

PLUBIB:

A PLUTO-CHARON BIBLIOGRAPHY DATABASE

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The PLUBIB database is a compilation of Pluto-Charon literature published, or in press, as of June 1995. As of this writing it contains 2158 citations (oops—make that 2159), and continues to grow at an average rate of just over 3 per week. It should be considered a representative, although incomplete, sample of all existing literature concerning Pluto and Charon.

I. INTRODUCTION

PLUBIB traces its origins back to a folder of Pluto photometry references assembled by this author in the course of his M.S. research at Vanderbilt University. Soon after beginning study at the University of Arizona's Lunar and Planetary Laboratory, the author met fellow graduate student Marc Buie, whose Ph.D. research concerned CCD spectrophotometry of Pluto. Marc suggested that spectroscopy references be added, and they quickly were incorporated. Then he half-jokingly suggested that, since so little was known about Pluto, a listing comprising *all* published references to the planet and its satellite might be feasible. Since that fateful day, I have cursed Dr. Buie many times and in several locales: poring through musty, old observatory circulars, searching the stacks for an ancient volume of some long-defunct scientific journal, standing in line at the photocopy machine, or searching for a few nano-hectares of working area on my desk.

Quickly the folder grew too large to carry. It became a box, and then a file cabinet. A good percentage of my desk is eternally blanketed by deep strata of preprints, reprints, and copies of references waiting to be read, then filed. Many nights have found me, bleary-eyed, searching the card catalogs of libraries on other continents via the Internet.

Early on, it was decided to assemble a machine-readable version, for the purposes of writing observing proposals, scientific papers, and “proofing” the bibliography sections of papers I had agreed to review. (It is rather surprising how often errors and omissions crop up in the fine print at the end of such

documents.) The file migrated from machine to machine, and from one word processing package to another. Each transmigration took longer and became a more tedious task than the preceding one. A “standard” format needed to be devised which was flexible, easily ported, and readily adaptable to the requirements of a particular task.

PLUBIB’s current format originally was modelled after the old *Icarus*-style references, since it is useful for a citation to contain: 1. the title of the paper; 2. name all coauthors (in case the principal is deceased); and 3. how many pages the reference spans.

Currently, PLUBIB is an ASCII file of T_EX-based definitions, with the references arranged first alphabetically by the surname of the first author, and then chronologically. The file of definitions, BIBLIO.TEX, is separate from the database. This arrangement allows the printout format to be modified (say, to suit the requirements of a particular journal), without having to edit the entire database. Equally important, it tends to make sorting the database by a particular field a relatively easy task.

A. What is in PLUBIB?

Refereed scientific papers, dissertations and theses, observatory and IAU circulars, abstracts, preprints, annual reports, and “reputable” magazine articles form the bulk of the listings. A few hardcover books appear, such as the University of Chicago Press volumes edited by Kuiper and Middlehurst, Hoyt’s *Planets X and Pluto*, and this volume, all milestone publications in the story of Pluto and Charon.

B. What is not in PLUBIB?

In general, textbooks, encyclopædias, and newspaper articles have not yet been incorporated. Primarily, this is due to time constraints. (Some may be added in the future, since much useful information is buried found in these volumes.) Also, it is difficult to define a standardized citation format for books with multiple editions, printings, and language translations that simultaneously is flexible enough to deal with changing publishing conventions over the past century, yet does not lead to excessive duplication.

Various print and electronic forms of “crackpot” literature, personal letters and communications, electronic mail messages, and science fiction stories are generally excluded, as are short-term ephemerides and almanac-type sources lacking historical value. Both “Operations Pluto” (the CIA code name for the Bay of Pigs Invasion, and the code name for the equally-secret PipeLine Underwater Transport of Oil project of the Second World War), are intentionally excluded.

C. Inclusion Criteria

The main criteria for inclusion of a citation are that the reference mention “Pluto” or “Charon” or, for those prediscovery listings, refer to searches or predictions of a new planet. Indirect references to many topics having direct

bearing on the Hadean system (e.g., vapor pressure of surface frosts as a function of temperature) are excluded by these selection criteria. However, examination of the literature cited in references which are included in the database usually will direct the researcher where to look.

Ultimately, it is the author's sole responsibility and judgment whether a reference merits inclusion. I have tried to build the database in such a way that it be of optimal use for my own purposes. Should others find it of some use, so much the better! There is an on-going effort to reduce errata and omissions, primarily by locating and obtaining a copy of each entry.

II. STATISTICS AND ANALYSIS

Figure 1 is a histogram of the entries in PLUBIB, sorted by publication year, as of this writing. A great deal of interesting, useful information can be derived from an analysis of this plot, and by considering the database as a whole.

Overall, since 1930 the average number of Pluto papers per year is about 27, while the median is about 11. The peak number of references appeared in 1993, and is in large part a result of papers submitted to the conference leading to the publication of this book. It is the only year when the total annual publications exceeded the immediate post-discovery flurry. Other obvious spikes are in 1979, following the discovery of Charon the previous year, and a "broad" impulse (1987-1989) comprised mainly of a combination of mutual events results combined with the 1988 occultation of a star by Pluto. Since the planet's discovery, 1947 is the only year to date without a publication.

PLACE FIG. 1 HEREABOUTS OR ON FACING PAGE

Local peaks occur immediately following most "major" discoveries about the Pluto-Charon system. Those most discernible: Kuiper's 1950 diskmeter experiments; the photometric observations by Walker and Hardie in 1954-1955 which revealed Pluto's rotational period; and a "blend" caused during the mid-1960's due to Hardie's second rotational light curve, the 1965 stellar appulse, and the discovery of the libration resonance with Neptune by Cohen and Hubbard. A minor peak about 1971 appears, which is a blend of spectroscopic results and ensuing discussion regarding a possible atmosphere, and the *Grand Tour* mission planning. Also contributing to the "Charon" peak in 1979 are speckle and infrared observations, and Walker's observation of a stellar from South Africa on April 06 of the preceding year. On the left shoulder of this "blend" is a blip (in 1977) caused by the spectroscopic identification of methane Cruikshank *et al.* and Lebofsky *et al.*

Analysis of the histogram shows the following representation is appropriate. Model a major discovery as a delta function. The "impulse response" of the literature to this discovery may be modelled as a function of the following

form:

$$n(t) = a \cdot \text{step}(t - t_0) \exp\left(-\frac{t - t_0}{\tau}\right). \quad (\text{A.1})$$

This is a decaying exponential function, with e -folding time τ , and peak amplitude a occurring at $t = t_0$. The overall time series of publications *vs.* year then is represented as the sum of many impulse responses,

$$N(t) = \sum_{i=1}^N n(t) = \sum_{i=1}^n a_i \cdot \text{step}(t - t_{0i}) \exp\left(-\frac{t - t_{0i}}{\tau_i}\right). \quad (\text{A.2})$$

Strictly speaking, the function (A.2) should be convolved with a square function, of width 1 year, to match the resolution of the histogram:

$$N(t) = \sum_{i=1}^n \left[a_i \cdot \text{step}(t - t_{0i}) \exp\left(-\frac{t - t_{0i}}{\tau_i}\right) \right] \otimes \text{square}\left(\frac{t}{1 \text{ year}}\right). \quad (\text{A.3})$$

Additionally, each event is not really independent of the others, as communication between researchers working toward initially independent goals does supply some feedback. Many examples of such feedback are apparent in Chapter XX of this volume by Marcialis.

The statistics of PLUBIB do not warrant individual τ_i 's to be assigned, however a typical value for the decay half-life is about 10 months ($\tau \approx 7$ months). This estimate has remained virtually constant as PLUBIB has grown from half its present size, the first time such analysis was attempted. This is an indication that the literature comprising PLUBIB is indeed representative of the entirety of Pluto-Charon publications.

The generally monotonic rise in the literature since the mid-1960s, $N(t) \propto (1965 - t)^{X^X}$, can be viewed as the sum of a series of similar "impulse responses," where the mean time between impulses is somewhat shorter than the typical decay time τ . The major cause of this increased rate, no doubt, is the mutual event season, although perihelion passage, *HST* observations, improvements in instrumentation, and more frequent, better occultation predictions all are secondary contributors. It will be interesting to see whether this trend continues into the next century.

The delay between each major discovery and its resultant impulse response shows another interesting trend. In the 1930s, the average time between "science" and publication was about 6 months. By the 1990s the delay between photons hitting detector and photons reflecting off the journal page and into the reader's eye has increased to an average of 1-2 years. The cause of this increase in phase delay is not at all clear. Perhaps it is a result of the demise of the "in house" observatory circular as a major form of communication. The percentage of sole-author publications has decreased sharply during the last third of this century; coordination of several coauthors usually induces delays.

Also to be considered is the annoying practice of magazines and journal editors to “misdate” their issues. Increasingly, monthly magazines release their “June” issue in April. This practice cannot be the sole cause of the increased response time, however, as some journals (e.g., *Icarus*) fall behind their targeted release dates, while others (e.g., *Astronomy*, *Sky & Telescope*) err in the other direction. Most likely, the lengthening delay is a true reflection of increased data analysis and/or publication times.

III. AVAILABILITY IN MACHINE-READABLE FORM

Up-to-date copies of the PLUBIB.TEX and BIBLIO.TEX files, may be obtained by contacting the author (umpire@lpl.arizona.edu), or via anonymous ftp from: ftp.lpl.arizona.edu, in the subdirectory marcialis.

(Note: Final statistical analysis, and filling in of the XX's which remain, will be done immediately before the book goes to press. I anticipate about 100 more references will be added by then, which is about 2 more pages' worth. —RLM 1996 April 11)

FIGURE CAPTIONS

Figure 1. Histogram of PLUBIB entries, sorted by year. Those entries dated prior to 1900 have been combined into a single bin.