo Karinos of Megara.

Overall, the scientific content of the publications in the «*Miscellanea D'Achiardi*» provides us with a thorough picture of the state of the art of meteoritics after the first half of the nineteenth century, when the cosmic origin of meteor and meteorites was gradually accepted, and before the major scientific progress produced by the application of the instrumental analytical techniques (such as X-ray fluorescence, X-ray diffractometry, neutron activation analysis, and mass spectrometry) in meteoritics.

#### THE CATALOGUE

The numbers in parentheses at the end of each entry are the original catalogue number of the «*Miscellanea D'Achiardi*» and the number of the file, respectively. Eight documents listed in the catalogue were not found in their files, nonetheless they are reported to maintain the complete list (these documents are indicated as «missing»).

Adams L.H., Washington H.S., 1924. *The distribution of iron in meteorites and in the Earth*. Journal of the Washington Academy of Science, 14, 14, 333-340, Washington (7072, CXL).

Alderman A.R., 1932. *The meteorite craters at Henbury, Central Australia*. Mineralogical Magazine, XXIII, 136, 19-32, London (8300, CLX).

Artini E., Melzi G., 1898. *Intorno ad un meteorite caduto ad Ergheo, presso Brava, nella Penisola dei Somali*. Esplorazione Commerciale, 1-13, Milan (2617, LVIII).

Berwerth F., 1901. *Der Meteorstein von Zavid*. Wissenschaftliche Mittheilungen aus Bosnien und der Hercegovina, VIII, 409-426, Vienna (3540, LXXII).

Berwerth F., 1902. *Der Meteoreisenzwilling von Mukerop, Bezirk Gibeon, Deutsch-Südwest-Africa*. Sitzungsberichten der Kaiserl. Akademie der Wissenschaften in Wien, CXI, 1-21, Vienna (3686, LXXIV).

Berwerth F., 1903. *Verzeichnis der Meteoriten im k. k. Naturhistorischen Hofmuseum*. Annalen des K.K. Naturhistorischen Hofmuseums, XVIII, 1-90, Vienna (3539, LXXII).

Berwerth F., 1903. *Der meteorische Eukrit von Peramiho*. Sitzungsberichten der Kaiserl. Akademie der Wissenschaften in Wien, CXII, 1-39, Vienna (3685, LXXIV).

Berwerth F., 1904. *Über die Metabolite, eine neue Gruppe der Meteoreisen*. Kaiserliche Akademie der Wissenschaften in Wien, XIII, 1-3, Vienna (3609, LXXIII).

Berwerth F., 1905. *Künstlicher Metabolit*. Sitzungsberichten der kaiserl. Akademie der Wissenschaften in Wien, CXIV, I, 345-356, Vienna (3810, LXXVI).

Berwerth F., 1906. *Das Meteoreisen von Kodaikanal und seine silikatausscheidungen*. Tschermak's Mineralogische und Petrographische Mitteilungen, XXV, 1-3, 181-198, Vienna (3811, LXXVI).

Berwerth F., 1907. *Die Tracht der Meteoriten*. Wien (4205, LXXXIII).

Berwerth F., 1907. *Etwas über die Gestalt und Oberfläche der Meteoriten*. Festschrift der Naturwissenschaftlichen Vereines an der Universität Wien, 29-40, Vienna (4319, LXXXV).

Berwerth F., 1908. *Steel and meteoric iron*. Journal of the Iron and Steel Institute, III, 37-51, London (4316, LXXXV).

Berwerth F., 1909. *Das Meteoreisen von Quesa*. Annalen des K.K. Naturhistorischen Hofmuseums, XXIII, 318-338, Vienna (4491, LXXXVIII).

Berwerth F., 1910. *Oberflächenstudien an Meteoriten*. Tschermak's Mineralogischen und Petrographischen Mittheilungen, XXIX, 1-12, Vienna (4527, LXXXIX).

Berwerth F., 1911. *Fortschritte in der Meteoritenkunde seit 1900*. Fortschritte der Mineralogie, Kristallographie und Petrographie, I, 257-284, Jena (4977, XCVIII).

Berwerth F., Tammann G., 1911. *Über die natürliche und künstliche Brandzone der Meteoreisen und das Verhalten der «Neumann'schen Linien» im erhitzen Kamacit*. Sitzungsberichten der Kaiserl. Akademie der Wissenschaften in Wien, CXX, 31-47, Vienna (4976, XCVIII).

Bombicci L., 1883. *Sunto di una memoria (R. Accad. Dei Lincei) sulla caduta dell'aerolito di Alfianello, sulle cause delle detonazioni che accompagnano la discesa dei bolidi, e sulla costante presenza del ferro nelle meteoriti*. Rendiconto dell'Accademia delle Scienze dell'Istituto di Bologna (Sessione del 22 aprile 1883), Bologna (92, II).

Bombicci L., 1883. *Météorites du cabinet de Minéralogie de la Royale Université*. 1-3, Bologna (588, X).

Bombicci L., 1883. *Sull'aerolito caduto presso Alfianello e Veronalanuova (provincia di Brescia); sulla causa delle detonazioni che accompagnano la caduta dei bolidi; e sulla costante presenza del ferro nelle meteoriti*. Memorie della classe di scienze fisiche, matematiche e naturali. Reale Accademia dei Lincei, XIV, 1-11, Rome (1917, XLV).

Bombicci L., 1887. *Sulla ipotesi dell'azione e selezione magnetica del globo terrestre sulle materie cosmiche interplanetarie contenenti ferro*. Memorie della Reale Accademia delle Scienze dell'Istituto di

- Bologna, IV, VIII, 389-394, Bologna (6436, CXXIX).
- Brauns R., 1930. *Einige Bemerkungen zu dem in Litauen niedergefallenen Meteoriten*. Mittheilungen aus dem Mineralogischen Institut der Universität Bonn., 401-407, Bonn (8063, CLVI).
- Brezina A., 1885. *Die Meteoritensammlung des k.k. mineralogischen Hofkabinetes in Wien am 1. Mai 1885*. Jahrbuch der K.K. Geol. Reichsanstalt, 35, 1, 151-276, Vienna (2004, XLVI).
- Brezina A., 1888. *Ueber das Eisen von Wolfsegg*. Allgemeiner Bergmannstag, 1-6, Vienna (2032, XLVI).
- Brezina A., 1889. *Cliftonit aus dem Meteoreisen von Magura, Arvaer Comitat*. Annalen des K.K. Naturhistorischen Hofmuseums, IV, 102-106, Vienna (2027, XLVI).
- Brezina A., 1889. *Darstellung von Meteoriten auf antiken Münzen*. Monatsblatt der Numismatischen Gesellschaft in Wien, 70, 312-314, Wien (2040, XLVI).
- Brezina A., 1889. *Reise zur Pariser Weltausstellung*. Annalen des K.K. Naturhistorischen Hofmuseums, IV, 1-7, Vienna (2031, XLVI).
- Brezina A., 1890. *Ueber Meteoreisen, seine Unterschiede vom künstlichen Eisen und über das Schneiden des ersten*. Oesterreichischen Zeitschrift für Berg- und Hüttenwesen, XXXVIII, 1-5, Vienna (1999 bis, XLVI).
- Brezina A., 1890. *Untersuchungen der Herren Barthelot und Friedel in Paris über das Meteoreisen von Magura*. Annalen des K.K. Naturhistorischen Hofmuseums - Notizen, V, 1-3, Vienna (2029, XLVI).
- Brezina A., 1893. *Ueber neuere Meteorite*. Verhandlungen der Gesellschaft Deutscher Naturforscher und Aerzte, 1-10, Nürnberg (597, X).
- Brezina A., 1896. *Die Meteoritensammlung des k.k. Naturhistorischen Hofmuseums am 1. Mai 1895*. Annalen des K.K. Naturhistorischen Hofmuseums, X, 3-4, 231-370, Vienna (2024, XLVI).
- Brezina A., 1904. *Über dodekaedrische Lamellen in Oktaedriten*. Sitzungsberichten der Kaiserl. Akademie der Wissenschaften in Wien, CXIII, 1-7, Vienna (3775, LXXV).
- Brezina A., 1905. *Meteoriten in moderner Reproduktionstechnik*. Österreichische Illustrierte Zeitung, 34, 842-845, Vienna (3894, LXXVIII, missing).
- Brezina A., Cohen E., 1902. *Ueber ein Meteoreisen von Mukerop, Bezirk Gibeon, Grossnamaland*. Jahreshefte des Vereins für vaterlande Naturkunde in Württemberg, 58, 292-306, Stuttgart (3435, LXX and 3847, LXXVI).
- Brezina A., Cohen E., 1904. *Über Meteoreisen von De Sotoville*. Sitzungsberichten der Kaiserl. Akademie der Wissenschaften in Wien, CXIII, 1-15, Vienna (3821, LXXVI).
- Calderini P., 1869. *Il bolide del 25 gennaio 1869 e certi suoi strani effetti*. Varallo (229, IV, missing).
- Capellini G., 1915. *Meteoriti senesi nel R. Museo Geologico di Bologna*. Bologna (5427, CVII, missing).
- Ceccherelli P.L., 1937. *Le meteoriti*. Dissertation thesis, Pisa (8756, CLXIX).
- Clarke F.W., 1889. *The meteorite collection in the U.S. National Museum: a catalogue of meteorites represented November 1, 1886*. Report of the Smithsonian Institution, 255-265, Washington (352, VI).
- Cohen E., 1887. *Der Pallasiit von Campo de Pucará in der Argentinischen Republik*. Neuen Jahrbuch für Mineralogie ecc., II, 45-52, Stuttgart (513, VIII).
- Cohen E., 1892. *Meteoreisen - Studien. II*. Annalen des K.K. Naturhistorischen Hofmuseums, VII, 3, 143-162, Vienna (2025, XLVI).
- Cohen E., 1894. *Meteoreisen - Studien. III*. Annalen des K.K. Naturhistorischen Hofmuseums, IX, 1, 97-118, Vienna (2026, XLVI).
- Cohen E., 1896. *Ueber den Meteoritenfall bei Madrid*. Mittheilungen des Naturwissenschaftlichen Vereines für Neu-Verpommern und Rügen, 1-6, Greifswald (641, X).
- Cohen E., 1896. *Die Meteoriten von Laborel und Guareña*. Annalen des K.K. Naturhistorischen Hofmuseums, XI, 1, 31-38, Vienna (2022, XLVI).
- Cohen E., 1897. *Über ein neues Meteoreisen von Locust Grove, Henry Co., Nord-Carolina, Vereinigte Staaten*. Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, VI, 76-81, Berlin (1672, XXXIII).
- Cohen E., 1897. *Das Meteoreisen von Forsyth Co., Georgia, Vereinigte Staaten*. Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, XVI, 386-396, Berlin (1674, XXXIII).
- Cohen E., 1897. *Ueber ein angebliches Meteoreisen von Walker Co., Alabama, Vereinigte Staaten*. Mittheilungen des Naturwissenschaftlichen Vereines für Neu-Verpommern und Rügen, 1-5, Greifswald (1724, XXXIII).
- Cohen E., 1897. *Meteoreisen - Studien. V*. Annalen des K.K. Naturhistorischen Hofmuseums, XII, 1, 42-62, Vienna (2028, XLVI).
- Cohen E., 1897. *Über das Vorkommen von Eisencarbid (Cohenit) im terrestrischen Nickeleisen von Niakornak bei Jakobshavn in Nord-Grönland*. Meddelelser om Grönland, XV, 293-304, Copenhagen (2404, XXXVI).
- Cohen E., 1897. *Meteoreisen - Studien. VI*. Annalen des K.K. Naturhistorischen Hofmuseums, XII, 2, 119-126, Vienna (2619, LVIII).
- Cohen E., 1897. *Ein neues Meteoreisen von Beaconsfield, Colonie Victoria, Australien*. Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, XLVI, 1035-1050, Berlin (2632, LVIII).

- Cohen E., 1898. *Ueber eine zum schneiden von Meteoreisen geeignete maschine.* Tschermak's Mineralogischen und Petrographischen Mittheilungen, XVIII, 5, 408-411, Vienna (2343, XXXVI).
- Cohen E., 1898. *Meteoreisen - Studien. VII.* Annalen des K.K. Naturhistorischen Hofmuseums, XIII, 1, 45-58, Vienna (2618, LVIII).
- Cohen E., 1898. *Über das Meteoreisen von Cincinnati, Vereinigte Staaten.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, XXXII, 428-430, Berlin (2630, LVIII).
- Cohen E., 1898. *Über ein neues Meteoreisen von Ballinoo am Murchisonfluss, Australien.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, II, 19-22, Berlin (2631, LVIII).
- Cohen E., 1898. *Nachtrag zur Beschreibung des Meteoreisens von Beaconsfield.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, 306-307, Berlin (2633, LVIII).
- Cohen E., 1898. *Ueber das Meteoreisen von Morradal, Norwegen* (2628, LVIII, missing).
- Cohen E., 1899. *Ueber den Wülfing'schen Tauschwerth der Meteoriten im Vergleich mit den Handelspreisen - Ueber das Meteoreisen von Quesa, Provinz Valencia, Spanien.* Mittheilungen aus dem Naturwissenschaftlichen Vereines für Neu-Vorpommern und Rügen, XXXI, 50-66, Greifswald (2493, XXXVII).
- Cohen E., 1899. *Meteoreisen - Studien. VIII.* Annalen des K.K. Naturhistorischen Hofmuseums, XIII, 2-3, 118-158, Vienna (2627, LVIII).
- Cohen E., 1899. *Meteoreisen - Studien. IX.* Annalen des K.K. Naturhistorischen Hofmuseums, XIII, 4, 473-486, Vienna (2626, LVIII).
- Cohen E., 1900. *Meteoreisen - Studien. X.* Annalen des K.K. Naturhistorischen Hofmuseums, XV, 1, 74-94, Vienna (2760, LIX).
- Cohen E., 1900. *Zusammenfassung der bei der Untersuchung der körnigen bis dichten Meteoreisen erhaltenen Resultate.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, LII, 1122-1135, Berlin (2781, LIX).
- Cohen E., 1900. *Die Meteoreisen von Kokstad, Bethanien und Muchachos.* Mittheilungen des Naturwissenschaftlichen Vereines für Neuverpommern und Rügen, 1-43, Greifswald (2892, LX).
- Cohen E., 1901. *Das Meteoreisen von N'Goureyma unweit Djenne, Provinz Macina, Sudan.* Mittheilungen aus dem Naturwissenschaftlichen Verein für Neu-Vorpommern und Rügen, XXXIII, 1-15, Greifswald (3345, LXIX and 3381, LXIX).
- Cohen E., 1902. *Das Meteoreisen von Rafrüti im Emmenthal, canton Bern, Schweiz..* Mittheilungen des Naturwissenschaftlichen Vereins für Neuverpommern und Rügen, 1-5, Greifswald (3433, LXX).
- Cohen E., 1904. *Verzeichnis der Meteorite in der Greifswalder Sammlung am 1. Mai 1904.* Mittheilungen des Naturwissenschaftlichen Vereins für Neuverpommern und Rügen, 1-34, Greifswald (3633, LXXIII).
- Dana E.S., 1886. *Catalogue of the collection of meteorites in the Peabody Museum of Yale College,* 1-44, New Haven (348, VI).
- Dana E.S. & Penfield S.L., 1886. *On two hitherto undescribed meteoric stones.* American Journal of Science, XXXII, 227-231, New Haven (326, V).
- Ducloux E.H., 1925. *Nota sobre el meteorito de La Colina.* Revista de la Facultad de Ciencias Químicas, III, 1, 65-, Buenos Aires (7462, CXLVI).
- Ducloux E.H., 1925. *Datos químicos sobre el aerolito «El Toba» como perteneciente al grupo meteórico de «Campo del Cielo».* Revista de la Facultad de Ciencias Químicas, III, 1, 117-, Buenos Aires (7461, CXLVI).
- Fletcher L., 1886. *An introduction to the study of meteorites, with a list of the meteorites represented in the collection.* British Museum (Natural History), 77 pp., London (242, IV).
- Fletcher L., 1899. *On a mass of meteoric iron from the neighbourhood of Caperr, Rio Senguerr, Patagonia - On the cliftonite and taenite of the meteoric iron found in 1884 in the sub-district of Youndegin, Western Australia.* Mineralogical Magazine, XII, 56, 167-174, London (2754, XLI).
- Fletcher L., 1901. *On the Meteoric Stones which fell near Zomba, British Central Africa, on January 25th, 1899; with notes on the chemical analysis of such bodies.* Mineralogical Magazine, XIII, 59, 1-37, London (2906, LX and 3320, LXIX).
- Fletcher L., 1904. *On various masses of meteoric iron reported to have been found in Great Namaqualand and the adjacent region - Historical note relative to the meteoritic fragment labelled «Cape of Good Hope» and «Great Fish River» - Note relative to the history of the mass of meteoritic iron brought by Dr. F. P. Moreno from Caperr, Patagonia.* Mineralogical Magazine, XIV, 63, 28-42, London (3635, LXXIII).
- Foote W.M., 1899. *Note on a new meteoric iron found near the Tombigbee River; in Choctaw and Sumter counties, Alabama, U.S.A.* American Journal of Science, VIII, 44, 153-156, New Haven (2836, LX).
- Foote W.M., 1913. *Factors in the exchange value of meteorites.* Proceedings of the American Philosophical Society, LII, 211, 516-542 (5039, C).
- Foote W.M., 1912. *Preliminary note on the shower of meteoric stones at Aztec, near Holbrook, Navajo County, Arizona.* American Journal of Science, XXXIV, 437-456, New Haven (5141, CII).
- Foote W.M., 1914. *Note on a new meteoric iron from Mount Edith, Ashburton District, West Australia.* American Journal of Science, XXXVII, 1-8, New Haven (5198, CIII).

- Genth F.A., 1886. *On a undescribed meteoric iron from east Tennessee.* Proceedings of the Academy of Natural Sciences of Philadelphia, 366-368, Philadelphia (367, VI).
- Goldschmidt V., 1894. *Ueber Wüstensteine und Meteoriten.* Tschermak's Mineralogischen und Petrographischen Mittheilungen, XIV, 2, 131-142, Vienna (552, IX).
- Grantham D.R., Oates F., 1931. *The Mbosi meteoric iron, Tanganyika Territory.* Mineralogical Magazine, XXII, 133, 487-493, London (8164, CLVII).
- Himmelbauer A., 1909. *Orientierung von Schnittflächen an Meteoreisen.* Tschermaks Mineralogische und Petrographische Mitteilungen, XXVIII, 153-166, Vienna (4331, LXXXV).
- Howell E.E., 1894. *Beaver Creek Meteorite.* American Journal of Science, XLVII, 430-435, New Haven (254, V).
- Klein C., 1889. *Die Meteoriten-Sammlung der Königlichen Friedrich-Wilhelms-Universität zu Berlin am 15. October 1889.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, XLI, 843-864, Berlin (544, IX).
- Klein C., 1903. *Die Meteoritensammlung der Königlichen Friedrich-Wilhelms-Universität zu Berlin am 5. Februar 1903.* Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, VII, 139-172, Vienna (3255, LXVIII).
- Kunz G.F., 1885. *On three masses of meteoric iron from Glorieta Mountain, near Canoncito, Santa Fe County, New Mexico.* American Journal of Science, XXX, 1-4, New Haven (330, V).
- Kunz G.F., 1885. *The meteorites from Glorieta Mountain, Santa Fé Co., New Mexico.* Annals of the New York Academy of Sciences, III, 11, 329-334, New York (387, VI).
- Kunz G.F., 1887. *Two new meteorites from Carroll County, Kentucky, and Catorze, Mexico.* American Journal of Science, XXXIII, 1-8, New Haven (315, V).
- Kunz G.F., 1887. *Taney County Meteorite, MO.* American Journal of Science, XXXIV, 467-471, New Haven (317, V).
- Kunz G.F., 1887. *Chattooga County, Georgia, Meteorite.* American Journal of Science, XXXIV, 471-472, New Haven (318, V).
- Kunz G.F., 1887. *East Tennessee (?) Meteorite.* American Journal of Science, XXXIV, 473-474, New Haven (307, V).
- Kunz G.F., 1887. *Powder Mill Creek Meteorite.* American Journal of Science, XXXIV, 477-478, New Haven (309, V).
- Kunz G.F., 1887. *Waldron Ridge, Tennessee, Meteorite.* American Journal of Science, XXXIV, New Haven (319, V).
- Kunz G.F., 1888. *On two new masses of meteoric iron. I. Meteoric iron from Linnville Mountain, Burke Co., North Carolina. 2. Meteoric iron from Laramie County, Wyoming.* American Journal of Science, XXXVI, 275-277, New Haven (294, V).
- Kunz G.F., 1905. *Moissanite, a natural carbon silicide from the Cañon Diablo Meteorite.* American Journal of Science, XIX, New Haven (3746, LXXV).
- Lasaulx von A., 1881. *Sitzungsberichten der niederrheinischen Gesellschaft für Natur- und Heilkunde zu Bonn* (665, XI).
- Lasaulx von A., 1883. *Meteorische Partikel im Tiefseeschlamm.* Sitzungsberichten der niederrheinischen Gesellschaft für Natur- und Heilkunde, 1-2, Bonn (667, XI).
- Lasaulx von A., 1884. *Ueber das Meteoreisen von Santa Rosa, Columbien 1810.* Verhandlungen der Niederrheinischen Gesellschaft für Natur- und Heilkunde, 7-18, Bonn (668, XI).
- Laspeyres H., 1887. *Meteoriten vom Dorfe Djati-Pengilon innerhalb des Distriktes Gendigan, im Bezirk Ngawi in der Residenz Madioen auf der Insel Java.* Sitzungsberichten der Niederrheinischen Gesellschaft für Natur- und Heilkunde in Bonn, 247-253, Bonn (680, XI).
- Laspeyres H., 1894. *Die Meteoriten-Sammlung der Universität Bonn. I. Abschnitt: Meteorsteine.* Mittheilungen aus dem Mineralogischen Institut der Universität Bonn, IX, 83-156, Bonn (652, X).
- Laspeyres H., 1895. *Die Meteoriten-Sammlung der Universität Bonn. II. Abschnitt: Meteoreisen.* Mittheilungen aus dem Mineralogischen Institut der Universität Bonn, IX, 141-220, Bonn (653, X).
- Laspeyres H., 1897. *Die steinigen Gemengtheileim Meteoreisen von Toluca in Mexico.* Mittheilungen aus dem Mineralogischen Museum der Universität Bonn, VIII, 586-600, Bonn (1696, XXXIII).
- Laspeyres H., Kaiser E., 1895. *Quarz- und Zirkonkrystalle im meteoreisen von Toluca in Mexico.* Mittheilungen aus dem Mineralogischen Museum der Universität Bonn - VI. Theil - Zeitschrift für Krystallographie ecc., XXIV, 5, 485-493, Leipzig (618, X).
- Laspeyres H., Kaiser E., 1895. *Chemische Zusammensetzung des meteoreisen von Werchne Udinsk in Sibirien.* Mittheilungen aus dem Mineralogischen Museum der Universität Bonn - VI. Theil - Zeitschrift für Krystallographie ecc., XXIV, 5, 493-494, Leipzig (618, X).
- Laspeyres H., Kaiser E. 1895. *Die Silicate in Meteoreisen von Netschaëvo in Russland.* Mittheilungen aus dem Mineralogischen Museum der Universität Bonn - VI. Theil - Zeitschrift für Krystallographie ecc., XXIV, 5, 495-496, Leipzig (618, X).
- Linck G., 1899. *Der Meteorit (Chondrit) von Meuselbach i. Th.* Annalen des K.K. Naturhistorischen Hofmuseums, XIII, 2-3, 103-114, Vienna (2625, LVIII).
- Marangio U.E.M., 1935. *Le meteoriti.* Dissertation thesis, Università di Pisa, Pisa (8831, CLXX).

- Merrill G.P., 1888. *On a new meteorite from the San Emigdio Range, San Bernardino County, California.* National Museum, Washington, 490-491, Washington (1223, XXII).
- Merrill G.P., 1888. *On the S. Emigdio meteorite.* Proceeding of United States National Museum, 161-167, New York (1704, XXXIII).
- Merrill G.P., 1896. *On the composition and structure of the Hamblem Co., Tennessee meteorite.* New Haven (701, XII, missing).
- Merrill G.P., 1901. *On a stony meteorite, which fell near Felix, Perry County, Alabama, May 15, 1900.* Proceedings of the United States National Museum, XXIV, 193-198, Washington (3138, LXV).
- Merrill G.P., 1902. *A newly found meteorite from Admire, Lyon County, Kansas.* Proceedings of the United States National Museum, XXIV, 907-913, Washington (3295, LXVIII).
- Merrill G.P., 1906. *On a new stony meteorite from Modoc, Scott County, Kansas.* American Journal of Science, XXI, 356-360, New Haven (3849, LXXVI).
- Merrill G.P., Stokes H.N., 1900. *A new stony meteorite from Allegan, Michigan, and a new iron meteorite from Mart, Texas.* Proceedings of the Washington Academy of Sciences, II, 41-68, Washington (2773, LIX).
- Millosevich F., 1928. *Le meteoriti del Museo Mineralogico dell'Università di Roma.* 38 pp., Roma (7493, CXLVII).
- Palache C., 1926. *Meteorites in the Mineralogical Museum of Harvard University.* American Journal of Science, XII, 136-150, New Haven (7257, CXLIII).
- Palache C., 1926. *Catalogue of the collection of meteorites in the Mineralogical Museum of Harvard University.* Proceedings of the American Academy of Arts and Sciences, 61, 6, 151-159, Boston (7258, CXLIII).
- Palache C., Lonsdale J.T., 1927. *The Tulia meteorite, Swisher County, Texas.* American Journal of Science, XIII, 353-359, New Haven (7251, CXLIII).
- Palache C., Shannon E.V., 1928. *A new meteorite from Washington County, Colorado.* Menasha (7433, CXLVI, missing).
- Palache C., Gonyer F.A., 1930. *A new iron meteorite from Carbo, Mexico.* The American Mineralogist, 15, 388-389 (7990, CLV).
- Palache C., Gonyer F.A., 1932. *Two new iron meteorites from Chile and Texas.* The American Mineralogist, 17, 357-360 (8358, CLXI).
- Prior G.T., 1912. *The meteoric stone of El Nakhla El Baharia (Egypt).* Mineralogical Magazine, XVI, 76, 274-281, London (5170, CII).
- Prior G.T., 1913. *The meteoric stones of Baroti, Punjab, India, and Witterkrantz, South Africa - On the remarkable similarity in chemical and mineral composition of chondritic meteoric stones.* Mineralogical Magazine, XVII, 78, 22-38, London (5214, CIII).
- Prior G.T., 1914. *The meteorites of Uwet, Kota Kota, and Angela: re-determination of nickel and iron in the Baroti and Wittekrantz meteoric stones.* Mineralogical Magazine, XVII, 80, 127-134, London (5561, CIX).
- Prior G.T., 1916. *The meteoric stones of Launton, Warbreccan, Cronstad, Daniel's Kuil, Khairpur, and Soko-Banja - On the genetic relationship and classification of Meteorites.* Mineralogical Magazine, XVIII, 83, 1-44, London (5560, CIX).
- Rinne F., 1897. *Kugelrunde Eiskristalle und Chondren von Meteoriten.* Neues Jahrbuch für Mineralogie ecc., I, 259-261, Stuttgart (1818, XXXV).
- Rinne F., 1905. *Physikalisch-chemische Bemerkungen über technisches und meteorisches Eisen.* Neuen Jahrbuch für Mineralogie, Geologie und Paläontologie, I, 122-158, Stuttgart (3723, LXXV).
- Rinne F., 1910. *Ein Meteoreisen mit Oktaeder- und Würfelbau (Tessera-Oktaedrit).* Neuen Jahrbuch für Mineralogie, Geologie und Paläontologie, I, 115-117, Stuttgart (4690, XCIII).
- Rinne F., Boeke H.E., 1907. *El Inca, ein neues Meteoreisen.* Neuen Jahrbuch für Mineralogie, Geologie und Paläontologie, 227-255, Stuttgart (3983, LXXIX).
- Rath vom G., 1875. *Die Meteoriten des naturhistorischen Museums der Universität Bonn.* 24 pp., Bonn (672, XI).
- Rook G., 1933. *Le meteoriti.* Dissertation thesis, Università di Pisa, Pisa (8655, CLXVI, missing).
- Salomon W., 1930. *Historisches über Meteoriten bei Siena (1794).* Mitteilungen zur Geschichte der Medizin u. der Naturwissenschaften, 29, 2, Heidelberg (8126, CLVII).
- Semsey von A., 1886. *Die Meteoritensammlung des Ungarischen National-Museum in Budapest.* 1-14, Budapest (8012, CLV).
- Silvestri O., 1880. *Sopra un pulviscolo meteorico, contenente abbondante quantità di ferro metallico, piovuto a Catania la notte dal 29 al 30 marzo 1880.* Reale Accademia dei Lincei, IV, 1-4, Rome (6352, CXXVII).
- Sinisi R., 1934. *Le meteoriti.* Dissertation thesis, Università di Pisa, Pisa (8627, CLXVI, missing).
- Spencer L.J., 1932. *Hoba (South-West Africa), the largest known meteorite.* Mineralogical Magazine, XXIII, 136, 1-18, London (8303, CLX).
- Spencer L.J., 1932. *A new pallasite from Alice Springs, Central Australia.* Mineralogical Magazine, XXIII, 136, 38-42, London (8302, CLX).
- Spencer L.J., 1933. *A new meteoric iron found near Kyancutta, South Australia.* Mineralogical Magazine, XXIII, 140, 329-333, London (8533, CLXIV).
- Spencer L.J., 1933. *Meteoric iron and silica-glass from the meteorite craters of Henbury (Central Australia) and Wabar (Arabia).* Mineralogical Magazine, XXI-II, 142, 387-404, London (8534, CLXIV).

- Stürtz B., 1885. *Meteoriten-Sammlung der verstorbenen Herrn Professor Dr. von Bambauer in Haarlem*. 8 pp., Bonn (625, X).
- Tassin W., 1902. *Descriptive catalogue of the meteorite collection in the United States National Museum to January 1, 1902*. Report of the United States National Museum for 1900, 671-698, Washington (3296, LXVIII).
- Tassin W., 1902. *The Casas Grandes Meteorite*. Proceedings of the United States National Museum, XXV, 69-74, Washington (3334, LXIX).
- Tschermak G. & Lump E., 1871. *Der Meteorit von Shergotty*. Mineralogischen Mittheilungen Notizen, 55-57, Vienna (2011, XLVI).
- Weinschenk E., 1899. *Zur Classification der Meteoriten*. Sitzungsberichten der Mathematisch-Physikalischen Classe der k. Bayer. Akad. D. Wiss., XXIX, II, 137-145, München (2897, LX).
- Winchell N.H., 1897. *The Fisher meteorite*. Chemical and mineral composition. The American Mineralogist, XX, 5, 316-318, Minneapolis (1734, XXXIV).
- Wülfing E.A., 1894. *Verbreitung und Wert der in Sammlungen aufbewahrten Meteoriten*. Jahresheften des Vereins für Vaterlande Naturkunde in Württemberg, 1-21, Stuttgart (2858, LX).
- Wülfing E.A., 1897. *Die Meteoriten in Sammlungen und ihre Literatur* (Advertisement), Tübingen (2979, LXII).
- Wülfing E.A., 1899. *Ueber den Tauschwert der Meteoriten*. Neuen Jahrbuch für Mineralogie, Geologie und Palaeontologie, II, 115-118, Stuttgart (2466, XXXVII).

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#### REFERENCES

- Arcangeli G., 1903. Alla Memoria del Prof. Antonio D'Achiardi. Nistri, Pisa, 29 pp.
- Bonatti S., 1946. Giovanni D'Achiardi. *Atti Soc. Tosc. Sci. Nat.* LIII: 1-16.
- Burke J.G., 1986. Cosmic Debris: Meteorites in History. University of California Press, Berkeley, 445 pp.
- Grady M.M., 2000. Catalogue of meteorites. Fifth edition (revised and enlarged). Cambridge University Press, Cambridge, U.K., 689 pp.
- Perchiazzi N., D'Orazio M., Folco L., 2004. The meteorite collection of Pisa University's Museo di Storia Naturale, Italy. *Meteor. Planet. Sci.* 39, 8, Suppl., A171-A176.

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