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CATALOGUE OF GALACTIC PLANETARY NEBULAE

UPDATED VERSION 2000

PART 1 (CATALOGUE)

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technical collaboration
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To my respected teacher Dr. Luboš Perek.

C O N T E N T S :

P A R T 1 (C a t a l o g u e)

Abstract 5

1. Introduction 6
2. Scope of the Catalogue and General Remarks 7
3. Objects Included and Omitted 11
4. Explanation of Tables 13
5. Finding Charts 16
6. Elementary Statistics 17

Acknowledgements 36

Errata to CGPN and to the Supplements 38

References 41

Table 1. General List of PNe and Misclassified PNe (according to galactic longitude) 43

Table 2. List of PNe (according to right ascension) 97

Table 3. List of Misclassified PNe 135

Table 4. Accurate Coordinates of PNe 143

Table 5. Possible pre-PNe 265

Table 6. Possible post-PNe 281

Table 7. Index of Discovery Lists 287

P A R T 2 (C h a r t s)

Table 8. List of Finding Charts 295

Finding Charts (according to galactic length) .... Plate 1 - 119

ABSTRACT:

This catalogue contains 1510 objects classified as galactic PNe up to the end of 1999. CGPN(2000) is a continuation of CGPN(1967) and also includes objects given in Supplements S1-S6. The catalogue is divided into two parts:

Part 1 - text and lists of objects (with corresponding remarks) given in the following tables:
- Table 1: general list of PNe according to galactic longitude (including also misclassified PNe),
- Table 2: list of PNe according to right ascension,
- Table 3: list of misclassified PNe,
- Table 4: accurate coordinates of PNe,
- Table 5: list of possible pre-PNe,
- Table 6: list of possible post-PNe,
- Table 7: index of discovery lists;

Part 2 - finding charts of objects listed in S1-S6 and of some objects from CGPN(1967) (not the charts given correctly in CGPN(1967));
- Table 8: list of finding charts.

The PK designation as well as the IAU PN G designation is indicated (Table 1 and 2), and equatorial coordinates for both the Equinox 1950 and 2000 are presented (Table 2 and 4). Two new lists are given: the list of possible pre-PNe (Table 5, n=334), and the list of possible post-PNe (Table 6, n=86).

In the elementary statistics of the present data of PNe we give the galactic distribution as well as the distribution on the sphere, the occurence of coordinates in different accuracy categories, the existence of finding charts and also the frequency of discoveries.

We also present some summarized lists of PNe: individual distances, binary and variable objects, the occurrence in clusters and x-ray sources. The summary of misclassified PNe is added.

The errata to CGPN(1967) and to the Supplements are summarized.

1 Introduction

This is the updated version of the "Catalogue of Galactic Planetary Nebulae" (Perek, Kohoutek, 1967) and includes the objects classified as PNe or possible PNe until 1965 and presented in CGPN(1967), as well as in the following supplements:

S1 - new objects published in 1966-1977,
S2 - 1978-1981,
S3 - 1982-1986,
S4 - 1987-1990,
S5 - 1991-1994,
S6 - 1995-1999.

Supplements S1-S5 to CGPN(1967) have been published (Kohoutek 1978, 1983, 1989, 1992, 1997), whereas the last Supplement 6 is only available from the author.

This version CGPN(2000) is a continuation of CGPN(1967). Moreover it has two new lists which appeared in Supplements 4, 5 and 6 only: the list of pre-PNe and the list of post-PNe. They deal with objects which have not been classified as regular PNe, but which are as we believe in the evolutionary stage before PNe (pre-PNe) and after PNe (post-PNe), respectively. These lists are incomplete and reflect the opinion of their authors.

We still use equinox 1950.0 of coordinates in all tables for various reasons. But rough coordinates of all PNe given in equinox 2000.0 are also listed (Table 2).

As in CGPN(1967) the definition of a planetary nebula has been taken in a rather wide sense. The total number of PNe is at present 1510 (classified till the end of 1999): 1183 objects classified more or less reliably as planetary nebulae; in addition 327 possible planetaries (denoted in the tables with an *). Meanwhile 245 objects have been removed for different reasons from the CGPN(1967) and from the Supplements as misclassified PNe; there certainly exist also objects in the present version of the Catalogue which do not belong here. The definitive classification of the objects is not at all simple.

Planetary nebulae are presented in this catalogue independently of the fact whether the objects are confirmed PNe or possible PNe (asterisk behind the designation), which fact may change already in the near future.

There are several objects called proto-planetary nebulae (PPNe). One of the first lists of such objects was compiled and published in S1. The particular list of PPNe does not exist in this catalogue: PPNe can be found either in the main list of PNe (Table 1), or in the list of possible pre-PNe (Table 5). The separation of these two categories is not reliably defined.

CGPN(1967) included all observational data on the objects. The amount of such data increased to such an extent in the last thirty years that we found it necessary to restrict ourselves only to the data belonging to the location and identification of the objects, i.e. to coordinates as well as to finding charts. For the remaining data one may refer to SIMBAD (CDS, Strasbourg, France) as well as to the literature concerning the individual objects.

The Hubble Space Telescope is of great importance for the study of PNe, particularly concerning the morphology of PNe and the binarity of their nuclei. There are several other satellites which contributed essentially to the increase of our knowledge of PNe, especially HIPPARCOS, IUE, IRAS, ISO and ROSAT. Although the contribution of telescopes on satellites is increasing very much and investigation of PNe in certain spectral regions is only possible from beyond the Earth's atmosphere, the majority of the data on PNe is at present still produced at observatories on the ground.

Unfortunately the AAO/UKST Hα Survey (Parker et al., 1999 and earlier announcements) could not be included in this updated version. This extensive 3-hour H-alpha photographic survey was started in 1997, should be completed in 2000/2001, and it is expected that $>$1000 new PNe will be found.

The structure of larger objects ($>$4 arcsec) in the northern sky can be seen in The IAC Morphological Catalog of Northern Planetary Nebulae (Manchado et al., 1996), which shows the sometimes complicated morphology of the objects called planetary nebulae. The structure of very large objects ($>$8 arcmin) is visible in the Atlas of Ancient Planetary Nebulae (Tweedy, Kwitter, 1996).

Valuable information about the objects including their identification charts can be found in the Strasbourg-ESO Catalogue of Galactic Planetary Nebulae (Acker et al.,1992-SECGPN) and in its First Supplement (Acker et al.,1996-S1 to SECGPN), where also the lists of publications are given. The classification criteria are somewhat different in SECGPN compared with CGPN, so that the objects included in both catalogues slightly differ.

This updated version does not contain identification charts of all objects. We do not repeat those charts which have already been published in CGPN(1967), except some charts having wrong or uncertain identification. Concerning the correct charts, which is the large majority, the user of the present version is referred to CGPN(1967). In CGPN(2000) the identification charts are mostly of objects discovered after 1965 which were included in the Supplements.

The idea of publishing the updated version of CGPN arose in the year 1976, and this was mentioned in Supplement 1. We remind the reader that the publication of CGPN was discussed already at the meeting of Commission 34 at the XII General Assembly of the I.A.U. in Hamburg, August 1964. This has been described in more detail in CGPN(1967).

2 Scope of the Catalogue and General Remarks

In order to answer the fundamental question

“ what is a planetary nebula? ”

we have compared the properties of various objects considering the current review literature and came to the following conclusion: A planetary nebula is a mainly gaseous object (also containing dust) expanding from its hot central star of intermediate mass in a late evolutionary phase on the way between red giants and white dwarfs. The central stars ionize and illuminate the respective nebulae. Although the parameters of the nebulae change very much during the rapid evolution of their nuclei and are therefore dependent on age, it is possible to summarize their typical values (extreme values are given in parenthesis).

N e b u l a :

Morphology: objects of mostly symmetrical shape (circular or elliptical discs or rings, sometimes bipolar structure with "equatorial" torus and "pole" condensations), with apparently sharp outer boundaries; often multiple shells (main nebula + faint outer structure or halo). The morphology depends on the wavelength (stratification); it also reflects the intrinsic absorption and the orientation in space.
Some objects have envelopes of neutral hydrogen and molecules.

Angular diameter: $\sim$ 20 40", depending on the wavelength (limits stellar - $\sim$ 20', Sh 2-216 even larger).

Spectrum:

emission lines:

(a) recombination lines mostly of H and He;
(b) collisionally excited (forbidden) lines of C, N, O, Ne, Mg, Si, S, Cl, Ar;
(c) fluorescent lines (rare) of OIII and NIII.

continuum emission:

free-bound, free-free, two-quantum processes, emission from grains (dust).

Spectrum depending on excitation conditions (exc. class), stratification, chemical composition.

Exc. classes: 0 - 10, main criteria: I([OIII]λ5007 +λ4959)/I(Hβ),
I(HeIIλ4686)/I(Hβ),
I([OII]λ3727)/I([OIII])λ4959).

(see also below)

IR-spectrum: nebular emission lines, dust continuum, IR-emission features.

IR-fluxes: $F_\nu(12\mu m)/F_\nu(25\mu m) \leqq 0.35$, $F_\nu(25\mu m)/F_\nu(60\mu m) \geqq 0.3$,
H2 (some objects).

Radio emission: continuum, mainly molecules CO, OH.

Dimension: diameter 0.1 pc - 0.2 pc (limits $\sim$ 0.005 pc or even smaller, $\sim$ 7 pc) depending on wavelength.

Electron density: 10^3 - 10^4cm^{-3} (but also $<10^3$cm^{-3} for old objects and $>10^4$cm^{-3} for young objects possible).

Electron temperature: 9 000°K - 15 000°K (limits 8 000°K - 23 000° K).

Total mass: ionized gas: 0.1 $M_\odot$ - 0.2 $M_\odot$ (limits $\sim$ 0.001 $M_\odot$, $\sim$ 1 $M_\odot$);
neutral gas + dust: sometimes much higher, very different;
dust mass/gas mass $\sim$ 2x10^{-4} to 3x10^{-2}.

Expansion velocity: non-isotropic, $\sim$ 25 km/s (limits 4 km/s, 60 km/s, outer condensations up to $\sim$ 300 km/s).

Age: 0 - $\sim$ 100 000 years.

N u c l e u s :

Spectrum: WR, O, Of, WR+Of, OVI, sdO, cont., peculiar, sometimes variable.

Effective temperature: 40 000°K - 100 000°K (limits $\sim$ 20 000°K - $\sim$ 250 000°K).

Luminosity: $\sim$ 5x$10^3 L_\odot$ (limits $\sim$ 10 $L_\odot$, $\sim$ $10^4 L_\odot$).

Radius: limits $\sim$ 0.005$R_\odot$, $\sim$ 1.5$R_\odot$.

Mass: $\sim$ 0.6$M_\odot$ (progenitors between 0.8$M_\odot$ and 6-8$M_\odot$).

Mass loss: var $\sim 10^{-10}M_{\odot}/yr$ - $10^{-7}M_{\odot}/yr$ ($\sim 10^{-5}M_{\odot}/yr$ in late AGB).
Gravity: log g $\sim$ 3.0 - 7.5.

The mean parameters of the nebulae and of their nuclei have been taken over mainly from Supplement 3 (with the extension given in Supplement 5). The summary of the criteria by which PNe are distinguished from several types of objects is given in Supplement 2.

Evolution of PNe

The main group of PNe is part of the so-called "blue-white sequence"which was already introduced by Vorontsov-Velyaminov (1947) for the description of the positions of PN nuclei in the HR diagram. This sequence was explained as the place of occurence of planetary nuclei in their evolution between red giants and white dwarfs (Vorontsov-Velyaminov, 1948 and 1953; Shklovsky, 1956; Harman, Seaton, 1964; and later). The actual best explanation of the expansion of the nebular envelopes was found in the model of the Interacting Stellar Winds (Kwok et al., 1978; Kwok 1982) based on the mass loss coming from AGB stars. The evolutionary track of central stars was calculated mainly by Paczyński (1971), Schönberner (1979) and Blöcker (1995).

There are two periods in the evolution of PNe which are still vaguely understood at present:

(a) The first period concerns the o r i g i n of PNe and the evolution of the new-born PN. It is generally believed, and the theoretical evolutionary tracks support this, that PNe evolve from red giants to post-AGB objects via stellar winds. Especially IRAS objects with colours similar to those of common PNe are highly suspected of accomplishing this evolution and they therefore deserve our particular attention. Nevertheless such objects are not yet classified generally as PNe; they are listed as **p r e - PNe** in a separate table (Table 5). Exceptionally some of these objects are classified as PNe even if the well-known nebular lines [OIII]λ5007,λ4959 are missing; in these cases other classification criteria support the idea that they are after all early PNe.

(b) The second period concerns very old PNe, where the nebulae have already disappeared and the central stars are very faint and similar to common WD. It is very difficult to detect such objects with the present observational techniques. Again in a separate table (Table 6) we list these objects as **p o s t - PNe.**

Excitation classes

The exc. classes were introduced in order to classify the spectra of planetary nebulae using the level of excitation (excitation potential of the emission lines). The classification criteria are based on the scheme which was developed mainly by Aller (1956), partly already by Page (1942) or even earlier. Only one criterion is sensitive over nearly the whole range of excitation: I([OIII]λ5007+λ4959)/I(Hβ). Moreover the ratio I(HeII λ4686)/I(Hβ) is suitable for high and very high, whereas I([OII]λ3727)/I([OIII]λ4959) for low and medium excitation classes. Unfortunately this last criterion should be taken with caution because of possible strong interstellar absorption which might weaken the λ3727 line. For low excitation classes the ratio I([NII]λ6584)/I(Hα) is also useful. We added exc. classes 0-1 and 1 for very-low-excitation (VLE-objects were introduced already by Sanduleak, Stephenson, 1973) mostly compact objects: in **exc. class 1** [OIII]λ5007 is very weak but still visible, **exc. class 0 - 1** is reserved for objects showing no visible [OIII]λ5007 line. In this case some additional indications for PNe (e.g. non-stellar angular diameter, continuous spectrum, infrared fluxes) should be given. The above exc. classes contain mainly objects the star temperatures of which are too low for producing the N1 line, but which are on the evolutionary way to common PNe.

The proposed scheme of excitation classes 0-10 is as follows:

exc. class	exc. level
0-1 and 1	very low
2-3	low
4-5	medium
6-7	high
8,9 and 10	very high

Designation

We intentionally use the same designation of PNe as in the edition CGPN(1967), i.e. in the system: **lll $\pm$ bb.n, where n=1,2 ...** is the number of the object in the respective area 1° x 1°. This designation (and not the more detailed one) was used in CGPN(1967) also in order to avoid a possible confusion due to the sometimes approximate coordinates (the positional accuracy of 26 % of the objects in CGPN(1967) was not better than 1 arcmin). At present the positional accuracy has been improved, and the designation can therefore be more detailed. We also give (Table 2) the IAU designations of galactic planetary nebulae, PN G lll.l $\pm$ bb.b, recommended by IAU Commission 5 (Astronomical Nomenclature) and also used in SECGPN. In order to avoid possible confusion we use the same PN G designation of objects as given in SECGPN; this is also in case our galactic coordinates would differ slightly from those of SECGPN due to improved equatorial coordinates.

We are of the opinion that the confusion concerning the PK designation which sometimes occurred in the literature was avoidable. We would have expected that the discoverer would publish the new objects either together with their galactic coordinates only, or with the first part of the designation, containing the galactic longitude and latitude and n o t with the number of the object in the respective area 1° x 1° (e.g. 255−15. only). If necessary it would have been possible to distinguish several objects in one area of the galactic longitude and latitude with letters A, B,.. (e.g. 255−15.A, 255−15.B,...). The definitive numbering of the objects in this area should have been reserved for the person who wrote the respective supplement to CGPN or the new updated version of this catalogue. As an example: there are several PK designations in the new catalogue of symbiotic stars (Belczyński et al., 2000, Table 8), which did not appear either in CGPN(1967) or in Supplements S1-S5 and which are not correct. To use them could therefore be confusing. - The above procedure has not been explicitely mentioned in CGPN(1967), but it was assumed to be self-evident; in reality it was sometimes not. For this reason we shall write about this matter in more detail now.

3 Objects Included and Omitted

We believe all objects classified as PNe and published until the end of 1999 are included in this version CGPN(2000). It contains PNe from CGPN(1967) as well as PNe discovered later and published in the supplements. These objects appear in **Table 2: List of PNe** (n=1510). Objects which have been removed from the list of PNe are given in **Table 3: List of misclassified PNe** (n=245). Objects from both tables are included in a **general list of PNe (Table 1)** (n=1755): all objects once classified as PNe, having therefore the PK designation, i. e.

n(Table 1) = n(Table 2) + n(Table 3).

Exceptions are Cn 1-1, MaC 1-1, PC 11 and M 1-27, which were once removed from PNe but later included again in this list.

We include in this catalogue only objects classified as PNe and given in **published** lists (at least in lists which appear in preprints) and not just given in lists in papers which are " in preparation ".

At present we include in the list of PNe several objects which also appear in the lists of symbiotic stars (SS). In our opinion it is not advisable to classify the objects **either** as **SS or** as **PNe**, and therefore some of them can appear **simultaneously** in both lists. We point out that the hot components of symbiotic stars resemble the central stars of PNe (luminosity, temperature, mass, diameter), being also on the post-AGB tracks, which means in the region of the HR diagram occupied by PNe. We would also like to emphasize the existence of the bipolar nebulae He 2-104 (Southern Crab, Schwarz et al., 1989) and BI Cru (Schwarz, Corradi, 1992), the classification of which as PNe seems to be probable already from their morphology, although these objects were included in the main list of SS (Allen, 1984). Allen's list of SS contains 144 objects and 44 of them are simultaneously classified as PNe! Also the new catalogue of SS (Belczýnski et al., 2000) contains 53 objects (24% of known SS), which are simultaneously classified as PNe. It seems that bipolarity as a result of an anisotropic mass-outflow is a phenomenon common for young PNe as well as for some SS, so that there exist emission-line objects having high-velocity bipolar nebulae and high core densities, which can be called "**symbiotic proto-PNe**". Probably there is a link between bipolar PNe and SS (Corradi, 1995). Also the observed continuum in the IR and the presence of TiO bands, which give evidence for a late-type (G-K-M or carbon) star and which is a strong criterium for SS, cannot be a reason for excluding such objects from the list of PNe, because PNe having binary (symbiotic) central stars may also exist. We emphasize the binary system BE UMa which consists of the components sdO+K5. Incidentally there exists a small group of so-called "yellow" symbiotic stars, named so because their cool components are of spectral type of about F. As noted in §6 (Elementary Statistics) the percentage of known binary and variable stars among the PN central stars is noticeably smaller compared with that of the "common" stars, so that a large number of binaries have probably not yet been detected. As for visual binaries a considerable contribution was made by using the Hubble Space Telescope (Ciardullo et al., 1999); the question of their physical association still remains open in many cases.

Our **criteria for excluding objects from the list of PNe as SS** are more narrow than the conventional definition of SS is. We exclude only such objects from the list of PNe which show

1) strong HeIIλ4686 emission line and simultaneously no (or nearly no) [OIII]λ5007, λ4959 lines, and

2) the presence of a 6825A emission feature, as in M 1-21 (006+07.1), He 2-417 (012−07.1) and He 2-374 (009−02.1).

Both criteria are empirical and reflect the appearance of some bright emission features in the optical region (visible also for faint objects). As to absorption features and the presence of the continuum of a late-type star, these are according to our opinion not sufficient criteria which distinguish necessarily between the SS and the (binary) central stars of PNe.

ad 1) The appearance of both bright HeIIλ4686 and N1, N2 lines is evidence for a PN of high or very high excitation class. But if we observe very weak N1, N2 and simultaneously bright HeIIλ4686 lines it would be strange for a PN even if we take into account different excitation zones.

ad 2) The appearance of the emission bands at $\lambda\lambda$6825A, 7088A, for a long time regarded as unidentified and even a little mysterious, is explained as a Raman scattering by neutral hydrogen of the OVI doublet $\lambda\lambda$1032A, 1038A (Schmid, 1989). It is proposed that OVI photons from a hot radiation source are absorbed by hydrogen near the cool giant atmosphere. These bands are observed only in the spectra of SS and not of PNe.

To find the spectral properties distinguishing between PNe and SS is of course useful, because there evidently exist some differences between them. We believe that the largest spectral differences between SS and PNe are given in the criteria presented above.

As in CGPN(1967) we left in the list of PNe several doubtful objects and objects having no emission lines detected at present. We have to accept the fact that some of them will be removed later from the list of PNe.

As written already in the Introduction we also present two lists of objects, which have not been classified as regular PNe, but which are in their evolution close to them: **pre-PNe (Table 5)**, objects being between post-AGB and very young PNe, and **post-PNe (Table 6)**, where the nebulae in most cases have already disappeared and the central stars are on the evolutionary way to WD.

There exists moreover a large group of objects which can be called **PN candidates**. These are partly objects from internal (unpublished) lists, but mainly objects from already published lists, which have not sufficient data to be classified as PNe. Before further observations and their interpretation are available, such objects can only be considered as PN candidates. In the past the objects were sometimes included in the list of PNe rather carelessly and without further confirmation. Also this fact led to a relatively large number of misclassified PNe. The classification as a PN should be made more thoroughly in future, and the category PN candidates should be reserved for the objects having insufficient data.

This also concerns distant objects in regions of large interstellar extinction, which is in the galactic equator, especially in the direction towards the galactic centre. Such objects are not visible in the optical region; only measurements made in IR- and radio-regions are at our disposal. This means that the common criteria for PNe (mainly the presence of the emission lines [OIII]λ5007,λ4959 or [NII] near Hα) cannot be applied.

Pottasch and collaborators (Pottasch et al., 1988) found that PNe appear in a certain region of the colour-colour diagram for IRAS sources. On the other hand, IRAS objects from the same region of this diagram (i.e. with far-IR colours that are typical for PNe) may be considered as PN candidates. Preite-Martinez (1988) using very similar criteria gave a classification of 388 IRAS sources from the IRAS PSC as possible new PNe. For some PN candidates radio measurements of continuum emission were made which show the presence of ionized gas. The detection of radio continuum emission provides strong evidence that the objects may indeed be PNe. However even this fact is at present not sufficient for classifying such objects as PNe.

Helfand and his group (Becker et al., 1994; Kistiakowsky, Helfand, 1995) classified many objects as PN candidates using VLA. Sometimes nothing at all is visible at the position of such PN candidates in the optical region, but many candidates have a bright line [SIII]λ9532 stronger than [OIII]λ5007.

Let us remind the reader that so far all known PNe have been recognized optically. Nevertheless it may be that in future many new additions to the group of PNe will be made as a result of radio and infrared studies only. For such a purpose clear criteria for classifying the objects as PNe according to their properties in IR and radio regions should be postulated. At present such objects were not included in this catalogue.

4 Explanation of Tables

Table 1: General list of PNe together with misclassified objects (according to galactic longitude)

PK designation: designation as in CGPN(1967) (see §2);
Name: name of the object as PN (see Table 7: Discovery Lists);
RA, DEC: rough coordinates (equinox 1950.0) having the accuracy 0.1^m, 1';
Discovery: discoverer of the object **as PN** (see Table 7: Discovery Lists) taken from CGPN(1967) (blank) or from S1-S6; discoverer of misclassified object (marked M) is given in parentheses; the supplement where the object was misclassified is also indicated.
Remarks: mainly independent discoveries, classif., identification, other names.

This **general list** contains not only real PNe (objects from Table 2), but also objects which were once classified as PNe but later removed from that list (objects from Table 3). The existing PK designation has been reserved for the given object only and is independent of its possible later new classification.

Table 2: List of PNe (according to right ascension)

PK designation (same as in Table 1);
Name (same as in Table 1);
RA, DEC: rough coordinates (equinox 1950.0) having an accuracy 0.1^m, 1';

Finding Charts: Plates Nos.1-119 (all objects given in S1-S6 and corrected charts of CGPN(1967));
RA, DEC: rough coordinates (equinox 2000.0) having an accuracy 0.1^m, 1';
PN G designation: taken from SECGPN or S1,
also possible PNe and rejected objects from SECGPN, —not present objects;
Remarks: mainly different names for objects given in SECGPN or S1.

This is the **actual list of PNe (till 1999)**. The name of the nebula is in most cases identical with the abbreviation of the person(s) who classified the object as a planetary nebula, or who gave the nebula his(their) own abbreviation. (For the abbreviations see Table 7: Index of discovery lists.) The exceptions are given in the CGPN(1967) or in the supplements.

There are 327 objects classified at present as "possible planetary nebulae" and denoted by * , added to the PK designation. These objects especially require further confirmation, which does not mean further observational data only, but also more precise theoretical consideration about what a planetary nebula is.

In the last column of this table and in the remarks the comparison with SECGPN is given. There are 63 objects included in this catalogue, which were rejected from SECGPN, and 101 objects which were classified there as possible planetaries. The objects rejected from SECGPN were mainly classified as symbiotic stars (n=35), peculiar em.-line stars (n=9) or they are objects where no em.-lines were observed (n=12). Our criteria for excluding objects from the list of PNe as SS are described in the former paragraph. As to the objects showing no em.-lines we are of the opinion that this situation is temporary only and that it may in principle change in the near future when better observational techniques will be used. On the contrary there are over 50 objects included in SECGPN and its S1 and not appearing in the main list of PNe in this catalogue. You can find a part of them as possible pre-PNe (Table 5) and possible post-PNe (Table 6). In general the difference between CGPN(2000) and SECGPN can be explained by the somewhat different classification criteria for PNe.

Table 3: List of misclassified PNe (according to right ascension)
PK designation (same as in Table 1);
Name (same as in Table 1);
RA, DEC: rough coordinates (equinox 1950.0) having an accuracy 0.1^m, 1';
Misclassified: in S1-S6;
Remarks: why the objects were misclassified.

This table contains objects once classified as PNe but removed from the list of PNe in S1-S6. In the remarks only rough reasons for misclassification are given; for more details see the corresponding supplement and the literature given there.

Table 4: Accurate coordinates of PNe (according to right ascension)
PK designation (same as in Table 1);
Name (same as in Table 1);
RA, DEC: accurate coordinates (for the given equinox) having an accuracy
(a) 0.01^s, 0.1"
(b) 0.1^s, 1"

(c) 1^s, 0.1'(mostly large objects);
Source: reference to the published literature or to the star catalogues;
Remarks: mainly concerning the individual coordinates and our measurements.

Many coordinates from the literature having accuracies (a) and (b) are listed in this table. For some objects only coordinates with the accuracy (c) were found in the literature; it is mainly a question of large nebulae without known and visible central stars. For about 800 objects the coordinates were improved (Kohoutek, Kühl, 1999) and measured on the Digitized Sky Survey with the accuracy (b) or exceptionally (c) for large objects. Let us mention that the coordinates given in various papers need not be independent of each other - the nature of the published coordinates was not indicated in all papers. Our aim was of course to use the original coordinates only.

Sometimes there are discrepancies in the individual coordinates. Larger discrepancies and probably typing errors are mentioned in the corresponding remarks.

The sources of coordinates can be divided into the following groups:
(a) coordinates given already in CGPN(1967) (34 entries);
(b) coordinates from various papers 1969-1999 reported in Astronomy Astrophysics Abstracts (volume, paragraph, number); there is one paper which appeared between 1967 and 1969 and which was reported in AJB (Astronomisches Jahrbuch);
(c) coordinates given in the main catalogues (AC, AGK2, AGK3, GSC, HIPPARCOS, IRAS, LS, LSS, PPM, SAO).

As to the IRAS sources we distinguish three categories:
(a) sources which are identical with the optical objects (the difference between the optical and IRAS coordinates does not exceed about 20") - they are given in the main table;
(b) sources which are near the optical objects (the difference 20-60"). It is in principle possible that some of these IRAS sources are also identical with the optical objects, but the above difference exceeds the IRAS positional accuracy - such sources are given in the remarks;
(c) sources more than 60äway from the optical objects are not mentioned.

Table 5: Possible pre-PNe (according to right ascension)
Name;
RA, DEC: coordinates with various accuracies (equ. 1950.0);
Remarks and references.

The list of possible pre-PNe (n=334) contains objects being on the evolutionary way between late AGB stars and PNe. They are often IRAS sources with colours similar to PNe. Some of these objects are also called proto-PNe. This list is incomplete and the references give the orientation only; it does not appear in CGPN(1967).

Table 6: Possible post-PNe (according to right ascension)
Name;
RA, DEC: coordinates with various accuracies (equ. 1950.0);
Remarks and references.

The list of possible post-PNe (n=86) contains objects the central stars of which are on the evolutionary way between very old and large PNe and white dwarfs. This list is incomplete and the references give the orientation only; it does not appear in CGPN(1967).

Table 7: Index of discovery lists

This list gives the abbreviations of the names of the discoverers used for names of planetary nebulae in this catalogue (the catalogue CGPN(1967) as well as all supplements have been included).

We repeat - and this is our main rule - that **that person is regarded as discoverer, who first denoted the object as a planetary nebula** (and not who discovered the object generally).

The new planetary nebula receives the PK designation (given by the author of the catalogue), the IAU PN G designation (may be given by the discoverer himself) and the name, which is either

1) the common or generally used name of the object (NGC, IRAS, BD, ESO,...); or
2) the abbreviation of the name of the discoverer (or first two discoverers maximum) according to Table 7, and given by the author of the catalogue; or
3) the abbreviation or name proposed by the discoverer himself (sometimes the name from his internal list).

Our further main rule is that the **discoverer receives only one single abbreviation** which is the same in his different lists of planetary nebulae published in different papers. (Unfortunately there exist some exceptions mainly with regard to discoverer, to SECGPN or by error). Our procedure differs from that of SECGPN and its Supplement 1, where either different abbreviations appear for one discoverer (example: Weinberger - We, Wei, WKG - Weinberger, Kerber, Gröbner), or one abbreviation was given to different discoveres (example: St - Stephenson, 1978; StWr - Stock, Wroblewski, 1972; SwSt - Swings, Struve, 1940).

5 Finding Charts

Table 8: List of finding charts (according to galactic longitude)

PK designation (same as in Table 1);
Name (same as in Table 1);
RA, DEC: rough coordinates (equinox 1950.0) having an accuracy 0.1^m, 1';
Discovery: CGPN (1967) or supplements S1-S6;
Finding charts: FC - main charts, plates Nos. 1-119 (charts for all PNe given in S1-S6 and corrected charts for objects from CGPN(1967));
C - central charts (crowded fields);
Date-Obs: UT date of observation;
P-Label: observatory plate label;

Remarks: mainly concerning finding charts and identifications.

The finding charts are given if available for all PNe which were discovered in S1-S6; we present also those charts from CGPN(1967) which (a) are wrong, (b) have uncertain identification, or (c) show no surroundings (for some bright nebulae). For the remaining objects we refer to charts given in CGPN(1967).

The identification charts are normally oriented (**N at the top, W to the right**) and of size **10 arcmin x 10 arcmin** in general. For some large objects there are charts of size 15 or 20 arcmin square. For objects in crowded fields we give also the central part of the corresponding charts having 2 arcmin square. Such C-charts are on the same plates as the main charts and behind them. The C-charts have the same Data-Obs and P-Label as the main charts except in four cases: the corresponding deviations are indicated in Remarks.

Most objects are marked with a cross: star-like nebulae, small nebulae and central stars of large nebulae, all measured by us (Kohoutek, Kühl, 1999), as well as nebulae having accurate coordinates given in the literature. There are several PNe, the identification of which was made according to coordinates only. Such identification is of course uncertain. Nebulae without known central stars but well visible on finding charts are marked with circles. If the abbreviation "*ID* " between the PK designation and the name of the nebula appears, there is no identification (n=35). These are mainly objects not visible on our broad-band charts because the discovery pictures were taken through narrow filters only either in the visual ([NII]λ6584, Hα, [OIII]λ5007) or in the near infrared ([SIII]λ9532). In these cases, or generally in all cases, in which the exact identification of the objects could not be given, the circles indicate again their position (the centres corresponding to the discovery coordinates), and we refer to the discovery literature.

The charts were taken from the Digitized Sky Survey and their colour system is given in Table 8. The **PK designation** and the **name** of the respective object are given above each chart. If appropriate the central chart (C) and no identification (*ID*) is also indicated. For greater convenience the charts are supplied with the coordinate grid using the computing programme of H. Hagen (private communication), where the scale of the charts can also be seen.

The finding charts (main charts and central charts) are published in Part 2 of the catalogue with their list given in Table 8. They are arranged according to the PK designation and correspond to Table 8. Their purpose is to give the base for identification of the objects and not for their morphology.

6 Elementary Statistics

Distribution of planetary nebulae

The distribution of PNe in galactic coordinates is typical for objects of the disk population: high concentration towards the galactic centre and towards the galactic equator (Figs.1-4).

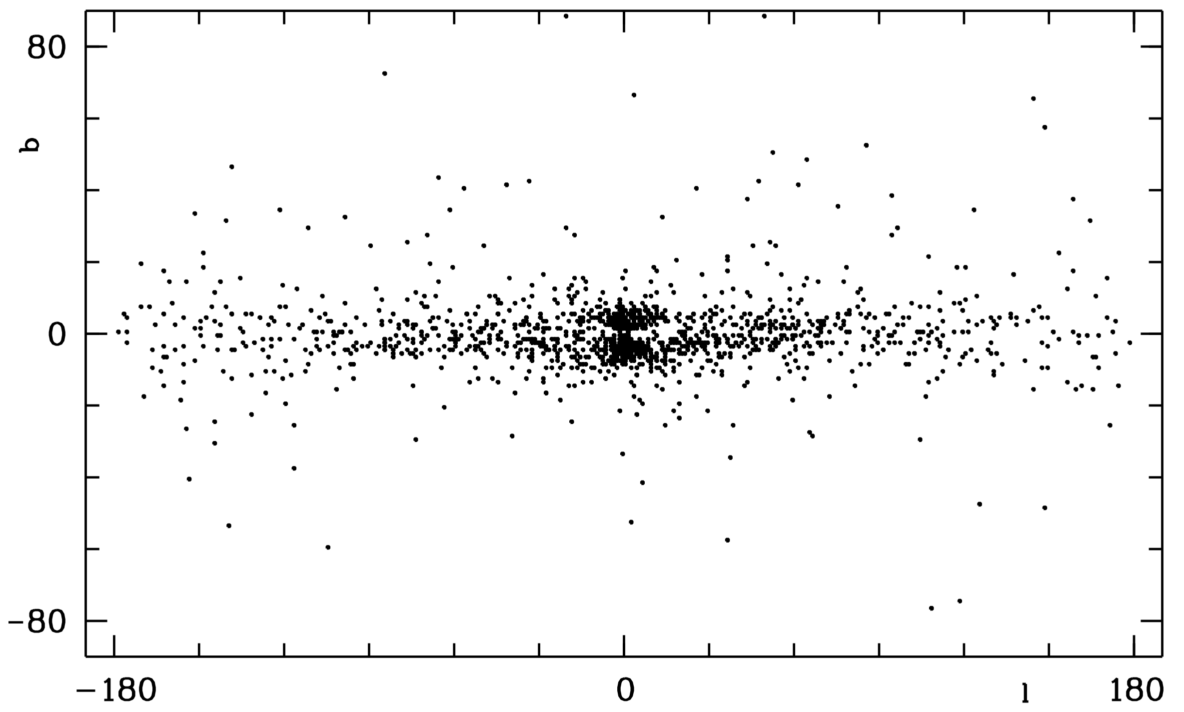

Fig.1 The distribution of PNe in galactic coordinates.

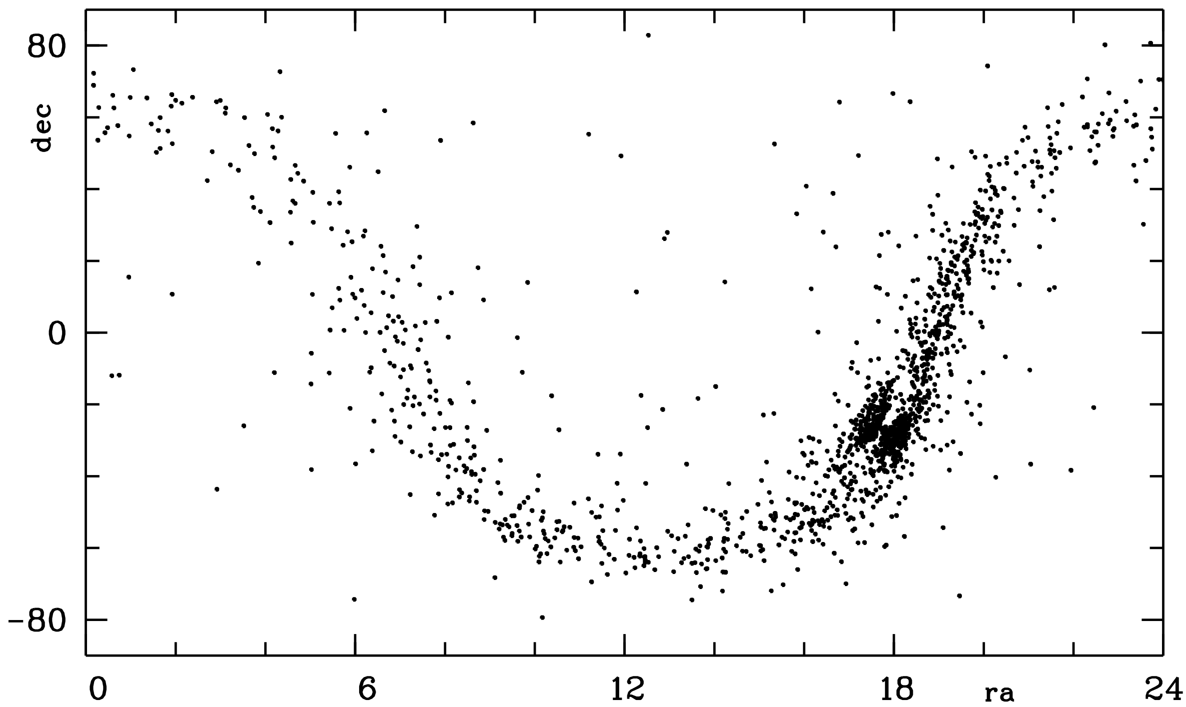

Fig.2 The distribution of PNe in equatorial coordinates.

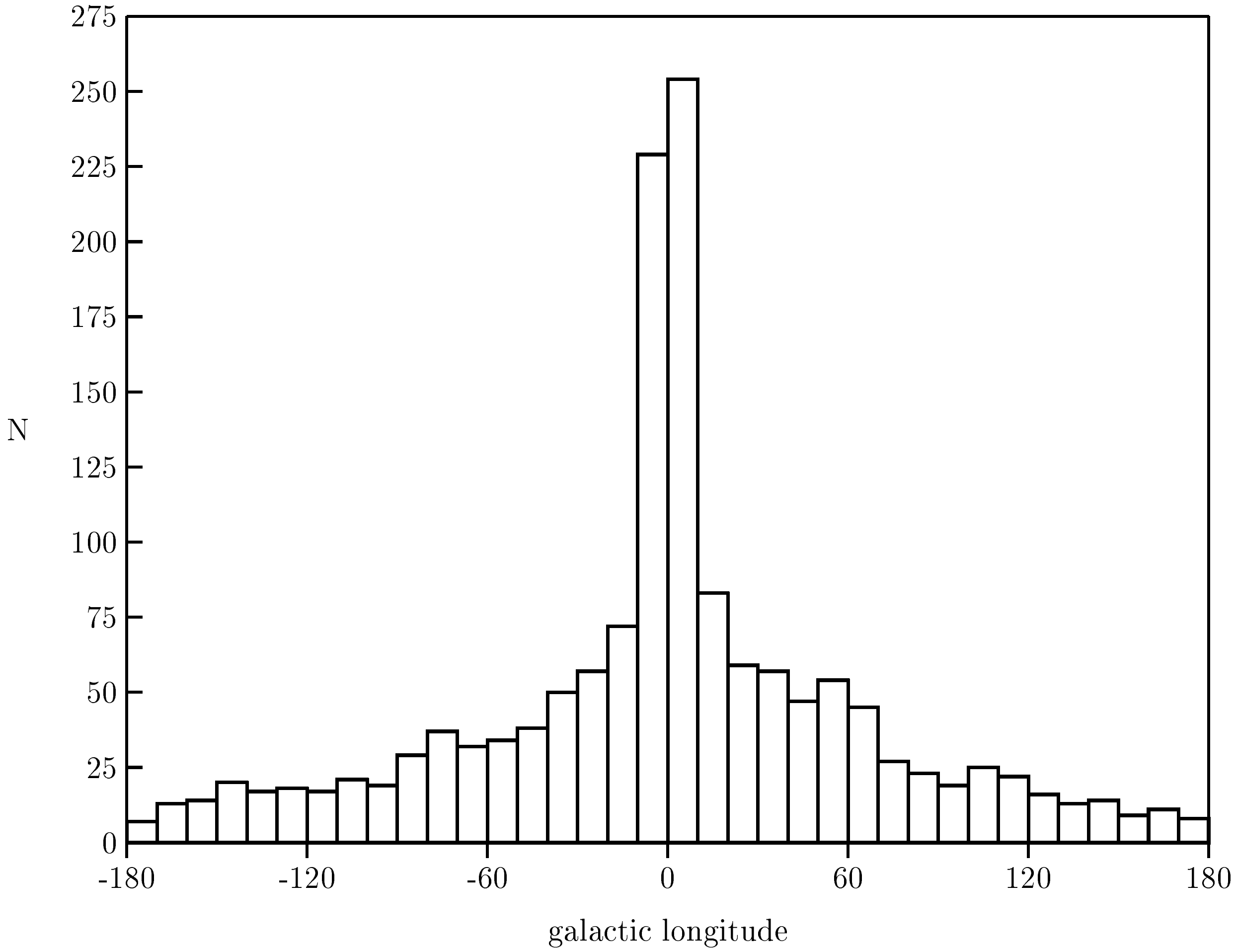

Fig.3a Frequency of PNe in galactic longitude.

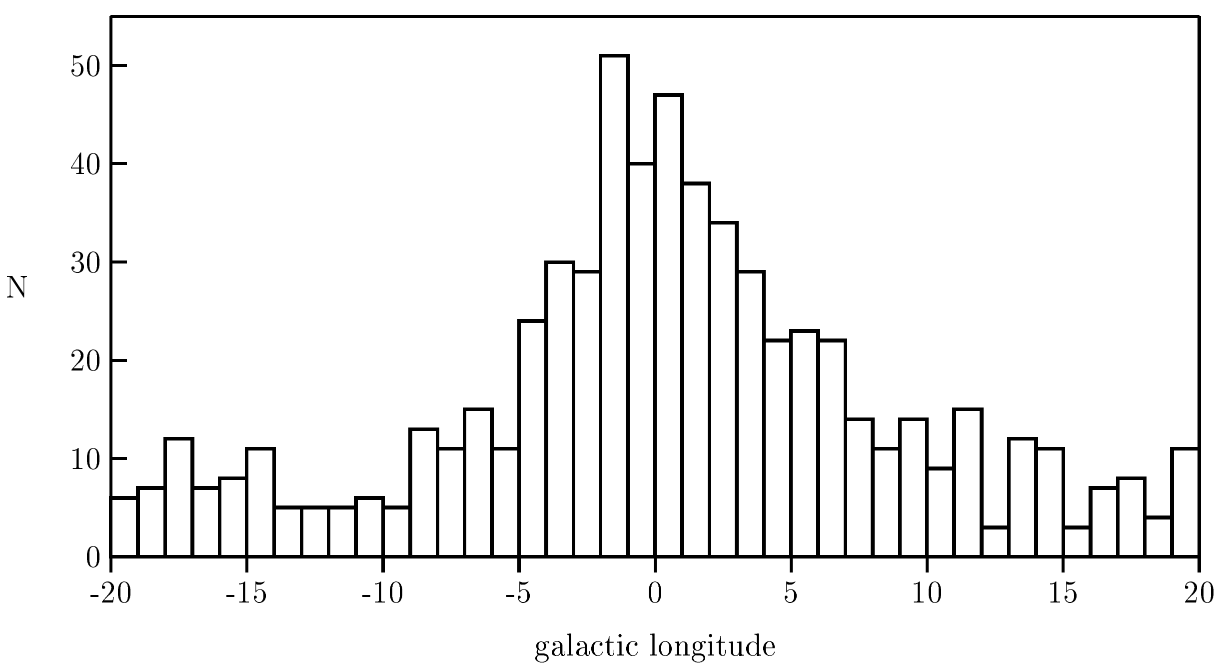

Fig.3b Frequency of PNe in galactic longitude in the central region.

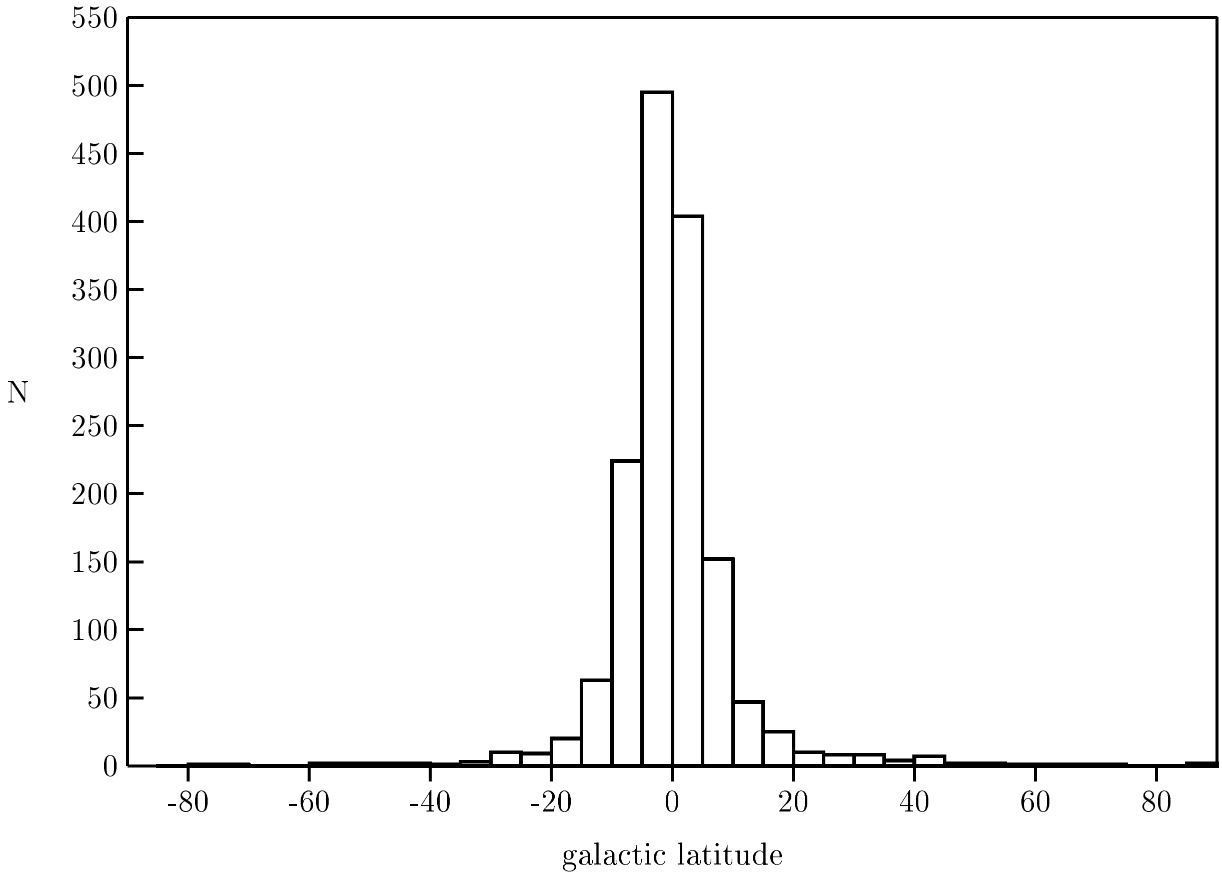

Fig.4 Frequency of PNe in galactic latitude.

The distribution in galactic longitudes is more or less symmetrical (Fig.3a). But the more detailed histogram shows a somewhat lower frequency of objects between l 345° and 355° (Fig.3b). The concentration towards the galactic equator is very high (Fig.4) and 1275 PNe (84%) are in the region b ± 10°.

The distribution on the celestial sphere shows again the presence of the galactic centre and the galactic equator (Fig.2). The appearance of PNe outside the centre is again not wholly symmetrical, objects between AR 12h-17h seem to be underpopulated compared with the region 19h-21h, which fact might be an observational effect.

Coordinates and finding charts

The best coordinates for each object given in the literature and measured by us are listed in Table 4 (about 7000 entries from 218 sources). The frequency of coordinates in the accuracy categories is as follows:

category (a): 964 objects
category (b): 544 objects
category (c): 2 objects

Nearly all PNe (n=1508) have coordinates of the accuracy category (a) or (b). Only two objects of the category (c) are large nebulae without known central stars (VB 1, 339−00.1*; EL 1647+64, 094+38.1*). We give the individual coordinates and not the best coordinates only or their mean values in order to see the scatter of coordinates which sometimes is considerable, especially at large nebulae without known central stars.

The finding charts are given either in CGPN(1967) or in this Catalogue. In the present version there are 714 finding charts (655 main charts, 59 C-charts). In 35 cases the object is not visible (ID) and we refer to the discovery literature.

Discoveries

The first object called planetary nebula was named more than two centuries ago (NGC 6720; Ch. Messier, A. Darquier, 1779). Due to the work of W. Herschel altogether 13 PNe were known at the end of the 18th century. In addition, further 65 PNe were found in the 19th century.

A substantial increase of new PNe can be registered since 1945 as a result of spectral surveys and of Schmidt cameras. (About 90% of known PNe have been discovered since 1945.) In the last decade the slight increase of new PNe is mostly due to observations in no-visual regions (mainly in infrared) and due to the use of CCD cameras, which are more sensitive than photographic plates. The following catalogues or lists (partly mentioned already in CGPN(1967)) are given below:

Catalogue or list	Number of PNe		Number of miscl. PNe
Curtis (1918)	102		
Vorontsov-Velyaminov, Parenago (1931)	121		
Vorontsov-Velyaminov (1948)	288		
Vorontsov-Velyaminov (1962)	591		
Perek, Kohoutek (1967) - CGPN(1967)	1036		
Kohoutek (1978-2000) - Supplements 1-6 to CGPN(1967)	721		247
Acker et al. (1992) - SECGPN	1143	*)	330
	347	**)	
Acker et al. (1996) - Supplement 1 to SECGPN	242	*)	
	142	**)	
This catalogue - CGPN(2000)	1510		245

*) true or probable
**) possible

The distribution of the number of PNe discoveries is given in the following figure:

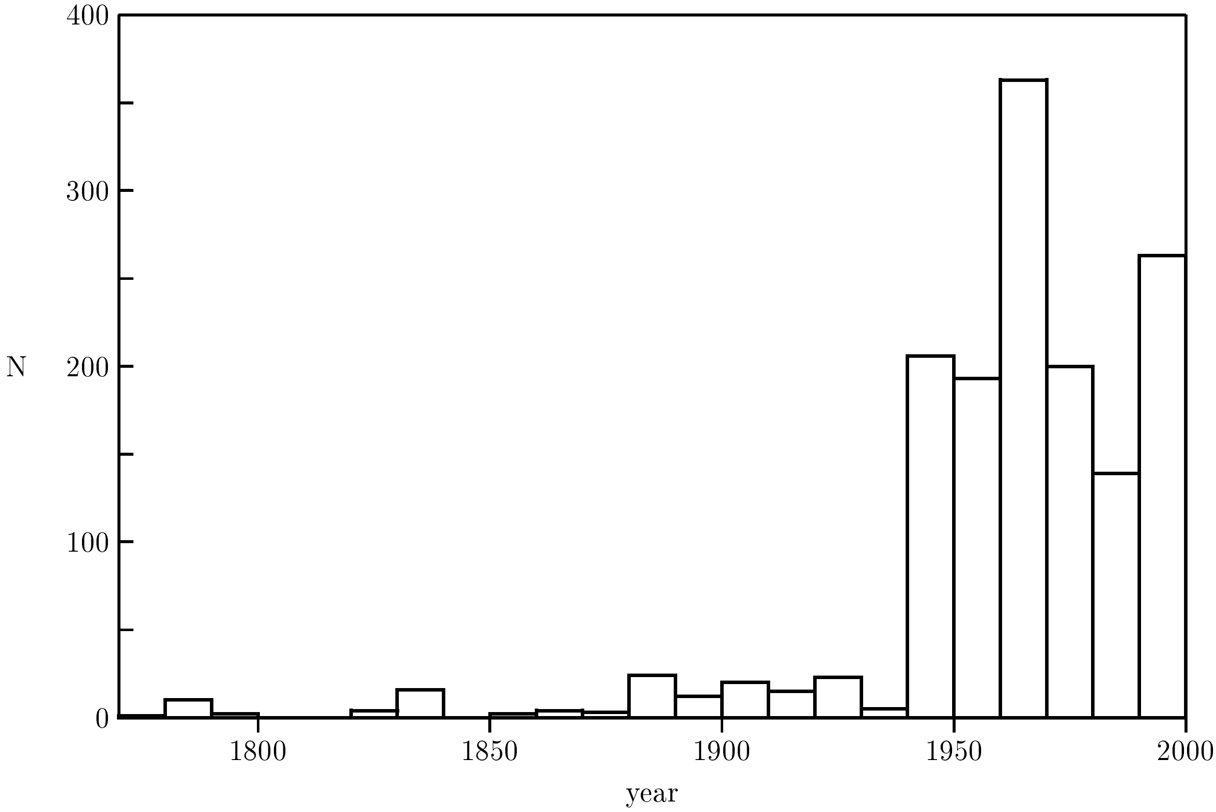

Fig.5 Dicoveries of PNe until 2000 in the respective decade.

Individual distances

Distance is one of the most fundamental parameters and appears in nearly all studies of PNe. There exist several **"statistical" distances** based on various assumptions concerning the system of PNe. The differences of the statistical distances for a given object are large mainly because of the differences of individual objects called planetary nebulae. A better situation exists with **"individual" distances** which are more or less reliable and are given basically by: trigonometric parallaxes of central stars, spectroscopic parallaxes of the companions of central stars, membership of clusters, expansion of nebulae and extinction of nebulae compared with the extinction in their vicinity. There are further methods which use some general conceptions, described mainly by Acker (1978), Sabbadin (1986) and Pottasch (1996), such as e.g. his "gravity" distances, depending on the correctness of the model atmosphere used.

We have divided the PNe with known individual distances into two categories according to the accuracy of the distances: the first category of distances is accurate up to 50% or less; we estimate the accuracy of the second category of distances to be within 50-150%. We would like to point out that the individual values given in the following table need not be wholly independent of each other, but we give them again in order to show the scatter of distances which is not small at all for some objects. However the present situation is much better than that some years ago because now almost 10% of all planetaries have known individual distances (77 in the first and 63 in the second category).

Design.	Name	Cat.	Dist. [pc]	Ref
001−06.2	SwSt 1	2	110:	3
002+05.1	NGC 6369	2	1800:	1
003−04.5	NGC 6565	1	1100	1
			2640	4
			1000	9
008+03.1	NGC 6445	1	2200	1
009−05.1	NGC 6629	2	2400	4
			1500:	1
010+00.1	NGC 6537	1	2400	1
010−01.1	NGC 6578	1	2000	1
011+05.1	NGC 6439	2	1100:	1
011−00.2	NGC 6567	1	1500	1
			1530	4
			1680	9
			1100	12
023−02.1	M 1-59	1	1400	1
			1450	12
025−04.2	IC 1295	1	1450	8
025−17.1	NGC 6818	2	2200:	1
029−05.1	NGC 6751	2	1450:	1
030+06.1*	Sh 2-68	1	560	8
			950	6c
			550	6d
033−02.1	NGC 6741	1	1400	4
			1700:	1
033−06.1	NGC 6772	1	1400	1
034+11.1	NGC 6572	1	500	1
			940	5
034−06.1	NGC 6778	2	1000:	1
034−10.1*	HtDe 11	1	1000	8
036−57.1	NGC 7293	1	100	1
			210	2
			300	4
			180	6b
			320	6c
037−06.1	NGC 6790	2	1100:	1
037−34.1	NGC 7009	2	2500	4
			600:	5
			500:	1
041−02.1	NGC 6781	2	1600:	1
043+37.1	NGC 6210	1	1570	5
045−04.1	NGC 6804	2	1700:	1
046+03.1	Sh 2-78	1	1420	8
046−04.1	NGC 6803	2	2500:	1
047+42.1	A 39	2	1580	6c
051+09.1	Hu 2-1	2	78:	3
051+02.1	IRAS1912+17	1	700	6a
054−12.1	NGC 6891	2	3800	4
060−03.1	NGC 6853	1	250	1
			380	2
			550	8
			400	6c
			310	6d

060−07.1	He 1-5	1		220	3
060−07.2	NGC 6886	1		1700	1
063+13.1	NGC 6720	1		400	1
				700	2
				990	8
				700	6c
				500	6d
				400:	12
064+05.1	BD+30 3639		2	600	1
				2090	5
065−27.1	Ps 1	1		9600	1
				10100	4
069−02.1	NGC 6894	1		1500	1
				1040	4
072−17.1	A 74	1		750	2
				750	8
				1000	6c
				600	6d
080−10.1*	RXJ 2117+34	1		750	6c
				200	6d
082+07.1	NGC 6884	1		1800	1
084−03.1	NGC 7027	1		1000	1
				840	5
				790	6b
085+52.1*	PG 1520+525		2	600	6c
086−08.1	Hu 1-2		2	1600:	1
088−01.1	NGC 7048		2	1900:	1
				2500:	12
089+00.1	NGC 7026	1		2200	1
				1450	4
089−05.1	IC 5117		2	2100:	1
093+05.2	NGC 7008		2	1100:	1
094+27.1	K 1-16		2	1700	6c
				200	6d
100−05.1	IC 5217		2	1300:	1
104+07.1	NGC 7139		2	1100:	1
104−29.1	Jn 1		2	110	6c
				500	6d
106−17.1	NGC 7662	1		650	1
				960	5
				790	6b
107+07.1*	IsWe 2	1		600	6c
				700	6d
				1490	8
107+02.1	NGC 7354		2	1500	1
				3430	4
111+11.1*	DeHt 5	1		440	8
				460	6c
				250	6d
118−74.1	NGC 246	1		500	1
				630:	3
				430	4
				570	5
				470	6a
				590	6b
				420	6c

120+18.1*	Sh 2-174	1		500	8
				520	6c
				350	6d
120+09.1	NGC 40	1		900	1
120−05.1	Sh 2-176	1		630	6c
				480	6d
124+10.1	EL 0103+73	1		510	6c
				600	6d
				480	8
125−47.1	PHL 932		2	110	3
				520	6c
128−04.1*	S 22	1		600	8
				660	6c
				600	6d
				800	11
130+01.1	IC 1747	1		2400	1
				2200	4
				2500	12
130−10.1	NGC 650-1		2	1550	8
				780	6c
				500	6d
				1200:	1
138+02.1	IC 289		2	1870	4
144+06.1	NGC 1501		2	1500:	1
148+57.1	NGC 3587	1		500	1
				425	6b
149−03.1*	IsWe 1	1		550:	6c
				450	6d
				480	8
149−09.1*	HtDe 3	1		1130	8
				510	6c
				500	6d
				800	11
156+12.1*	HtDe 4	1		320	6c
				500	6d
156−13.1*	HtWe 5	1		470	6c
				450	6d
158+17.1	PuWe 1	1		430	2
				280	6c
				500	6d
				470	8
158+00.1*	Sh 2-216	1		130	2
				130	6c
				120	6d
				110	8
164+31.1	JnEr 1		2	900	6c
165−15.1	NGC 1514	1		600	1
				185	3
				660	4
				400	6a
				740	6d
166+10.1	IC 2149		2	900:	1
194+02.1	J 900		2	1600:	1
196−10.1	NGC 2022		2	1500:	1
197+17.1	NGC 2392	1		600	1
				2700	4

				1600	5
197−06.1	WeDe 1	1		800	6c
				600	6d
				880	8
204+04.1	K 2-2	1		1170	8
205+14.1*	A 21	1		540	2
				630	6c
				500	6d
				530	7
				600	8
206−40.1	NGC 1535		2	2700	4
				1500:	1
211+22.1*	BN 0808+11	1		600	6c
				970	6d
215+03.1	NGC 2346	1		800	1
				690	6a
				900	6d
				1060	9
215−24.1	IC 418		2	2000	4
				330:	1
215−30.1	A 7		2	550	6c
217+14.1	A 24		2	320:	2
				800	6d
219+31.1	A 31		2	210:	2
220−53.1	NGC 1360	1		350	3
				670	4
				420	6c
				550:	1
221+46.1*	BN 0950+13		2	525	6c
221−12.1	IC 2165		2	2400:	1
224+01.1	We 1-6		2	1100	11
231+04.2	NGC 2438		2	2000:	1
234+02.1	NGC 2440	1		2100	1
				885	4
				1000:	12
				2190	9
238+34.1	A 33		2	1260	6c
243−01.1	NGC 2452	1		3500	1
				3230	4
				3570	9
				3100:	12
244+12.1	A 29	1		460:	2
				300	7
259+00.1	He 2-11		2	770:	7
261+32.1	NGC 3242	1		2000	4
				465	5
				420	6b
				500:	1
261+08.1	NGC 2818	1		2300	4
265+04.1	NGC 2792	1		2000	1
				1930	4
				1910	9
272+12.1	NGC 3132	1		700	1
				510	6a
				420	6d
				540	9

273+06.1*	HBDS 1	1		1000	6c
				900	6d
278−05.1	NGC 2867		2	2000:	1
279−03.1	He 2-36	1		780	6a
281−05.1	IC 2501		2	1700:	1
283+09.1*	ESO-215-04	1		865	6c
				1050	6d
285−14.1	IC 2448		2	4500	4
				830	10
286−04.1	NGC 3211	1		2000	1
				1530	4
				1910	9
286−29.1	K 1-27		2	1200	6c
294+43.1	NGC 4361	1		1300	4
				1200	6c
				1400:	1
294+04.1	NGC 3918	1		2000	1
				1790	4
				2240	9
298−04.1	NGC 4071		2	1500:	1
303+40.1	A 35	1		130	3
				200	6a
				360:	1
307−03.1	NGC 5189	1		1600	1
				1730	9
307−04.1	MyCn 18		2	1400:	1
309−04.2	NGC 5315	1		2500	1
				2820	4
				2620	9
315−13.1	He 2-131	1		610	4
				590	9
				710	10
316+08.1	He 2-108		2	8300	4
318+41.1	A 36	1		240	3
				600	6c
				400:	1
320−09.1	He 2-138		2	5000	4
322−02.1	Mz 1		2	1100:	1
327+10.1	NGC 5882	1		1100:	1
				560	10
329+02.1	Sp 1		2	1500:	1
331−01.1	Mz 3		2	4500	12
334−07.1*	CPD-53 8315	1		130	3
335+12.1*	DS 2	1		850	6c
				720	6d
338−08.1	NGC 6326		2	800:	1
339+88.1	LoTr 5	1		420	6a
341+05.1	NGC 6153		2	1700:	1
342+10.1	NGC 6072		2	1800:	1
345+00.1	IC 4637		2	1600	4
345−08.1	Tc 1		2	3800	4
				590	10
349+01.1	NGC 6302	1		1600	5
350+04.1	H 2-1		2	4600	4
358−00.2	M 1-26	1		1900	4
				1800:	1

				1800	12
358−07.1	NGC 6563		2	700:	1
359−00.1	Hb 5	1		2000:	1
				2000	12
				1500:	1

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Binary central stars

Altogether 35 central stars have been recognized as binaries up till now, partly resolved as visual binaries (see Ciardullo et al., 1999) and partly known as close binary nuclei (Bond, 2000). They are listed in the following table; observers should be encouraged to make more observations of central stars because the percentage of known binaries is much smaller compared with that of the "common" stars. There would also be an opportunity to get further individual distances of PNe.

Design.	Name	Remarks
005−08.1	Hf 2-2	Close binary nucleus, orbital period 0.399 days.
009+10.1	A 41	Close binary nucleus, orbital period 0.113 days.
017−21.1	A 65	Close binary nucleus, orbital period 1.00 days.
045+24.1	K 1-14	On the POSS a pair of stars separated by 9.1 arcsec is in the centre of the nebula. The actual nucleus is a star lying 2.4 arcsec southwest of the brighter POSS star; it is a probable physical pair (component d=0.36 arcsec, p.a.=242 deg).

053−03.1	A 63	Close binary nucleus, eclipsing binary, orbital period 0.465 days. The CS is a possible physical pair (component d=2.82 arcsec, p.a.=94 deg).
055+16.1	A 46	Close binary nucleus, eclipsing binary, orbital period 0.472 days.
093+05.2	NGC 7008	The CS is a probable physical pair (component d=0.42 arcsec, p.a.=241 deg).
118−74.1	NGC 246	The CS is a physical pair (component d=3.81 arcsec, p.a.=130.3 deg).
130−10.1	NGC 650-1	The CS is a doubtful physical pair. The companion itself is almost certainly a physical system (d=0.16 arcsec).
136+05.1	HEFE 1	Close binary nucleus, orbital period 0.582 days.
144+65.1	BE UMa	Close binary nucleus, eclipsing binary, orbital period 2.29 days.
158+17.1	PuWe 1	The CS is a doubtful physical pair. The component itself is a close pair (d=0.6).
197+17.1	NGC 2392	The CS is a possible physical pair (component d=2.65 arcsec, p.a.=213 deg).
206−40.1	NGC 1535	The CS is a probable physical pair (component d=1.04 arcsec, p.a.=334 deg).
208+33.1	A 30	The CS is a possible physical pair (component d=5.25 arcsec, p.a.=144 deg).
215+03.1	NGC 2346	Close binary nucleus, orbital period 15.99 days.
215−30.1	A 7	The CS is a possible physical pair (component d=0.91 arcsec, p.a.=250 deg).
217+14.1	A 24	The CS is prob. an optical double (component d=3.33 arcsec, p.a.=159 deg).
219+31.1	A 31	The CS is a probable physical pair (component d=0.26 arcsec, p.a.=242 deg).
228−22.1	DeHt 1	LoTr 1. Close binary nucleus, orbital period unknown.
238+34.1	A 33	The CS is probably a physical pair (component d=1.82 arcsec, p.a.=209 deg).
239+13.1	NGC 2610	The CS is a possible physical pair (component d=0.61 arcsec, p.a.=277 deg).
253+10.1	K 1-2	Close binary nucleus, orbital period 0.676 days.
272+12.1	NGC 3132	The CS is probably a physical pair (component d=1.71 arcsec, p.a.=47 deg).
283+25.1	K 1-22	The CS is a probable physical pair (component d=0.35 arcsec, p.a.=218 deg).
283+09.1*	ESO-215-04	Close binary nucleus, orbital period 0.357 days.
286−29.1	K 1-27	The CS is a probable physical pair (component d=0.56 arcsec, p.a.=315 deg).
303+40.1	A 35	Close binary nucleus, orbital period unknown.
311+02.2	SuWt 2	Close binary nucleus, orbital period 2.45 days.
329+02.1	Sp 1	Close binary nucleus, orbital period 2.91 days.
329−02.2	Mz 2	The CS is a probable physical pair (component d=0.28 arcsec, p.a.=218 deg).
335−03.1	HtTr 4	Close binary nucleus, orbital period 1.74 days.
339+88.1	LoTr 5	Close binary nucleus, orbital period unknown.
342−14.1	Sp 3	The CS is a probable physical pair (component d=0.31 arcsec, p.a.=42 deg).
345+00.1	IC 4637	The CS is a possible physical pair (component d=2.42 arcsec, p.a.=330 deg).

Variable objects

There are altogether 123 PNe (besides 26 variables belonging to the objects, which were removed from the list of PNe) listed in the GCVS + supplementary lists (Kholopov et al., 1985-1990) or in the catalogue of suspected variable stars (Kholopov et al., 1982). The fact that 54% of the above objects were classified as suspected variables reflects the difficulties of recognizing PNe as variable objects (mainly due to the disturbing effect of the nebulae). Moreover 4 objects of the 56 known variables appeared to be constant. The remaining variables are in most cases symbiotic variables of Z And type (n=10) and unique objects (n=8). Only 3 objects (A 46, A 63, BE UMa) are Algol-type eclipsing binaries. In the following summary all variable PNe (also misclassified objects) are listed including their type of variability according to GCVS. The main purpose of this summary is to encourage observers to monitor the PNe in order to find further variables, which would be very desirable.

A) Planetary nebulae:

Design.	Name	Variable	Type
002+05.1	NGC 6369	V 2310 Oph	ZZ:
002−05.1*	He 2-370	V 2756 Sgr:	ZAND
005−05.2*	He 2-390	V 3929 Sgr	ZAND:
007+01.1	Hb 6	AS Sgr	CST:
007+01.2*	M 3-18	V 2416 Sgr	ZAND
008+03.2*	Th 4-4	V 4141 Sgr	ZAND:
009+10.1	A 41	MT Ser	ELL/PN
010+04.2	V 4334 Sgr	V 4334 Sgr	?
011−07.1*	V 348 Sgr	V 348 Sgr	unique
037−03.3*	K 3-25	V 352 Aql	NL
037−05.1	A 58	V 605 Aql	unique
048+04.1*	K 4-12	V 1413 Aql	ZAND+E
053−03.1	A 63	UU Sge	EA/D/PL
055+16.1	A 46	V 477 Lyr	EA/PN
058−10.1	IC 4997	QV Sge	unique
060−07.1	He 1-5	FG Sge	unique
061−09.1	NGC 6905	NT Del	ZZ:
063−12.1*	He 2-467	LT Del	ZAND
064+05.1	BD+30 3639	V 1966 Cyg	E:/PN
075+05.1*	V 1016 Cyg	V 1016 Cyg	NC+M
076−05.1*	LSII+34 26	V 1853 Cyg	ACYG
080−10.1*	RXJ 2117+34	V 2027 Cyg	ZZO
094+27.1	K 1-16	DS Dra	ZZO
120+09.1	NGC 40	V 400 Cep	WR
133−08.1*	M 1-2	V 471 Per	CST
136+05.1	HEFE 1	V 664 Cas	R
144+65.1	BE UMa	BE UMa	EA/WD/D
144+06.1	NGC 1501	CH Cam	ZZ
166−06.1*	CRL 618	V 353 Aur	E
174−14.1	H 3-29	GL Tau	CST:
215+03.1	NGC 2346	V 651 Mon	unique
215−24.1	IC 418	ZZ Lep	NL:
228−22.1	LoTr 1	AB Lep	RS:
243−01.1	NGC 2452	V 354 Pup	ZZ
253+10.1	K 1-2	VW Pyx	unique
274+02.1*	He 2-34	KM Vel	M

280−02.1*	He 2-38	V 366 Car	M+ZAND
283+09.1*	ESO-215-04	KV Vel (not KU)	R/PN
299+00.1*	BI Cru	BI Cru	ZAND
303+40.1	A 35	LW Hya	R:
307−03.1	NGC 5189	KN Mus	ZZO
311+03.1*	He 2-101	V 704 Cen	L:
312−00.1*	V 417 Cen	V 417 Cen	L
312−02.1*	He 2-106	V 835 Cen	M
315+09.1*	He 2-104	V 852 Cen	M:
320−09.1	He 2-138	MM TrA	BE
326−10.1*	Cn 1-2	KX TrA	ZAND:
327−04.1*	He 2-147	V 347 Nor	M:
331−12.1	CPD-59 6926	V 839 Ara	BE
332−09.1*	CPD-56 8032	V 837 Ara	unique
339+88.1	LoTr 5	IN Com	R:/PL
344−08.1*	PC 18	AE Ara	unique
351+03.1*	H 2-2	V 455 Sco	ZAND
355−06.1	M 3-21	V 567 Sgr	CST
356−07.1*	He 2-349	V 615 Sgr	ZAND
358−21.1	IC 1297	RU CrA	L:

009−05.1	NGC 6629	NSV 10766
010+18.1*	K 2-8	NSV 20901
010−06.1	IC 4732	NSV 11021
012−07.1*	He 2-417	NSV 24553
013+05.1*	Sa 3-96	NSV 24041
014−05.1	V-V 3-5	NSV 24521
017−10.1	A 51	NSV 11642
023−01.1*	K 3-9	NSV 24539
025+40.1	IC 4593	NSV 7526
025−17.1	NGC 6818	NSV 24857
034+11.1	NGC 6572	NSV 24329
036+17.1	A 43	NSV 24029
036−01.1	Sh 2-71	NSV 24661
037−06.1	NGC 6790	NSV 11959
037−34.1	NGC 7009	NSV 25448
045+24.1	K 1-14	NSV 23577
045−04.1	NGC 6804	NSV 24799
046−04.1	NGC 6803	NSV 24796
047+42.1	A 39	NSV 7743
051+09.1	Hu 2-1	NSV 24612
054−12.1	NGC 6891	NSV 25070
061+08.1	K 3-27	NSV 24721
061+02.1	He 2-442	NSV 12270
063+13.1	NGC 6720	NSV 11500 (cst?)
066−28.1	NGC 7094	NSV 25698
072−17.1	A 74	NSV 13633
075−04.1*	He 2-468	NSV 25253
077+14.1	A 61	NSV 11917
081−14.1	A 78	NSV 13798
082+07.1	NGC 6884	NSV 25033
083+12.1	NGC 6826	NSV 12382
089+00.1	NGC 7026	NSV 25472
089−02.1*	M 1-77	NSV 25551
106−17.1	NGC 7662	NSV 14555
111−02.1	Hb 12	NSV 26083

118−74.1	NGC 246	NSV 15170
123+34.1	IC 3568	NSV 19422
138+02.1	IC 289	NSV 1056
146+07.1	M 4-18	NSV 15974
164+31.1	JnEr 1	NSV 17664
165−15.1	NGC 1514	NSV 15907
166+10.1	IC 2149	NSV 16733
189+19.1	NGC 2371-2	NSV 17461
193−09.1	H 3-75	NSV 16624
197+17.1	NGC 2392	NSV 3604
197−03.1	A 14	NSV 2861
208+33.1	A 30	NSV 4241
214+07.1	A 20	NSV 3563
232−04.1	M 1-11	NSV 3447
261+32.1	NGC 3242	NSV 4848
278−05.1	NGC 2867	NSV 18182
279−03.1	He 2-36	NSV 18259
286+02.1	He 2-55	NSV 18536
294+43.1	NGC 4361	NSV 19380
311+02.2	SuWt 2	NSV 19992
315−13.1	He 2-131	NSV 20337
318+41.1	A 36	NSV 6376
319+06.1	He 2-112	NSV 20150
322−05.1	NGC 5979	NSV 20395
325+04.2*	He 2-127	NSV 20307
330+04.1*	Cn 1-1	NSV 20412
339+00.1*	He 2-176	NSV 20734
346+08.1*	He 2-171	NSV 20689
353−04.1*	H 1-36	NSV 23921
354+04.2*	H 2-5	NSV 21208
358+01.3*	H 1-25	NSV 22772
359−07.1	M 2-32	NSV 24340

B) Not planetary nebulae (misclassified):

Design.	Name	Variable
000−01.4M	Bl 3-14	NSV 24017
001+04.1M	MaC 1-5	V 2116 Oph
001−00.1M	Bl 3-11	V 4375 Sgr
003−04.6M	Ap 1-11	V 2506 Sgr:
004+06.1M	H 2-12	V 843 Oph
010−03.1M	He 2-396	V 3811 Sgr:
037−06.2M	K 4-26	V 850 Aql
047−03.1M	K 4-27	V 976 Aql:
050+03.1M	M 1-67	QR Sge (NSV 11797)
050−03.1M	K 4-31	V 998 Aql
055−01.2M	K 3-44	FT Sge
064+00.1M	K 3-47	AA Vul
104−06.1M	M 2-54	NSV 25967
108−05.1M	K 4-46	LL Cas
110−00.1M	We 1-12	V 807 Cas
195−00.1M	Sh 2-266	V 1308 Ori
235+01.1M	V-V 1-7	NSV 17554
241−07.1M	M 4-1	NSV 17408
266+02.1M	Pe 2-3	NSV 18145

289−00.1M	AG CAR	AG CAR
299−00.1M	He 2-80	NSV 19372
302−00.1M	He 2-87	NSV 19475
326−01.1M	He 2-139	NSV 20427
338+05.2M	He 2-156	QS Nor (KZP 2635):
354+04.2M	H 2-5	NSV 21208
358−01.2M	Sa 3-80	NSV 23955

Planetary nebulae in clusters

A summary of PNe in clusters is given as a compilation from the existing literature. We would like to emphasize that only **positional coincidences** (PNe are in or near the clusters) are indicated. Due to the relatively short lifetime of planetary nebulae the probability of a real coincidence PN-cluster is rare, and the question of such a relation remains unanswered. This summary should not replace thorough studies of distances and radial velocities made in the original literature, and it has an informative character only.

Design.	Name	Cluster	Cluster design.	
002+01.4	JaFu 1	Pal 6	GCl-75	C 1740−262
002−02.2	M 3-20	An(Tr 31)	OCl-9	C 1756−281
009−07.1	IRAS18333-2357	NGC 6656 = M 22	GCl-99	C 1833−239
065−27.1	Ps 1 (Kustner 648)	NGC 7078 = M 15	GCl-120	C 2127+119
172+00.1*	A 9	NGC 1912 = M 38	OCl-433	C 0525+358
231+04.2	NGC 2438	NGC 2437 = M 46	OCl-601	C 0739−147
243−01.1	NGC 2452	NGC 2453	OCl-670	C 0745−251
261+08.1	NGC 2818	NGC 2818	OCl-743	C 0914−364
324−01.1	He 2-133	An(Lynga 5)	OCl-942	C 1538−564
327−05.1	KsRm 1	NGC 6087	OCl-948	C 1614−577
329−02.3	HeFa 1	NGC 6067	OCl-953	C 1609−540
347+01.1	Vd 1-8 (Sa 2-167)	NGC 6281	OCl-1003	C 1701−378
353−05.2	JaFu 2	NGC 6441	GCl-78	C 1746−370
359−01.3	M 3-45	An(Basel 5)	OCl-1038	C 1749−300

X-ray sources

Using the data of recent x-ray satellites (EXOSAT, Einstein, ASCA, ROSAT) 16 PNe were identified as X-ray sources. X-ray emissions can in principle appear
1) as point sources originating in the photospheres or possibly in the coronal regions of hot central stars ($T \geqq 100000$ K), and
2) as extended (diffuse) sources showing the existence of very hot ($T \geqq 10^6$ K) nebular plasma and fast stellar winds.
Both emisssions together are sometimes called "two-component model".

The evidence for extended emission is completely unclear and some detections reported earlier may be spurious (see Chu et al., 1993; Chu, Ho, 1955). The aim of the following summary is to motivate further research of the X-ray emissions of PNe which can be very useful for our understanding of the origin of PNe.

Design.	Name	Remarks	Ref
036−57.1	NGC 7293	ROSAT PSPC point source	1
		Einstein source	3
		ROSAT PSPC two components source	5
		ROSAT PSPC two components source	8
		EXOSAT LE source	14
060−03.1	NGC 6853	ROSAT PSPC point source	1
		ROSAT PSPC extended source	2
		Einstein source	3
		ROSAT PSPC:no extended source	10
		ROSAT:no extended source	7
		ROSAT source	11
		EXOSAT LE source	14
064+05.1	BD+30 3639	ROSAT PSPC point source	1
		ROSAT PSPC extended source	2
		ROSAT extended source	6
		ROSAT HRI extended source	13
080−10.1	RXJ 2117+34	ROSAT PSPC source	16
094+27.1	K 1-16	ROSAT PSPC source	11
096+29.1	NGC 6543	ROSAT PSPC extended source	1
		ROSAT PSPC extended source	2
118−74.1	NGC 246	ROSAT PSPC point source	1
		Einstein point source	3
		ROSAT source	11
		EXOSAT LE source	14
148+57.1	NGC 3587	ROSAT source	1
		ROSAT PSPC two components source	8
		ROSAT PSPC point source	9
		EXOSAT LE source	14
198−06.1	A 12	ROSAT PSPC extended source	2
		ROSAT:no extended source	7
206−40.1	NGC 1535	ROSAT PSPC two components source	8
		ROSAT PSPC:previous reports spurious	9
		EXOSAT LE source	14
208+33.1	A 30	ROSAT PSPC extended source	1
		ROSAT PSPC extended source	7
		ROSAT HRI source	12
220−53.1	NGC 1360	ROSAT PSPC point source	1
		EXOSAT source	4
		ROSAT source	11
		EXOSAT LE source	14
238+34.1	A 33	Einstein source	3
294+43.1	NGC 4361	ROSAT PSPC extended source	2
		ROSAT:no extended source	7
		EXOSAT LE source	14
318+41.1	A 36	ROSAT source	1
		ROSAT PSPC two components source	8
		EXOSAT LE source	14
339+88.1	LoTr 5	ROSAT PSPC point source	1
		ROSAT PSPC extended source	2
		ROSAT:no extended source	7
		ROSAT source	11
		EXOSAT source	15

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Misclassified PNe

It is well known that PNe are a rather heterogeneous group of em.-line objects having different morphology or being star-like, especially when we consider their evolutionary stage. There are altogether 245 objects which are no longer classified as PNe (Table 3 and Table 1).

It is relatively easy to recognize extragalactic objects (ad 1) according to their morphology on direct photographs or even better from the red-shift of the spectral lines.

As to the galactic objects the largest group of misclassified PNe are actually red stars (ad 2) with strong continua near Hα. The red stellar continua simulate the existence of emission lines Hα and [NII] on low-dispersion spectra. Objects with no emission lines (ad 5) belong also to this category. The reflection nebulae (ad 5) may in principle also be objects in the evolutionary phase before PNe, i.e. pre-PNe. Galactic objects with emission lines are most similar to PNe. Several types of em.-line stars (ad 3) without nebulae look like young PNe; symbiotic stars (ad 6) as well as compact HII regions (ad 4) can be extremely similar to PNe. Also novae with their nebulae could match PNe.

The last category represents objects which are actually not real nebulae (ad 7,8) or objects which are identical with already known PNe or their condensations (ad 9).

Four objects given also in Table 3 (MaC 1-1, 217−00.1*; Cn 1-1, 330+04.1*; PC 11, 331−05.1*; M 1-27, 356−02.2*) were once removed from the list of PNe as em.-line stars but have now been included again in the list of PNe.

The theoretical definition of "what is a planetary nebula" plays a great role for the decision as to whether we include the object in the list of PNe or not. This definition depends of course on the present state of knowledge.

Former confusion with another object-type:	**N**
1. galaxy, em.-line galaxy	53
2. red star	53
3. em.-line star (Hα em. only, Be, BQ[ ], WR, OB, peculiar)	40
4. HII region	27
5. object with no em. lines, reflection nebula	24
6. symbiotic star	20
7. plate fault, nova	17
8. several faint stars, no FC and no observations	4
9. identity with another PN or a knot in another object	7

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I used 714 finding charts, mainly of the Second Digital Sky Survey (DSS2) and I thank all institutions which are engaged in this project:
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I obtained the data as fits-files from the Online Digitized Sky Surveys (DSS1 & 2) server at the ESO/ST-ECF Archive, using the webpage of ESO.

I thankfully acknowledge the database SIMBAD operated at CDS (Strasbourgh, France).

ERRATA to CGPN(1967) and to the SUPPLEMENTS:

Several corrections have already been published in the years 1967 and 1969 (L. Perek, L. Kohoutek, 1967, Bull. Astron. Inst. Czech. 18, 252; 1969, ibid. 20, 381). We include them in the following list which contains the errata to CGPN(1967) as well as to the supplements S1-S5. "New FC" means a new finding chart in CGPN(2000) because the chart given in CGPN(1967) indicates the respective object in the wrong position (in most cases wrong in the original chart from the discoverer or in the literature), or there is no identification in CGPN(1967) at all.

CGPN(1967):

Page	Design./Neb.	Column	Instead of	Read
15		Surface brightnesses	H mag/cir.1' =7.57−logS	H mag/cir.1' =7.57−**2.5**logS
28		Ha	Haro G.,1952, Bol.Ton.y T.1 No.1, 93.	Haro G.,1952, Bol.Ton.y T.1 No.1, **9**.
44	He 2-248	Design.	341−29.1	341−**9**.1
44	Me 2-1	Design.	342+17.1	342+**2**7.1
44	NGC 6072	Design.	342+0.1	342+**1**0.1
48	356+2.1	Name	Th 3−31	Th 3−**13**
68	55−1.1	Name	K 3−42	K 3−4**3**
74	144−15.1	bII	+15.54	−15.54
74	171−25.1	Name	Ba I	Ba **1**
78	190−17.1	Rad.velocity	−234	**−23.4**
86	229−2.1	Position	8 08.0	**7** 08.0
91	261+8.1	Spectrum	4340-6717 2	4340-6717 **8**
104	318+41.1	Dimensions	W 61a	**VV** 61a
107	Cn 1-2	Magnitude	−11.10 F Hβ	−11.**0**0 F Hβ
118	352+5.1	Rad.velocity	0 Mi 57 +32 Ma 64	+**32** Mi 57 **0** Ma 64
122	355−3.2	Name	H 2 23	H 2**-**23
126	358+7.1	Position	17 08 33.9	17 0**9** 33.9
128	Th 3-26	Design.	368+3.8	3**5**8+3.8
132	359+3.2	Position	18 22 56	1**7** 22 56
138	1−1.1	Position	1960 Mi 59	19**5**0 Mi 59
140	2−3.1	Position	−28 12 49	−28 **21** 49
142	2−7.1	Position	1960 Koal	19**5**0 Koal
146	4+6.1	Position	−21 26	−21 26 28
148	5+5.1	Position	−21 30 24	−21 30 **3**4
152	7−6.1	Position	1960 Koal	19**5**0 Koal
159	11−9.1	Spectrum	VVal 45	**Vy**al 45
160	13−3.1	Position	18 22 33.3	18 2**6** 33.3
166	25−17.1	Position	19 36 42.4	19 36 **04.24**

172	33−2.1	Position	18 54 28.56	18 5**7** 28.56
184	49+2.1	Dimensions	Ko 46d	Ko **64**d
198	68+1.2	Position	19 47 24	19 **57** 24
205	86−8.1	Detailed inv.	exp.8	ex**c**.8
220	159−15.1	Rad.velocity	+10.3	−10.3
242	107+2.1	Name	7375	73**54**
253	6+2.5 (17:49.7)	Name	M 1-13	M 1-**31**
256	107+21.1 (20:05.3)	Name	K 1-26	K 1-**6**
256	K 4-37 (19:49.0)	Design.	62+2.1	6**6**+2.1
265	He 2-131	Design.	315−3.1	315−**1**3.1
266	He 2-262	Name	**H 2-16**	–
266	He 2-261	Name	–	**H 2-16**
274	Th 1-4		Pe 1-21	**Pe 1-21**
Pl.6	249−5.1	A 23	no ident.	**new FC**
10	265−2.1	Ve 26		**new FC**
12	274+2.1	He 2-34	id. uncert.	**new FC**
15	285+1.1	He 2-52	id. uncert.	**new FC**
16	288−0.1	Hf 39		**new FC**
30	324−1.1	He 2-133		**new FC**
32	326−10.1	Cn 1-2		**new FC**
46	351−5.1	He 2-275		*)
47	353+8.1	MyCn 26		**new FC**
49	356−0.1	Th 3-34		**new FC**
53	357−4.3	H 1-43		**new FC**
55	358+1.4	Bl B	id. uncert.	**new FC**
55	358−2.1	M 4-7		**new FC**
55	358−2.2	Bl 3-6		*)
61	1+5.1	H 1-14		**new FC**
63	2+1.1	H 2-20		**new FC**
63	2−1.1	Pe 2-11		**new FC**
69	4−5.2	He 2-376		**new FC**
88	37−5.1	A 58		**new FC**
98	59−1.1	He 1-3		**new FC**
105	72−17.1	A 74	no ident.	**new FC**
112	144+6.1	1501	scale 1'	scale **5**'
Pl.113	164+31.1	2474-5	2474-5	**JnEr 1**

*) Correct finding chart in Acker et al. (1988).

SUPPLEMENTS:

Supplement 1 (Proc. IAU Symp. No.76, p.47; 1978):

All names of PNe were printed in capital letters. This was therefore a mistake in some cases. For this reason instead of

AE, CN, HE, KR, LO, SA, SH, SUWT, WE

read

Ae, Cn, He, Kr, Lo, Sa, Sh, SuWt, We

in the text, in Tables 1 and 2, in the Appendix to Table 1 as well as in the corresponding remarks.

Supplement 2 (Proc. IAU Symp. No.103, p.17; 1983):

Page	Design.	Name	Instead of	Read
18		Pu 2	175+6.1	**173+3.1**
		Pu 2	5 59.20	5 **3**9.20
18	217+2.1		Sp 3-1	S**P** 3-1
20	31−0.1		−0 06.8	−**1** 06.8
22		References to Table 1	Sp 3	S**P** 3
23	65−27.2		CiPg	**CIPG**
23		NGC 1985	176−0.1	176+0.1

Supplement 3 (Proc. IAU Symp. No.131, p.29; 1989):

31	11+17.1*		DeHt 1	DeHt **10**

Supplement 4 (Proc. IAU Symp. No.155, p.36; 1992; Astron. Nachr. 315, 63; 1994):

65	9−07.1	Remarks	NGC 6566	NGC 6**65**6

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The correct spelling of some names used in the tables:

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Belczyński K.
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