

Introduction

Introductory Remarks

The introduction to previous editions of the “Dictionary” started with statements deeply influenced by the breathtaking evolution of minor planet astronomy during the last decades. These sentences, characterized by a tone of disbelief and astonishment about the explosive dynamism of this field, hold more today than ever: “In a period when discoveries flourish, more and more minor planets are being discovered; it is inevitable that this dictionary can be no more than an inventory of the situation at this moment. A compilation of this nature is by definition bound to be out of date before it appears in print. There are, however, two reasons that justify this effort. After having named more than 16,000 minor planets, a historic goal was achieved. It seems reasonable to avail ourselves of this opportunity to summarize an interesting aspect of this narrow branch of astronomy during the past two centuries. The second reason is a purely technical one: we now are forced for the first time to handle the enormous amount of minor-planet data in two volumes.” The actual dimensions, however, assumed horrendous proportions. Triggered by gigantically successful automated CCD surveys and the establishment of even more powerful computing facilities combined with the dedication of their users, the situation changed dramatically anew. The use of the term “historic,” therefore, should be reconsidered.

Compared with the figures in the first edition of the “Dictionary” in 1992, the number of minor planets has increased by a factor of more than 120! Obviously, this greatly influences our editorial policy. Whereas previous editions compiled the discovery data of all already *numbered* planets, we are forced since the 5th edition to go back to the roots, i.e., we must limit ourselves to the compilation of all *named* asteroids in order to fulfill the book’s title.

At first glance, this book is simply a compilation of data. For the historians of our science, however, the naming of an object is a complex and revealing matter. Piazzi’s discovery of Ceres was the beginning of an absolutely new branch of science that gave an extraordinary impulse to the development of mathematical tools for astronomy. The brilliant work in the period between Gauss and Poincaré made celestial mechanics prosper to the extent that it is now applied in many very different branches of science. The entire second half of the nineteenth century was characterized by intensive observational and numerical work on minor planets. As the importance of

this field decreased, the process of name giving changed in a very obvious way. Mystification changed to profanation. The previously dramatic and rare discovery of new members of our Solar System changed to the finding of ever fainter and smaller objects in large numbers. These changes were reflected in the nomenclature of minor planets.

Interest in questions of nomenclature originated not only from the perspective of cultural history but also from a very pragmatic consideration. The large number of new discoveries made it more and more difficult to give a newly numbered planet an adequate name. Recently the same name was given to two different minor planets; an oversight that was promptly corrected. There are, unfortunately, several cases of different names for the same fact, e.g. (639)-(68), (4769)-(646), (2889)-(290), (3199)-(1068), (11040)-(635), and (3053)-(263), respectively. Such synonymous minor planet names are listed in Appendix 12.

The Minor Planet Names Committee (MPNC) of the IAU Commission 20 – in 1994 enlarged to the Small Bodies Names Committee (SBNC), renamed in 1997 to the Committee on Small Bodies Nomenclature (CSBN), since 2015 the Working Group on Small Bodies Nomenclature (WG SBN) of Division F – was founded in order to study the proposals for names (of minor planets and comets) and to investigate whether the suggested names do not resemble too strongly any other names previously assigned – a work that is not always easy to manage! Discoverers of minor planets might also find this book useful. On the other hand, they will still have to seek advice in the literature of classical antiquity if, for instance, a newly discovered Trojan is to be named. Some people have already had the awkward vision of a ‘first Trojan soldier’, ‘second Trojan soldier’, etc. We can but hope that this will not become customary!

The multitude of newly discovered new classes of minor planets forced astronomers to look for generic names like the Trojan example. Much turmoil developed from the discovery of many members of the Transneptunian (or Kuiper) Belt. In view of this situation the proposal to incorporate Planet X, better known as planet Pluto, into this new class by assigning it the number (10000) produced fierce debates. Overwhelmingly, the astronomical community voted in favor of this change but the proposal was rejected by the IAU Secretariat. The result (134340) Pluto is very easy to remember! Nevertheless, some Kuiper Belt Objects (KBOs) were introduced into groups of generic names. The clas-

sical KBOs (or ‘cubewanos’) were given names of the creation gods from classical mythology and names of the underworld gods were used for the so-called ‘plutinos.’ The naming of the class of ‘centaurs,’ however, soon will reach the unpleasant situation of a rather limited supply of classical names. In 2002 the proposal from the Dutch science journalist Govert Schilling (b. 1956) to use names from the novels of the English author John Ronald Reuel Tolkien (1892-1973) was newly discussed for the naming of the so-called ‘scattered-disc objects’ among the KBOs. Experiences from the Pluto debate, however, raised these discussions into the frame of a political decision which may prevent a quick resolution. Problems in nomenclature seem to grow at least proportionally with the necessity of naming itself.

Everyone has their own specific ideas as to what to include in a book and what not to include. It is not easy to reach a general consensus. We have mainly used original quotations in order that the character of this compilation be evident. From number (1565) Lemaître, which was the first object to be numbered after World War II, this policy has been applied to every minor planet. From that time onward, the Minor Planet Center – then in Cincinnati, Ohio, now in Cambridge, Massachusetts – took the task of nomenclature over from the Astronomisches Rechen-Institut (ARD) – then in Berlin, now in Heidelberg. The *Minor Planet Circulars* (MPC) – since May 14, 2021, the *WGSBN Bulletin* – report not only on new name assignments but also on many names that have since replaced for numbers earlier than (1565). The names of these older planets were usually taken from the lists of Herget (1955, 1968). The explanations of these older names could, in most cases, be found in the contemporary literature, including the *Astronomische Nachrichten* (AN), the *Zirkulare des Rechen-Instituts* (RI), etc. These explanations often have the character of an official announcement. These older explanations differ widely regarding accuracy, completeness, and the aesthetic use of language; thus they reveal much about the proposer of the name, who is usually the discoverer, and his or

her cultural background. In this compilation we deviate from the English language in only those few cases in which important original contributions exist.

The minor-planet sky, like the surface of the Moon or of Mars, has become a sort of ‘astronomer’s cemetery’. When a minor planet has been named for a deceased astronomer, we have supplemented the relevant name quotations with biographical data. References given to published obituaries may be helpful for detailed study. Many names are correlated in various ways, so the reader will find cross references throughout the catalogue. In this way, entire genealogical tables could be set up; there is ample evidence for specific preferences on the part of particular name proposers. Comparisons show a change in the ‘Zeitgeist’, and there are, also more or less subtle allusions to events of world-wide importance. From the very beginning of this project, it was clear that not only the names and their explanations should be mentioned but also the most important circumstances under which the discoveries were made. There is only a slight correlation between the discovery date of a minor planet and its definitive number. In many cases, an object could be numbered only some decades after its discovery; and more time might have elapsed before a name was assigned to the numbered minor planet. It must furthermore be considered that in many cases the discoverer is not the patron who names the object. All these facts must be considered when one wants to use this book not only as a mere dictionary, but, as a resource on cultural and astronomical history.

The author and colleagues who were involved in compiling this dictionary took pains to handle the vast amount of data carefully. Nevertheless there may remain inaccuracies or omissions for which the author accepts the blame. In future the remaining gaps will be filled and many new names added. We are convinced that there will be more studies on minor planet names with meanings so far unknown

	or		(1) Ceres		(9) Metis		(17) Thetis
	or		(2) Pallas		(10) Hygeia		(26) Proserpina ²
	or		(3) Juno		(11) Parthenope		(28) Bellona
	or		(4) Vesta		(12) Victoria ¹		(29) Amphitrite
	or		(5) Astraea		(13) Egeria		(35) Leukothea
			(6) Hebe		(14) Irene		(37) Fides
			(7) Iris		(15) Eunomia		
			(8) Flora		(16) Psyche		

¹ The given name Clio was changed into (12) Victoria.
² The erroneously assigned name (32) Pomona was changed into (26) Proserpina.

The minor planet symbols are adopted from Webster’s *A Dictionary of the English Language*, G. & C. Merriam & Co., Springfield, MA, USA, p. 1780 (1884). (Courtesy of R. W. Sinnott, Cambridge, MA, USA)

or doubtful, plus further research on the existing nomenclature. We would welcome any corrections or comments from the users of this compilation.

Minor Planet Designations

The choice of an appropriate name for a celestial body presents difficulties as the total number of objects increases rapidly and considerably. Eventually one is forced to introduce a numbering system. Very large numbers of objects, however, require the simultaneous use of numbers and names in order to avoid mistakes. In particular, minor-planet nomenclature requires such a procedure.

Until the middle of the nineteenth century, nomenclature problems did not exist. Ceres, Pallas, Juno, and Vesta were mentioned in the scientific literature without associated numbers. They were handled the same way as the major planets known at the time. Problems only arose in about 1850 with the dramatic increase of minor-planet discoveries. It became customary to assign a special symbol to the name and number of a minor planet, following the custom of the traditional symbols associated with the major planets. This procedure, however, soon failed. On the one hand, it was difficult to print these symbols; on the other hand, it soon became impossible to remember all the different symbols assigned. It seems that Luther (1855) was the last astronomer who assigned a special symbol to a minor planet, namely to (37) Fides.

In place of symbols, the system of ordinal numbers was introduced. Ferguson (1852) initiated this development with (16) Psyche. He used an encircled number rather than setting the number in parentheses as is practiced today. Obviously, Ferguson adopted this style of designation from Encke (1851) who declared in the *BAJ* for 1854: “Endlich füge ich noch hinzu, daß bei der Verwicklung und Schwierigkeit der neueren Planetenzeichen ich mir erlaubt habe, statt der Zeichen Zahlen in einen Kreis eingeschlossen einzuführen.” [Finally, I want to add that – in view of the complications and difficulties with the recently used planetary symbols – I took the liberty to introduce encircled numbers instead of symbols.] Wolf (1892) stated that he and Gould introduced the encircled numbers as early as 1851.

A number was assigned by the editor of the *AN* upon publishing the discovery of a minor planet. This custom soon resulted in awkward consequences. By the end of 1857, some fifty planets had been discovered – on October 9th Ferguson had detected (50) Virginia. The numbering, until then a chronological one, became confused because Goldschmidt had already found a new planet on September 9th, which was later named (56) Melete. This wasn't the first time the numbering method had been criticized. Laugier (1859) proposed that the numbering should be absolutely chronological. Indeed, new discoveries were given names very soon, but as for the number, the chronological order was to be fol-

lowed strictly. Foerster (1861) gave a rather sarcastic outline of this policy of the *Berliner Astronomisches Jahrbuch* (*BAJ*): “Was die Benennungen der Planeten betrifft, so werden dieselben von Berlin aus vom Planeten (60) an nur mit Nummern bezeichnet werden ... Die Namensgebung könnte fortan nur eine Quelle von Lächerlichkeiten werden.” [As for naming planets, Berlin defines them by numbers only from planet (60) onwards ... The naming process could become a source of ridicule.]

The problems of nomenclature and numbering were further complicated by the question of who was the true discoverer and who had the right to propose a name and act as the ‘patron.’ Wolf (1859) wrote a noteworthy comment: “So wenig man Flamsteed die Entdeckung des Uranus, oder Lalande die Entdeckung Neptun's zugeschrieben hat, so wenig darf man Goldschmidt die Entdeckung von (56) zuschreiben, – nicht wer zuerst gesehen oder beobachtet, sondern wer zuerst erkannt hat, ist der Entdecker.” [The discovery of Uranus cannot be ascribed to Flamsteed, the one of Neptune not to Lalande, accordingly you cannot ascribe the discovery of (56) to Goldschmidt, – the discoverer of a planet is not the one who first saw or observed it, but the one who first recognized it as a new object.] This was the first time that the patronage of a new discovery could be transferred to the person who computed the orbit if the first observer had not realized the nature of the object. Nowadays, this problem remains of some importance.

The sharp increase in discovery rate mandated that the *BAJ* or the *AN* assign numbers promptly. Although the basic idea of chronological numbering remained, other deficiencies in the nomenclature system soon emerged. In quite a few cases subsequent confirming observations of a ‘discovery’ could not be made; hence the number of spurious minor planets accumulated. What should then be done with the numbers which had been assigned to them? Tietjen, then editor of the *BAJ*, proposed a way out of this dilemma. Krueger (1892) had suggested that all subsequent new discoveries should be given a provisional designation: “...der Herausgeber der Astronomischen Nachrichten wird die neuen Planeten von jetzt an zunächst nur mit einer provisorischen Bezeichnung, 18.. A, B, C, ..., nach dem Datum der Anmeldung bei der Centralstelle für Astronomische Telegramme versehen. Die definitive Numerierung wird der Herausgeber des Berliner Astronomischen Jahrbuchs erst später zu geeigneter Zeit vornehmen und hierbei alle diejenigen Planeten, bei denen ein genügendes Material zur Berechnung der Bahnelemente nicht vorhanden sein sollte, von der Numerierung ausschließen.” [From now on, the editor of the *AN* will first give the new planet a provisional designation, 18.. A, B, C, ..., according to the date of registration at the Central Bureau for Astronomical Telegrams. The definitive number will be given only later by the editor of the *BAJ*. This procedure will make it possible to exclude all planets from numbering whose orbital elements could not be calculated due to a

lack of material.] Only one year later, in 1893, it was realized that one single capital letter in the provisional designation was not enough, so it was decided to start at the beginning of the alphabet again. That is, 1893 Z was followed by 1893 AA, 1893 AB, and so on. Krueger (1893) noted that the assignment of the letter should be done without respect to the interruption by the beginning of a new year. During World War I some additional systems for provisional designations were introduced, raising new problems. For example, the astronomers in Simeis did not have a regular transmission line during this time, and found it necessary to introduce their own provisional numbering.

The solution of the designation problem goes back to a suggestion by Bower (1924) and this system is still in use: “To produce homogeneity of nomenclature, the following suggestion is made. Assign as a provisional designation, the year of discovery and two capital letters. The first letter will indicate the time in the year of discovery; A, the interval Jan. 1-15, B Jan. 16-31, C Febr. 1-15, D Febr. 16-29, etc. where the letter I is omitted and the letter Z is unused. The second letter will indicate the order in the discovery interval that notice came to the Recheninstitut; A = first, B = second, etc. This designation is of the same brevity as the one most used, accurately indicates time of discovery, approximately indicates the right ascension at discovery, and has a sufficient expansibility to make unnecessary more than one system of designation.” The Berlin Recheninstitut adopted this suggestion and, since 1925, has acted accordingly. Kopff (1924) suggested the following refinement to the system of Bower: “Diese Vorschläge sind noch dahin zu ergänzen, daß bei Entdeckung von mehr als 25 Planeten in einem halben Monat, ein Fall, der allerdings kaum vorkommt, das Alphabet an zweiter Stelle von neuem wieder zu laufen beginnt unter Hinzufügung des Index 1, 2 ... an den zweiten Buchstaben; so wäre z.B. der 26. Planet in der ersten Januarhälfte 1925 mit 1925 AA₁, der 27. mit 1925 AB₁, der 51. mit 1925 AA₂ zu bezeichnen.” [These suggestions are to be complemented as follows: In the improbable case (*sic!*) of more than 25 discoveries within half a month, the alphabet for the second letter starts running once more followed by an index number; so the 26th planet in the first half of January 1925 should be designated 1925 AA₁, the 27th planet 1925 AB₁, the 51st planet 1925 AA₂.] In this way the demand for a chronological ordering was finally met. The numbered planet with the currently largest index number is (544981) K14Ws5F = 2014 WF₅₄₅, denoting the 13,631th principal designation assigned in the second half of November 2014! This dictionary lists the principal designations following the new-style system with any entry.

The currently largest index number is K15Bz9V = 2015 BV₆₁₉ denoting the 15,496th principal designation assigned in the second half of January 2015 – this planet is not yet numbered – there exist only two observations of this object!

In the course of time, a permanent number was given only if a certain number of observations, appropriately distributed over time, was assured. The ARI assigned a definitive number in practically all cases if a first elliptical orbit from three observations yielded sufficiently small residuals for all observations not taken into account. Herget (1952) sharpened these conditions considerably: “An unnumbered minor planet will be assigned a permanent number when elements have been derived which: a) depend upon observations in at least two oppositions, b) include perturbations, and c) produce satisfactory residuals for all known observations. Condition a) will not be required if the perihelion distance is less than 1.67 a.u.”. During the decades following Herget’s refinements, the conditions became even stricter. Except for very unusual, earth-approaching planets, observations from three oppositions were demanded, including one longer-observed arc in one opposition. After having numbered a new record of 384 minor planets in 1990, Marsden (1991) even announced: “However, the general increase in the accuracy of the orbits of the numbered minor planets would seem to dictate that the standards for new numberings should be more stringent than hitherto. Although earth-approaching objects may be numbered after two oppositions and uniformly well-observed objects after three, it seems not unreasonable generally to delay numbering until there are four or even more oppositions...” Precise quantitative guidelines are discussed by Marsden (1996).

Evolution of Naming Rules

Let us now turn to the historical evolution of naming minor planets. Ceres, Pallas, Juno, and Vesta are terms taken from classical mythology. With the increase of discoveries beginning around 1850 it seemed only natural to follow these examples. The name given to the early minor planet (12) Victoria, however, was the first of many to initiate a long controversy. One of the most pugnacious astronomers in this field was the founder of the Bilk Observatory near Düsseldorf, Luther (1861), who vehemently adhered to classical names. He dictated: “So lange als für andere Himmelskörper, z.B. für Sterne, Cometen, die Trabanten des Saturn und Uranus und sogar für die Mondgebirge besondere Namen für zweckmäßig erachtet werden, dürfte es auch zweckmäßig sein, die auf der classischen Mythologie beruhenden Planeten-Namen beizubehalten, indem die alleinige Bezeichnung durch Nummern leicht eine ergiebige Quelle von Fehlern und Verwechslungen werden könnte. Unclassische Namen sind freilich ... auf die Dauer nicht haltbar, so daß es rathsam sein wird, statt solcher ausschließlich die Nummern zu gebrauchen.” [As long as people believe it appropriate to give special names to celestial bodies like stars, comets, the moons of Saturn and Uranus and even for the mountains of the Moon, it seems also appropriate to adhere to names from classical mythology, since a mere number could easily lead to mistakes and misun-

derstandings. Unclassical names, however, ... are not tenable in long run; instead of such an alternative, one should rather turn to the numbers alone.] His demand culminated in the rule: "Classische Namen werden gebraucht, unclassische verworfen; für die unclassischen Namen haben die Berechner das Recht, classische Namen zu substituieren." [Classical names are necessary, unclassical names are rejected; (orbit) computers have the right to substitute classical names for unclassical ones.]

This dogmatic attitude was immediately and strongly criticized. Steinheil (1861) noted smugly: "Welchen Vortheil aber soll es bieten ... nur classische Namen zu wählen? Sollen uns die neuen Planeten daran erinnern, daß wir einst im Gymnasium gewesen sind? Hat die Astronomie der Philologie so viel zu verdanken, daß sie keiner anderen Erinnerung, als dieser, Raum geben soll? Ich glaube nicht, daß dieses nachgewiesen werden kann." [What advantage should there be ... in choosing only classical names? Are the new planets to remind us of having gone to a classical secondary school? Does astronomy owe so much to philology as to remember nothing but this? I do not think that this can be proved.] And he goes on: "Herr Dr. Luther scheint aber auch die practische Seite nicht genau erwogen zu haben, denn wenn zwei oder mehr Rechner einen Planeten bearbeiten, welcher soll das Recht der Umtaufe haben, oder soll es allen bleiben?" [It seems that Dr. Luther has not taken into account the practical side of his demand. Who should have the right to substitute unclassical names if two or even more orbit computers are working on the same planet; each of them?] Attempts to give up names entirely in favor of only numbering failed as well. Goldschmidt (1861) agreed to the defenders of a classical line such as the one taken by Luther, Hind, and the editor of the AN, Peters: "Ich stimme ... gegen die Abschaffung der Namen, da die größten Verwirrungen daraus entstehen würden. Haben sich einige missfällige Namen eingestellt, so ist es nicht der Mühe werth, den Patten deshalb Verdruß zu machen. An einem Planeten ist alles Ziffer, das einzige, was poetisch bleibt, ist der Name, und der soll auch wieder Ziffer werden, ohne daß eigentlich eine besondere Ursache dazu da wäre." [I vote ... against the repeal of names, which would cause great confusion. Some displeasing names are not worth the trouble of annoying their patrons. A planet is all number – the name is the only poetic part of it, and this would now become again a number without there being a real cause to do so.] Peters (1861) tried to put an end to this controversy by standing on his authority as editor of the AN: "... glaube ich den Wunsch äußern zu dürfen, dass die Controverse über den, in wissenschaftlicher Beziehung unerheblichen Gegenstand, in diesen Blättern nicht weiter geführt werde." [... I do not like this controversy, which being of no scientific importance will not be discussed further in this journal.]

The determination of the classicists remain unbroken, however. A decade and a half later Luther

(1878) attacked again: "In Bezug auf die neuerdings wieder allzubunt werdenden Benennungen ... wäre es zu Gunsten der Würde der Wissenschaft gewiß sehr zu wünschen, daß die Entdecker dem älteren Brauche gemäß vorzugsweise klassisch mythologische Namen wählen und neuere Anspielungen jeglicher Art vermeiden möchten... Durch strengeres Festhalten an den Namen des klassischen Alterthums ... wird es hoffentlich gelingen, die wachsende Schaar der kleinen Planeten vor zunehmender Gleichgültigkeit zu bewahren." [The names having now become a more than colorful mixture ... it seems very advisable to return to the old usage of preferring classical, mythological names. Allusions of any kind should be avoided – for the sake of the honor of science... A stricter adherence to classical names will hopefully help to shield the growing number of minor planets from increasing indifference.] Bruhns (1878) concurred with Luther: "... da einmal classische Namen üblich und allgemein adoptirt sind, ist es das Vorteilhafteste, von dem Gebrauche nicht abzuweichen und alle Namen, welche sich auf lebende Personen oder auf vorübergehende Ereignisse beziehen, zu vermeiden... Nur durch die Wahl klassischer Namen wird es auch ferner möglich sein, den gewählten Namen allgemeine Anerkennung zu verschaffen." [... classical names being in use and commonly adopted, it seems to be best not to deviate from this usage and to avoid all names referring to living people or current events ... Only the choice of classical names will further win general recognition.] At the end of the 19th century Holden (1896) still denounced some unclassical, female names by reproaching: "Many of them, at least, read like the Christian names in a girl's school."

After the number of minor planets had reached some 400, however, the classical line could no longer be maintained. The rule was restricted to the choice of female names. Bauschinger (1899) gave the opinion of the ARI by threatening: "Es ist Anlaß gegeben die Herren Entdecker zu ersuchen, bei der Namensgebung der kleinen Planeten von dem herkömmlichen Gebrauch, weibliche Namen zu wählen, nicht abzugehen; es ist dieser Gebrauch bisher nur einmal aus guten Gründen bei (433) Eros durchbrochen worden. Männliche Personennamen werden im Berliner Jahrbuch keine Aufnahme finden." [There is reason to ask the discoverers not to deviate from the rule of choosing female names; so far this rule has only once been offended – and for a good reason – with (433) Eros. Male names will not be accepted in the BAJ.] Kreutz (1899) agreed and concluded that male names would not be admitted by the AN. This policy could, of course, not be long maintained. First, names of cities were given the feminine suffix 'a' or 'ia', until finally more and more male names were transformed in this way to follow the rule. This was practiced for a long time. While an exact date is unknown, World War II seems to have ended this procedure.

At the beginning of the 20th century the nature of the nomenclature problem changed notably. First there

was a gradual abandoning of classical names – the large numbers forced a pragmatic approach. The importance of naming, however, has never been denied. Bauschinger (1901) argued for the policy of the ARI as expressed in the BAJ, edited by the Recheninstitut, as well as in the AN: “... darf nicht übersehen werden, daß auch die Namen ihre volle Berechtigung haben. Abgesehen davon, daß ein durch 100 Jahre üblicher Gebrauch nicht ohne Nothwendigkeit aufgegeben werden sollte, bieten die Namen ein werthvolles mnemotechnisches Huelfsmittel ... Nummern und Buchstaben werden leicht verwechselt, der Namen dagegen prägt sich mit der ganzen Geschichte des Planeten leicht dem Gedächtnis ein.” [...it may not be ignored that names have their justification, too. Other than the fact that a usage that has been practiced for a century should not be given up without necessity, names offer a good mnemonic tool ... numbers and letters are mixed up easily; a name, however, stamps upon the memory all the history of a planet.]

There was an appeal made to the discoverers to make use of their naming rights within a reasonable span of time. On behalf of the ARI, Bauschinger asserted that the right of giving a name should be withdrawn from the discoverer if a name had not been assigned to a planet after observations at a second opposition. This system has worked until the present time. In order to make this dictionary as complete as possible, the Minor Planet Center gave the order in MPC 17 249 (1990 Dec. 2) that the resolution of IAU Commission 20 from 1979 would be applied: “... if the discoverer does not exercise his established right within ten years after the numbering of a minor planet, that right will be lost.” As a consequence of the adoption of this resolution, the discoverers’ rights of naming all planets with a number lower than (2378) was terminated effective 1991 May 1. A similar notice was announced in MPC 22 089 (1993 June 4) in order to support the second edition of this dictionary: “... This applies to minor planets up to (2892), for which, under the “ten-year rule”, discoverers will lose their naming privileges.” For the benefit of the third edition this procedure was announced once more in MPC 26 205 (1996 Jan. 5) and applied now to all minor planets up to (3414). The Editorial Notice in MPC 33 151 (1998 Dec. 8) announced a similar procedure for the fourth edition which “... particularly applies to minor planets up to (4044).”

After the World War II, the rule of assigning names with female endings was finally given up. The note in MPC 837 leaves no doubt on this matter: “The custom of attaching feminine endings to masculine names has had numerous exceptions in the past. Names which are submitted will not be rejected or modified if they are masculine.” This rule still exists, although quite recently some exceptions have again followed the traditional rules.

Compulsory regulations concerning the assignment of names were first given by Herget (1952) in MPC 837. The Minor Planet Center retained the decisive

authority: “The discoverer may propose the name for each numbered planet, and this name shall be recognized only after it has been announced in the MPC. The announcement shall also contain an explanation of the significance of the name and the reason for assigning the honor.” Without this rule, the meaning of many of the names and their patrons would tend to vanish in the dark of the history of astronomy. At the same time as announcing the regulations, Herget justified this procedure as well as his liberal attitude towards the assignment of names: “The principal justification for exercising control over the assignment of names is to avoid names which are too similar to others as to cause confusion, and to prevent names which are deliberately offensive or in bad taste. In the past, names have been rejected on the grounds of political connotations. This policy will not be continued in the future... The discoverer is usually motivated, with complete sincerity, to assign what he considers an honor, and his privilege should not be restricted because someone else holds a different opinion.”

Herget’s views did not remain unchallenged. Occasionally there were discussions about the admissibility of suggested names. These discussions were mainly about questions of taste and about eventual political implications. Regulations were discussed and resolutions were passed in various IAU General Assemblies. The Minor Planet Names Committee is the decisive authority. Before 1991, the Names Committee was composed of the President and Vice President of Commission 20 and the Director of the Minor Planet Center. When controversies arise the proposer of a name should have the right to appeal to the entire Commission 20. This right has been exercised in several cases, with differing results. The regulation in use at the present time was passed at the 1985 IAU General Assembly held in New Delhi. The resolution, published e.g. in MPC 10 194 (1985 Dec. 27), reads as follows: “Names proposed for minor planets will not be accepted if, in the opinion of the Minor Planet Names Committee, they are too nearly similar to those of other minor or major planets or natural satellites, or are in questionable taste. Names should be pronounceable, preferably expressible as a single word, and no more than sixteen characters long. Names glorifying individuals or events principally known for their political or military activities or implications are considered unsuitable unless at least one hundred years have elapsed since the individuals died or the events took place. Objects involved with the Jovian triangular libration points should be named in accordance with the tradition of honoring heroes of the Trojan War. In a disputed case, the proposer may appeal the committee’s decision at a general meeting of Commission 20, provided that due written notice is given to the President of the Commission.” In view of the increasing problems in the field of nomenclature the suggestion to enlarge the Minor Planet Names Committee to seven members was accepted at the 1991 IAU General Assembly held in Buenos Aires. Subsequent actions by Commis-

sion 20 increased the size, renamed it the Small Bodies Names Committee at the 1994 The Hague General Assembly and required the group of nine experts, and in 1997 the Kyoto Assembly changed it into the Committee on Small Bodies Nomenclature with then 13 astronomers. The 2009 IAU General Assembly in Rio de Janeiro changed the number into 12 members, with additional four representatives from MPC, IAU Division III, CBAT and WGPSN. Since 2018 the Working Group on Small Bodies Nomenclature (WG SBN) has 15 voting members (see Appendix 9) to judge on the names of both minor planets and comets. In the past, it has happened that names were chosen for natural satellites of the major planets that had already been assigned to minor planets; an agreement with the Working Group on Planetary System Nomenclature (WGPSN) was established in order to avoid an unnecessary duplication of names. After consultations, policies were also set down for naming transjovian bodies. As mentioned earlier the problems involved with the nomenclature of a terrific growing number of objects increase too.

The rapid evolution in naming minor planets also called for detailed decisions on the form of the citations. Marsden (1995, unpublished) formulated the following guidelines: “Citations should be concise, to the point and devoid of remarks that, if tied directly to the name proposal they support, might cause some to think that the name should be rejected for some ... reasons ... Citations supporting names of persons should not be “potted biographies” (but they should include birth and death dates), nor those supporting names of places “travelogues.” A name may have no obvious connection with astronomy in general or minor planets in particular; a more obscure connection would therefore be of interest to the readers and should be mentioned.

Propaganda, whether political or for the aggrandizement of the proposer, should not be included in a citation. A name is often of very personal significance to the proposer; if the proposer chooses to acknowledge this in the citation, this should be done very specifically, rather than in terms of generalities. Final editing of the citations is done by the Minor Planet Center staff. The actual text of a citation will not exceed a maximum of ten printed lines in the MPCs.” In view of increasing costs with the production of the printed MPCs the maximum size of the citations were shortened considerably in the meantime. Principles, guidelines and rules, necessarily, became more and more important constituents in this particular field of astronomy.

This dictionary cannot discuss in detail the evolution of specific nomenclature. Above all it cannot enter into particulars concerning the delicate question of who is the discoverer of a planet and who, after a discoverer’s death, should have the moral right to assign a name to a planet. Recent discussions on such cases leave no doubt that many of our colleagues attach as much importance to the problem of nomenclature as was done more than a century ago.

Information Content of the Catalogue

This entire catalogue results from the analysis of a computerized data base set up by Schmadel. Data fields were defined as narrowly as possible, so that the data could satisfy a wide range of uses. Some data fields are obviously obligatory, such as the definitive number or the date of discovery, others, such as the explanation of the name, are not. The data fields depend logically on each other in ways which can be used for plausibility checks or completeness control. For example, wherever a naming citation is given, the data field must also contain the relevant references to the citation. The data base contains additional information such as classification marks. These are not provided with every entry, but some of the appendices were set up with their help.

The catalogue gives the provisional designation assigned by the Minor Planet Center. This systematic representation gives the discovery date of a planet with an accuracy of half a month. Prior to 1925 – see e.g. Krüger (1892, 1893) – the provisional designations did not follow a strict rule. Detailed information were copied from Strobel (1963). In some exceptional cases after 1925 the provisional designations did not follow Bower’s (1924) system. The catalogue also lists designations assigned according to the modern method to planets discovered before 1925. These designations are marked with the letter ‘A’ instead of the number ‘1’ in the date of the year. A third group of provisional designations comes from the generally known Palomar-Leiden Survey made by van Houten et al. (1970). It consists of an ordinal number followed by the suffix ‘P-L.’ Further investigations describing searches for Trojan planets are reported in papers by van Houten et al. (1984, 1991) and van Houten-Groeneveld et al. (1989). The suffixes ‘T-1,’ ‘T-2,’ and ‘T-3’ refer to the three surveys for Trojans.

The obligatory entries concerning the discovery circumstances report three pieces of information: the date of discovery, the name(s) of the discoverer(s), and the place of discovery. The date refers to UTC, so it does not depend on the meridian of the place of discovery. The names of the discoverers (of all already numbered planets) are given in about 8% of all cases. If more than one name is given this indicates that there was a team working at the same observatory. In many cases an individual discoverer was not named, so the name of the observatory is given as the corporate discoverer. The place of discovery is always a geographical mark like a city, nearby locality, or a mountain. This procedure was preferred rather than quoting particular observatories; these often have branches elsewhere, or have moved to other places or closed down. Moreover, planets were discovered at small, private observatories. Appendix 4 is a list of concordances and shows the relationship between place names and the ‘observatory code’ of the observatories and surveys and gives the number of discoveries at this place. It should be emphasized that the whole data base is used to construct the

appendices whereas the printed catalogue only contains those minor planets already named. Following the discovery place the citation of the numbering information is provided in parentheses with a leading asterisk.

Starting with the Addendum 2003–2005 of DMPN 5th Ed. we include in brackets approximate values for a (semi-major axis), e (orbital eccentricity), and i (inclination of the orbit). These data facilitate the classification to minor planet families and groups.

During the first third of the last century, in particular, the discovery rate was so rapid that in several cases more than one independent report on the same object was given to the AN or to the ARI, before it could be published. These independent discoveries are also listed, together with the relevant dates, discoverers, and places.

The explanations of names constitute the main part of the catalogue. We attempt to give complete original quotations. This was possible with all entries originating from the MPC. All insertions by the author, such as life dates or cross references to other planets are indicated by braces. Names from mythology are often interpreted differently by different poets from the classics; in such cases, several interpretations are given.

We have attempted to classify the explanations of names with respect to their reliability by a flag in the data base. Approximately 0.7% 0,66588 of all background information on particular names is indicated as uncertain or questionable by using adverbs like ‘probably’ or ‘possibly.’ A total of 22,731 of all planet names, corresponding to more than 98.9% 98,929 of all names, are assumed to be absolutely correct. This is not very remarkable, since the majority of explanations could be quoted from literature or from the MPCs. The meanings of 117 names are still in question; these names are appropriately indicated in the dictionary. Most of such cases involve female names which could not be assigned to a specific woman. This small portion indicates the great success of efforts made by the astronomers involved.

Ever since the discovery of the first planets the right of naming has often been transferred to other astronomers; this practice is still being followed. If any information on the proposer was available, it is provided following the explanation of the name. Sometimes we were able to give quite detailed information on the problems of naming, on the discovery circumstances, or on the discoverers themselves. Astronomer colleagues are honored in many cases. The naming citations by themselves give but few biographical facts; more explicit descriptions of the lives of deceased astronomers are found in the literature. Therefore, we took many bibliographical remarks from obituaries published in the volumes of *Astronomy and Astrophysics Abstracts* during the past decades and nowadays the obituaries of AAS, ADS, and RAS and place them at the end of the respective entries.

The dictionary contains additional useful information in the appendices. Alphabetical lists of all discoverers and of all observatories involved with the discoveries are given. The discoverers are listed with the total number of discoveries, and, in parentheses, the number of co-discoveries involved. The time interval between the first and the last discovery is also given. Appendix 11 lists the planet names that could not be interpreted so far, together with the year of the discovery and the discoverer. There is also a table that gives the names of minor planets of special types that cannot be inferred from the data base (Appendix 10). The objects with special characteristics were compiled from a data base of the orbital elements of all numbered planets. Whereas the Trojans are defined by semi-major axes of mean Jovian distance, the Aten, Amor, and Apollo planets are Earth approaching, thus deserving the special interest of astronomers. In many assignments one can see how this special type of orbit influenced the names.

Statistics and Classification of the Names

The object (1) Ceres was discovered on January 1, 1801 and is thus the ‘eldest’ numbered and named planet; (606 701) Golda currently is the named planet with the highest number. Overall 607,011 planets were numbered up to December 2021. The distribution of the discoveries during the more than two centuries can be taken from the cumulative diagram Fig. 1. The immense increase of the rate of discovery during the last years is obvious. One century after Piazzi, about 0.08% of the planets that are now numbered had been discovered. The number 1000 was surpassed in 1924; the number 2000 about two decades after World War II. The progress of the numbering process during the last few years has been extremely rapid. It is therefore appropriate to measure the evolution in terms of consecutive ten or hundred thousand newly numbered objects – minor planets (10 000), (50 000), (100 000), (200 000), (300 000), (400 000), and (500 000) (600 000) were numbered in March 1999, November 2002, October 2005, November 2008, October 2011, July 2014, October 2017, and October 2021, respectively!

Brian Marsden (1979), then Director of the Minor Planet Center and a leading expert in this field, enormously underrated this evolution when he said: “At the present and anticipated future rate of growth, it is not unreasonable to suppose that there will be 4,000 numbered minor planets by the end of the century.” He, in fact, underestimated the real evolution by a factor of five. The rate of growth becomes evident by noting that during only 16 months (!) in 2001/2002 as many minor planets were numbered as during the span of 201 years before that. This rate of growth is all the more impressive when one notes that the standards applied to the quality of the orbital elements are now much stricter. The discovery rate of numbered planets is discussed in some de-

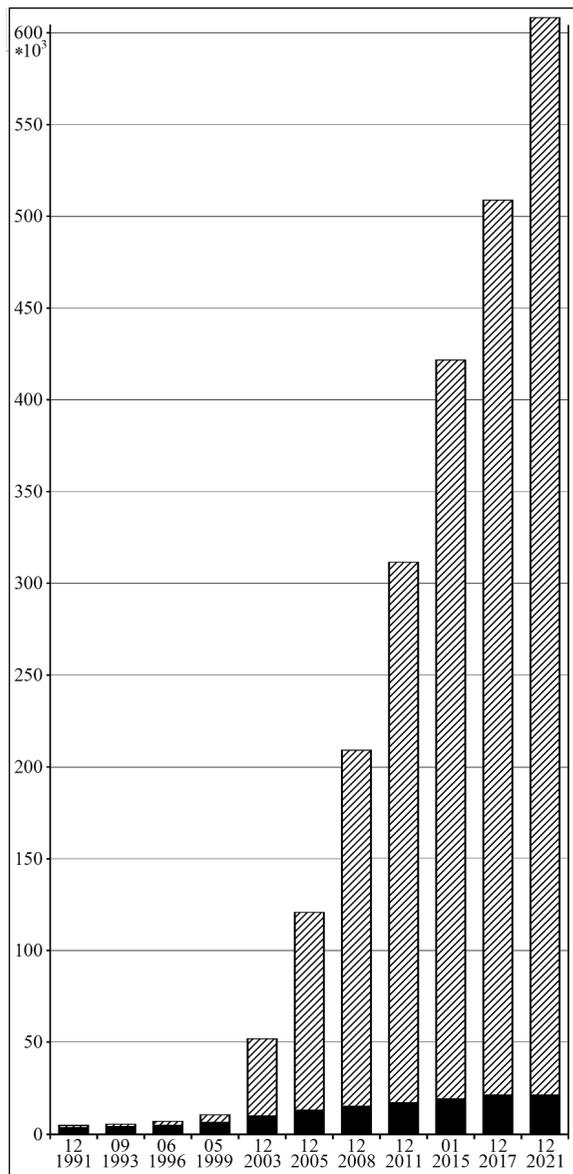


Fig.1: Evolution of minor planet numberings. The portion of named planets is indicated by black boxes.

tail by *Bowell et al. (1989)* and more recently by *Marsden (1996)*. However, both papers gave results which are completely untenable today. Actually we are faced with a growth of minor planet numberings of 100,000 within approximately 3 years – the first $4,096 = 2^{12}$ objects were numbered by 1989, this number grew to $32,768 = 2^{15}$ at the end of 2001 and reached $524,288 = 2^{19}$ at May 2019, peaking with 12,067 new numbers within 37 days in September-October 2021! Presumably this tendency will be flattened out in forthcoming years because of saturation effects in the observing as well as data handling capacities. One has to bear in mind that at peak times observational data are reported to the Minor Planet Center with a frequency nearing 1 Hz!

In general, the earlier a planet was discovered, the sooner it was named. For example, each of the first 4,595 planets were assigned a name. Unfortunately, the naming ratio seriously dropped off during the last few years. While this ratio was nearly constant with 75 – 80% at the first half of the last decade of the last millenium, it decreased to approximately 60% at the end of the millenium. The actual ratio amounts to only 3.8% (Fig. 1). Reasons for the delay in the naming process which unfortunately reduces the security of redundancy are the lack of staff at the WG SBN and the MPC. Occasionally, a limitation (e.g., by the magnitudes) or even a general stop of the naming was considered. The completeness of names declines considerably with higher numbers.

There has always been a preference for names consisting of a single word. This rule could not be maintained, however, since the names of some of the people to be honored consist of two or even three words. Thus names combined of more than one word had to be tolerated. Some designations contain a hyphen, and some an apostrophe. For some time a diacritical mark, such as an umlaut could not be adequately represented by data processing machines. The use of diacritical marks causes no such problem with machine-readable data now, and consequently such marks are found in many names. The length of a chosen name is also interesting. Names consisting of a single character have never been accepted. For reasons of data processing, however, a maximum length of 16 characters was adopted. Unfortunately, this rule was violated in the special case of the cometary minor planet (4015) Wilson-Harrington. The following table shows the present distribution of the length of names:

Number of characters	Minor Planet names	Number of characters	Minor Planet names
2	9	10	2,502
3	158	11	2,235
4	765	12	1,732
5	1,834	13	746
6	2,857	14	510
7	3,231	15	262
8	3,167	16	128
9	2,840	17	1

About 40% of the names consist of six to eight characters. The old rule to assign planets a four-letter name if their orbital elements have exceptional characteristics is now rarely applied. With an increasing number of names difficulties arise when names are too similar. We therefore observe a slight trend towards longer names. This will in part be compensated by the proposal to limit concatenated or contrived names of people to 12 characters.

The names may be classified, of course, according to many different criteria. We decided to arrange groups of countries and groups of free classification. Names dedicated to countries, cities, rivers, build-

ings, etc., can be classified very easily. There may be difficulties, for example, in assigning names of astronomers, artists, or other people to only one country if they happen to have worked in several different ones. Names from mythology cannot be assigned to a particular country. Names given in honor of a discoverer's relatives were, as a rule, not classified by countries. Nevertheless, as can be seen in Appendix 7, the statistics on classifications is quite informative. There is a clear predominance of the 'great powers' in the field of minor planets: about 63% of the names that can be definitely assigned to a country come from the USA, Japan, the former USSR, Germany, Italy, and France. The USA and especially Japan became outstanding only during the last decades. The USSR and Germany owe their ranking mainly to the observatories at Simeis/CrAO, Heidelberg, and Tautenburg, respectively. The preponderance of countries from the Northern Hemisphere is striking.

After the publication of the first edition of this "Dictionary" some very useful papers dealing with name classifications have been appeared. Combes (1993) published a very interesting list with free classification criteria. Schmadel (1992) compiled a special catalogue of astronomers belonging to the European Southern Observatory (ESO). Special investigations concerning names with close relations to certain countries have been undertaken by Meeus (1988), Denoyelle (1995/96), Schnell and Haupt (1996), and by Haupt and Hahn (2007).

Classification according to other criteria is not so straightforward. After several attempts we found 19 rough categories which came up rather automat-

ically. The MIT Lincoln Laboratory together with the Society for Science & the Public has started the *CERES Connection Program* to promote science education. This program names minor planets in honor of students in fifth through twelfth grades and their teachers. Setting up the two new categories *Students*, and *Teachers* more than 17% fall in these categories! In this way more than 96.5% of all names could be classified, compared to only 88.5% according to a classification based on country. A first analysis shows that the names of minor planets do not reflect an 'astronomers' cemetery,' a 'female sky,' or even an 'Iliad sphere,' as has often been suggested. There are, however, periods during which the naming could be so described.

Mythological names predominated only in the first three quarters of the 19th century. Later, classical names were almost exclusively invoked for the Trojans. These are divided (with some unfortunate mistakes) into groups of Greek besiegers and their Trojan opponents. The Trojan planets are distinguished by their 1:1 resonance with Jupiter. They were given male names in contrast to the normal, 'female' planets. This anti-feminine character shows as well in the clear preponderance of male names to female names, in the ratio of 3 to 1: as far as naming minor planets is concerned, emancipation has not yet been very successful.

The suspicion that a cemetery for professional astronomers has been founded cannot be substantiated either, since only about 15% of all names refers to this profession. Appendix 6 shows that many other scientists have been honored, and the list of amateur astronomers is also remarkable. The list of names

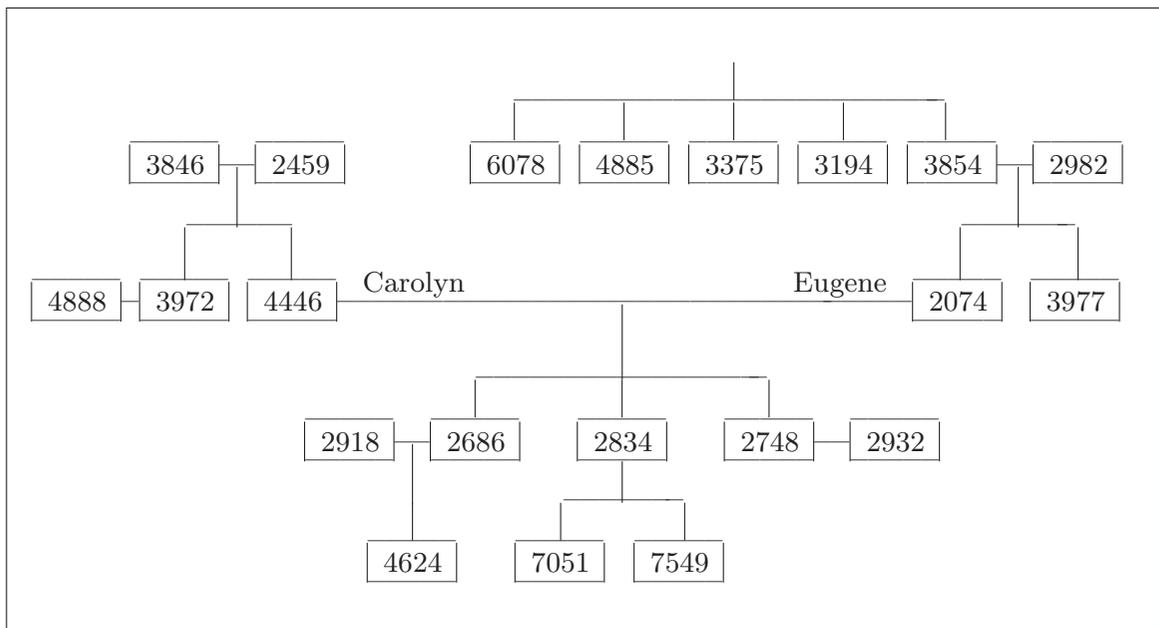


Fig. 2: The Shoemaker dynasty

referring to relatives of the discoverer have decreased considerably in comparison to the figures from earlier editions. As an analogy to characters from classical mythology, genealogical tables can be reproduced. An example with the names of relatives suggested by the discoverer couple Carolyn and Eugene Shoemaker is given in Fig. 2. Without going into details we see that spouses of the patrons prevail over their children as well as over their parents. It is much easier for a grandchild to become astronomically immortal than it is for a grandparent. And the uncles and aunts of the discoverers are much less represented than their friends.

A quickly increasing group is given by the amateur astronomers as well as famous scientists outside of the field of astronomy. Distinguished musicians, painters, and writers constitute a substantial group of names. Dramatists and novelists are still prevailing in the group of intellectuals, but musicians and composers are coming up rapidly. One can also try to find out if a particular discoverer tends towards names in particular categories. One can see personal preferences very clearly, but trends common to many discoverers only rarely. Today, plants and animals are seldom chosen, whereas acronyms and abbreviations are in fashion. Somewhat to our regret, there are not many entries in the category of curiosities. This is a wide field for imaginative discoverers.

Planets named in honor of famous contemporaries can be further analyzed and arranged into subcategories. This is shown for two groups. Appendices 8 and 9 give lists of Nobel laureates and of IAU officers who gave reason for being honored with a planet's name. Remarkably, not only physics prize-holders were honored. Considering the great number of all Nobel laureates, this list is rather short. This is very different from the list of astronomers who were once officers in the IAU, the discoverers' professional representation. Here we find nearly no gaps and one can assume that remaining ones will soon be filled.

Sources of Information

During the second half of the 19th century, the AN were the leading resource in this regard, because they appeared promptly and were distributed widely. The AN were both a scientific journal and a data base. Contributions taken from this source are referred to here by 'AN,' followed by the number of the volume and the column, as well as by the year. Informations from the *Beobachtungs-Zirkulare der Astronomischen Nachrichten* and the *Nachrichtenblatt der Astronomischen Zentralstelle*, abbreviated with 'BZ' and 'NAZ' are used like-wise. All other journals are referred to by the system of abbreviations used in *Astronomy and Astrophysics Abstracts*. Concurrently with the AN, the BAJ gained a central importance. Reports on current affairs were often pub-

lished in the Circulars of the BAJ; for these, we use the abbreviation 'BAJ Circ.,' followed by the serial number and the year. We, frequently, also use the *IAU Circulars* as well as the *Central Bureau Electronic Telegrams* with abbreviations 'IAUC' and 'CBET', respectively.

Two series of informative papers have taken over the role of these journals as distributors of data about minor planets since 1926, namely the RI and its successor, the MPC. From 1926 until the end of World War II, the ARI, Berlin, edited special circulars publishing observations, orbital elements, namings, etc. Every astronomer working in this field knows these circulars as 'RI', an abbreviation for 'Rechen-Institut'. When the Minor Planet Center was founded after World War II, the function of the RI was taken over by the *Minor Planet Circulars*. This dictionary refers to the MPC by the letter 'M', followed by the appropriate number. Starting in 2000, the Minor Planet Center established a new series, the *Minor Planet Circulars Orbit Supplements*, announcing new numberings and orbits. In this book we are using the abbreviation 'MPO' with a following number. Since May 14, 2021, new names are published in the *WG SBN Bulletin*. In this book we refer to this publication by the letter 'B', followed by the volume, the edition, and the page count. A relation between the 'M', the 'MPO' number, or the 'B' specification and the respective publication date is given in an appendix. These tables facilitate the evaluation of the naming and numbering times, respectively.

An important source of information has been the compilation *The Names of the Minor Planets*, edited by Paul Herget and published by the Cincinnati Observatory (1955, 1968). It reports not only on discovery circumstances but also gives explanations to the names of numerous minor planets, with reference to the astronomers who contributed to the explanations of these names. We took over, partly revised and completed a great part of the notes published by Herget. This is shown in the dictionary by the letter 'H,' followed by the page number. On the matter of names from classical mythology, we sometimes quote Zimmermann (1964), referred to by the letter 'Z' followed by the appropriate page number.

The bibliographical data contained in the references include other important publications which were very helpful for the description and explanation of names. Other sources were the compilations of Hockey et al. (2007) and Brüggenthies and Dick (2005). In many cases, colleagues gave helpful comments. Such private communications to the author (LDS) are not mentioned explicitly; instead, the names of these colleagues are given in parentheses, following the relevant citations. Generally, any information not provided in the original sources has been included in braces.