ISO/IEC JTC 1/SC 2/WG 2
PROPOSAL SUMMARY FORM TO ACCOMPANY SUBMISSIONS
FOR ADDITIONS TO THE REPERTOIRE OF ISO/IEC 10646[1]
Please fill all the sections A, B and C below.
Please read Principles and Procedures Document (P & P) from http://www.dkuug.dk/JTC1/SC2/WG2/docs/principles.html **for guidelines and details before filling this form.**
Please ensure you are using the latest Form from http://www.dkuug.dk/JTC1/SC2/WG2/docs/summaryform.html**.**
See also http://www.dkuug.dk/JTC1/SC2/WG2/docs/roadmaps.html **for latest** *Roadmaps.*

A. Administrative

1. **Title:**   **Proposal to encode the Greek Zero Sign in the UCS**
2. Requester's name: **Raymond Mercier**
3. Requester type (Member body/Liaison/Individual contribution):   **Expert Contribution**
4. Submission date: **2004-2-8**
5. Requester's reference (if applicable): _____
6. Choose one of the following:
This is a complete proposal: _____
or,   More information will be provided later: _____

B. Technical - General

1. Choose one of the following:
          a. This proposal is for a new script (set of characters):   _____
                    Proposed name of script: _____
.   b. The proposal is for addition of character(s) to an existing block: **Yes**
                    Name of the existing block: **Ancient Greek Numerical Characters (1018A)**
2. Number of characters in proposal: **1**
3. Proposed category (select one from below - see section 2.2 of P&P document):   **C-Major extinct**
 A-Contemporary _____ B.1-Specialized (small collection) _____ B.2-Specialized (large collection)   _____
 C-Major extinct _____   D-Attested extinct   _____ E-Minor extinct   _____
 F-Archaic Hieroglyphic or Ideographic   _____   G-Obscure or questionable usage symbols   _____
4. Proposed Level of Implementation (1, 2 or 3) (see Annex K in P&P document):   **Level 1**
          Is a rationale provided for the choice?   _____
                    If Yes, reference: _____
5. Is a repertoire including character names provided?   **Yes**
          a. If YES, are the names in accordance with the "character naming guidelines"
                    in Annex L of P&P document?   **Yes**
          b. Are the character shapes attached in a legible form suitable for review?   **Yes**
6. Who will provide the appropriate computerized font (ordered preference: True Type, or PostScript format) for
          publishing the standard?   _____
          If available now, identify source(s) for the font (include address, e-mail, ftp-site, etc.) and indicate the tools
          used: **RaymondM@compuserve.com**
7. References:
          a. Are references (to other character sets, dictionaries, descriptive texts etc.) provided? **Yes**
          b. Are published examples of use (such as samples from newspapers, magazines, or other sources)
                    of proposed characters attached?   **Yes**
8. Special encoding issues:
          Does the proposal address other aspects of character data processing (if applicable) such as input,
          presentation, sorting, searching, indexing, transliteration etc. (if yes please enclose information)?
          No
9. Additional Information: **The property for this character is No**
Submitters are invited to provide any additional information about Properties of the proposed Character(s) or Script
that will assist in correct understanding of and correct linguistic processing of the proposed character(s) or script.
Examples of such properties are: Casing information, Numeric information, Currency information, Display behaviour
information such as line breaks, widths etc., Combining behaviour, Spacing behaviour, Directional behaviour, Default
Collation behaviour, relevance in Mark Up contexts, Compatibility equivalence and other Unicode normalization
related information. See the Unicode standard at http://www.unicode.org for such information on other scripts. Also
see http://www.unicode.org/Public/UNIDATA/UCD.html and associated Unicode Technical Reports for information
needed for consideration by the Unicode Technical Committee for inclusion in the Unicode Standard.

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[1] Form number: N2652-F (Original 1994-10-14; Revised 1995-01, 1995-04, 1996-04, 1996-08, 1999-03, 2001-05, 2001-09, 2003-11)

C. Technical - Justification

1. Has this proposal for addition of character(s) been submitted before?   **No**

    If YES explain _____

2. Has contact been made to members of the user community (for example: National Body,
    user groups of the script or characters, other experts, etc.)?   _____

        If YES, with whom?   **Members of the scholarly community**

        If YES, available relevant documents: _____

3. Information on the user community for the proposed characters (for example:
    size, demographics, information technology use, or publishing use) is included?   **Scholars**

    Reference: _____

4. The context of use for the proposed characters (type of use; common or rare)   **Common in Greek papyri,
manuscripts and printed editions**

    Reference:

5. Are the proposed characters in current use by the user community?   **Yes**

    If YES, where? Reference: **See proposal**

    Character present in various editions of Greek texts, used by scholars of Greek

6. After giving due considerations to the principles in the P&P document must the proposed characters be entirely
    in the BMP?   **Yes**

        If YES, is a rationale provided?   **Accordance with the Roadmap**

        If YES, reference: _____

7. Should the proposed characters be kept together in a contiguous range (rather than being scattered)?   **N/A**

8. Can any of the proposed characters be considered a presentation form of an existing
    character or character sequence?   **No**

        If YES, is a rationale for its inclusion provided?   _____

        If YES, reference: _____

9. Can any of the proposed characters be encoded using a composed character sequence of either
    existing characters or other proposed characters?   **No**

        If YES, is a rationale for its inclusion provided?   _____

        If YES, reference: _____

10. Can any of the proposed character(s) be considered to be similar (in appearance or function)
    to an existing character?   **No**

        If YES, is a rationale for its inclusion provided?   _____

        If YES, reference: _____

11. Does the proposal include use of combining characters and/or use of composite sequences? **No**

        If YES, is a rationale for such use provided?   _____

        If YES, reference: _____

        Is a list of composite sequences and their corresponding glyph images (graphic symbols)
        provided?   _____

        If YES, reference: _____

12. Does the proposal contain characters with any special properties such as
    control function or similar semantics?   **No**

        If YES, describe in detail (include attachment if necessary)   _____

13. Does the proposal contain any Ideographic compatibility character(s)?   **No**

        If YES, is the equivalent corresponding unified ideographic character(s) identified? _____

        If YES, reference: _____

# Consideration of the Greek symbol 'zero'

Raymond Mercier
RaymondM@compuserve.com

The Unicode Character Set has no codepoint for 'zero' among the Greek symbols. This symbol occurs notably whenever a sexagesimal notation is used in astronomical texts to record degrees, minutes and seconds, or hours minutes and seconds. In this proposal I present evidence from papyri, manuscripts and printed texts to show the various forms of this symbol, and I urge the acceptance of an agreed codepoint for it. This is important if editions of Greek astronomical texts are to be recorded satisfactorily in Unicode.

As will be clear from these notes zero appears in a variety of forms, with a marked change towards the end of the medieval period. Nevertheless it might be best to regard these are scribal variations, without any need to create a separate codepoint for the later forms.

CUNEIFORM TEXTS

In later Babylonian astronomical texts, of the Seleucid period, the zero in sexagesimal notation is marked by a separation symbol. This is listed in Labat's *Manuel d'Épigraphie Akkadienne*,

			Signe de séparation.	
⋪				378
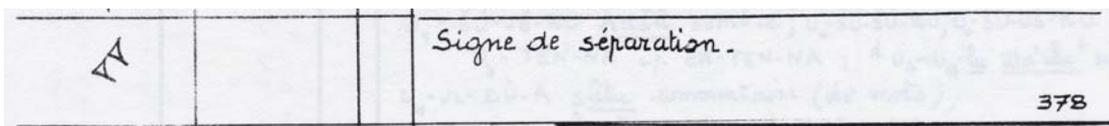
This is found in astronomical texts, such as this, reproduced from Kugler's *Babylonische Mondrechnung*, Tafel II, and its transcription, p. 34.
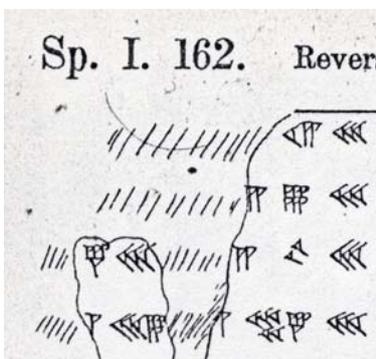
Zeile	F''			
1.	2^0	12'	30''	'''
2.	2	6	30	
3.	2	0	30	
4.	1	54	30	

The zero, marked by a separation sign, is clear in the third row.

As Jones remarks in the passage quoted below, the cuneiform sign is more plausibly the source of the zero in the papyri, rather than from an abbreviation of οὐδέν

PAPYRI

Erik J.Knudtzon, O.Neugebauer, 'Zwei astronomische Texte', *Bulletin de la Société Royale de Lettres de Lund* (*Kungl. Humanistiska Vetenskapssamfundet i Lund*) 1946-7, 77-88, 2 Plates.

This is a study of an astronomical table in P. Lund 35a . The zero appears clearly in Tafel 1, in line 7 of col.vii : .
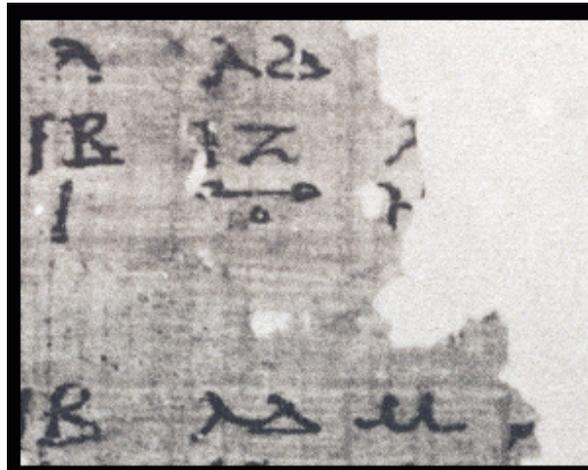
which is transcribed (p. 79) as

Georges Ifrah, *Histoire universelle de chiffres*, Paris : Robert Lafont, 1994.

In Vol. I, p. 375, we have an illustration of other forms of zero found in papyri.

PAPYRUS GRECS

ᔆ ᔆ ᔆ	� symbol	ō	⟨symbol⟩
+ Iᵉʳ siècle	après + 109	IIᵉ siècle	467 ap. J.-C.
Pap. Aberdeen	Pap. Lund	Pap. London	Pap. Michigan
Nº 128	Inv. 35 A	Nº 1278	Inv. 1454
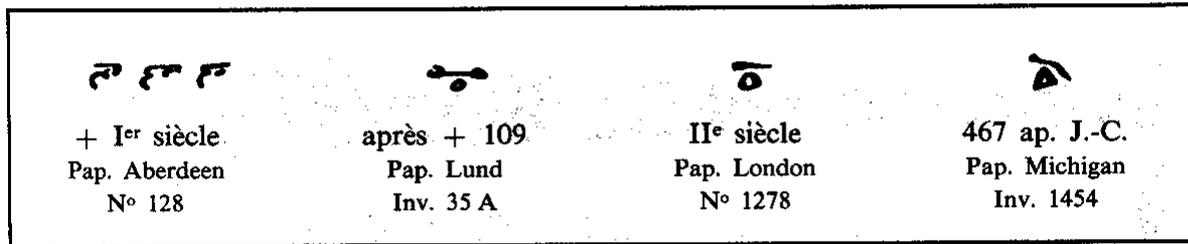
Fig. 13.74 A. – *Le zéro « séxagimal » des astronomes grecs.*

The form shown for Pap. London 1278 is more representative of that found in other astronomical papyri. That shown in Pap. Aberdeen 128 is clearly a cursive form, from which the ductus is clear, a line starting at the upper right, and ending with a half-drawn circle under the stroke.

A. Jones, *Astronomical Papyri from Oxyrhynchus (P. Oxy. 4133–4300a),* American Philosophical Society, 1999.

p. 61:

> The symbol for zero is a special case in that it probably does not stand in place of a specific word. It represents either an 'empty' place in a sexagesimal fraction or 'no whole units' (usually preceding a sexagesimal fraction). It was always closely tied to the sexagesimal notation, and only occurs in astronomical contexts. The most common form of zero in the papyri is a small circle with a horizontal stroke above it, but there are many variations (Fig. 16, below). The stroke is not the horizontal bar sometimes written above alphabetic numerals; the latter is never drawn above a zero, and is generally written further above the base line. I share Neugebauer's doubts of the supposition often repeated in paleographical handbooks that the symbol was an abbreviation of οὐδέν (Neugebauer [1957b] 14). It was the counter- part of the cuneiform punctuation mark ⟨symbol⟩ , which was used in the same way in sexagesimal numerals, and the direct ancestor of the zero of Arabic astronomical manuscripts (Irani [1955]). A Demotic counterpart is known only from P. Carlsberg 32, where the occurrences are unfortunately damaged so that it is not clear whether the horizontal stroke that can be seen was the entire symbol or only part of it.
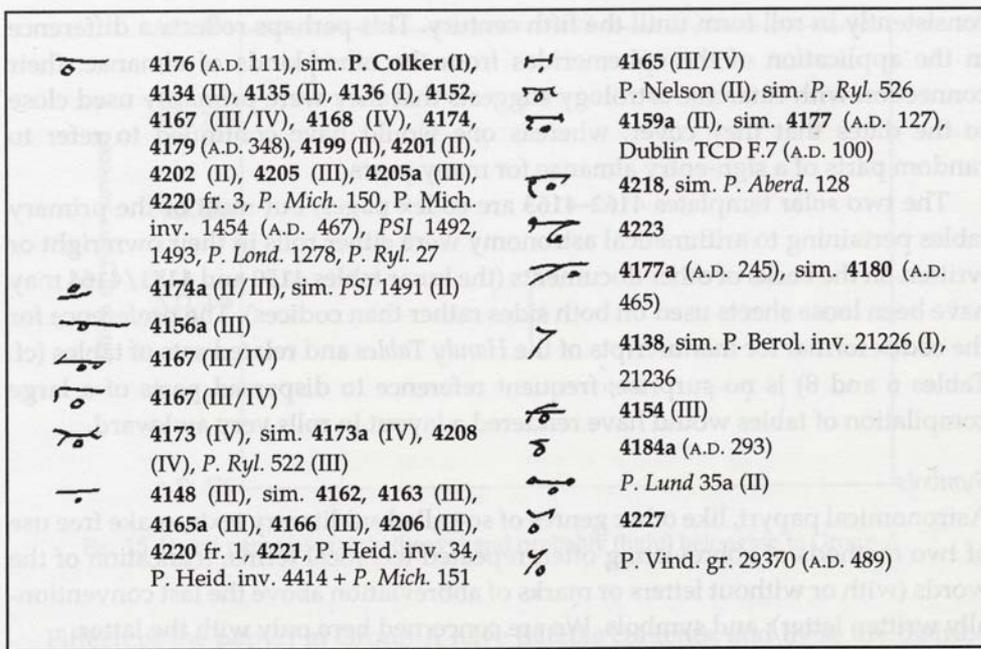
FIG. 16. Forms of the zero symbol in astronomical papyri.

There are a great many tables in which the zero is shown. Of these there are eleven photographs in the Plates. This is a list of the papyri that are illustrated in the plates, together with the form of zero symbol used in each.

	Plate	line etc	zero
4136	II		o
4138	XI	10	o
4152	III	3,4	o
4154	III	6	o
4155	III	bottom	o
4163	IV	bottom	o
4165	VI	col.iii, etc	o
4167 fr.3	V	col.v	o
4174a	VI	col.i line 1	o
4203a	X		o
4205	V	col.i, bottom	o

The photo of 4167 in Plate V is reasonably clear, with many examples of zero.
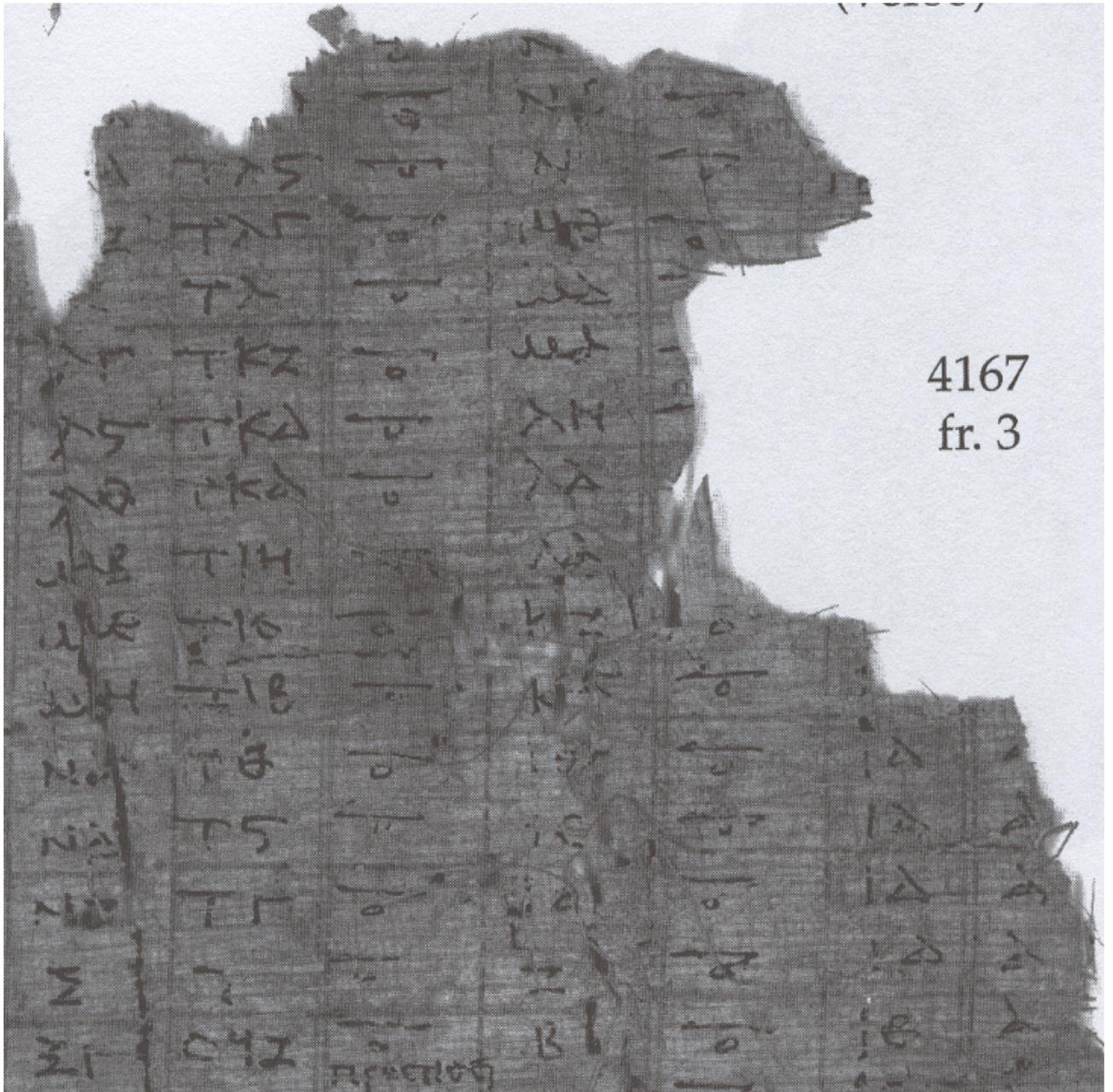
4167
fr. 3

The zero shown here is quite typical of all the papyri shown in the Plates, with the curious exception of P4174a, where it appears as ̲o̲, with the line drawn under the small o.

MANUSCRIPTS

Fifth century

O. Neugebauer and H.B. van Hoesen, *Greek Horoscopes*, American Philosophical Society, 1959; pp. 152-157, 188.

The examples in this volume are taken from a variety of sources, epigraphs, papyri, and manuscripts. Among the manuscripts there is a clear example in the horoscope L.497. This is dateable to A.D. 497, and is found in three manuscripts Vienna, Cod. phil. gr. 179; Modena, Cod. 85; Florence, Laur 28/34. The zero is found in the line

Transcription:

$$\sigma \, \delta \, \iota\bar{\zeta} \, \lambda\acute{\epsilon} \cdot \exists \, \bar{\delta} \, \iota\acute{\beta}$$
$$\tau\acute{\upsilon}\chi\eta \, \iota\bar{\varsigma} \, \bar{o}$$
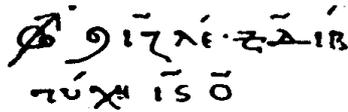
Mars Leo 17;35, Jupiter 4;12
Lot 16;0

Here the bar over the zero is rather shorter than in the papyri, so the result is much the same as omicron + macron.

Ninth century

In ninth century Byzantine manuscripts the character for zero differs little from the papyri. For example in Vat gr 1291 fol.31,

ΣOA	ΛZ	IB	A
ΣOB	MH	IB	Ō
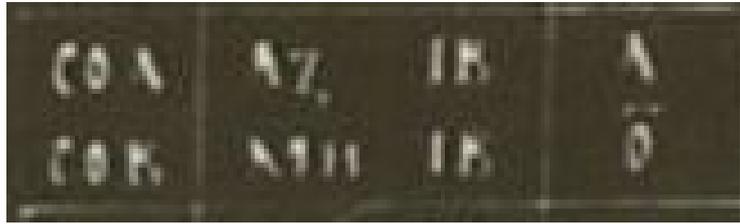
Here the zero consists of a full size uncial omicron with a macron.

Florence Laur 28/26 (ca 886-912) fol. 121.
Uncial script.
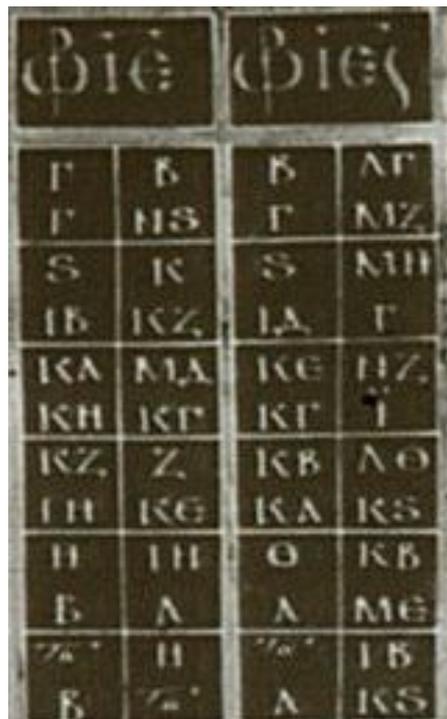
The last two lines read:

ō	H	ō	IB
B	ō	A	KΣ

Here the zero shows a closer resemblance to that in the papyri than to the zero in the contemporary manuscript Vat gr 1291 shown above.

Fourteenth century

In the some late medieval manuscripts the form of the symbol has altered considerably. For example, from a fourteenth century Byzantine manuscript (Escorial Σ-I-11, fol.53r), a copy of the Persian Syntaxis. For zero we have a character that might have arisen from a very cursive handling of the older ō, or $\overline{o}$, but is nevertheless quite different from it.
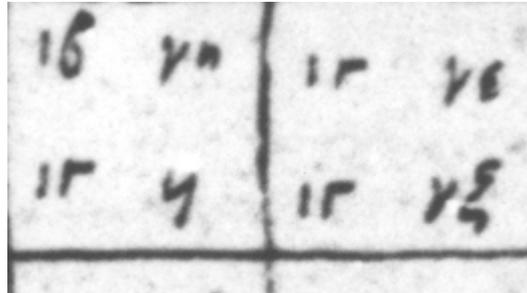
which reads

12;58	13;55
13;0	13;57

Here the zero is quite similar to the Coptic ϥ (U+03E5); of course it is not suggested that there is any historical connection with the Coptic character.

Fifteenth century
Manuscript of the Astronomical Manual of Gemistos Plethon

Vienna phil gr 140, fol.90

The zero appears repeatedly in the central column. This is a small circle surmounted by a line, of such a size that the whole no larger than other Greek characters, that is smaller than omicron + macron.

Twelfth century Arabic
Manuscript of the Zīj al-Sanjarī

Private possession, sold by Quaritch (London), fol.141r.

ا	ō	له
ب	ا	ō
ج	ا	لا
د	ب	ب

The zero symbol clearly follows the Greek papyri.

Twelfth century Arabic
Manuscript of the Zīj al-Sanjarī

Vatican Library, Vat. ar. 761 fol.168.
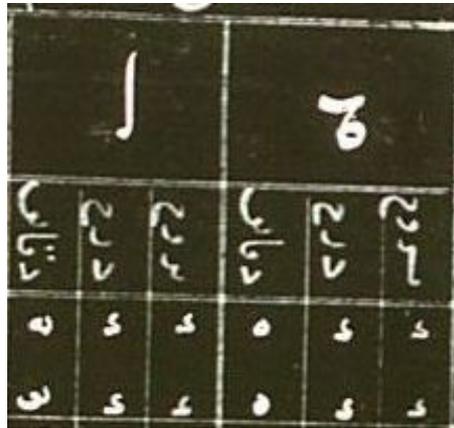
The first row shows an exceptionally clear example of the zero.

Thirteenth century Persian
Manuscript of the Zīj-i Īlkhānī
Cambridge University Library, Browne O.2.7, fol.9r
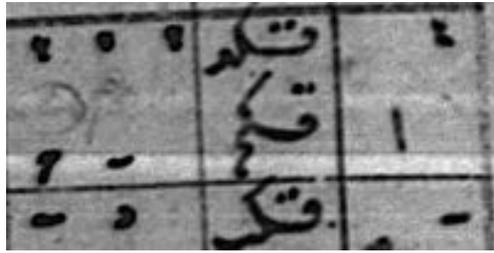
٩ ٩ ٩	قكد	٩
ح ب[٩]	قكج	ا
ب د[٩]	قكب	ب

The zero symbol is clearly a cursive development from the regular circle with the macron. This form is found almost unchanged in the Persian Syntaxis noted above, which is in fact a Greek version of the Zīj-i Īlkhānī.

PRINTED EDITIONS

J.L.Heiberg, *Claudii Ptolemaei, Opera Astronomica Minora*, Leipzig: Teubner, 1907.

In the Greek texts edited here Heiberg has used symbols for the Greek zero that vary from one text to another.

p.78

In this edition of the Planetary Hypotheses, Heiberg, in the last line, has used a simple circle is used to represent zero. It is the same size as the Greek characters.

p.150

Through the edition of this text, Inscriptio Canobi, Heiberg has used an omicron together with an accent sometimes called Vrachy.

p.169

In this edition of the Handy Tables Heiberg has used an ordinary Latin number zero.

Ivor Thomas, *Greek Mathematics*, volume II, Loeb Classical Library, London & Cambridge Mass.,1951.

In this volume zero is found in extracts from Ptolemy's *Syntaxis*, where it is printed as a circle, slightly distinct from omicron.

Compare this zero with lower case omicron in the table on page 444.

p. 444
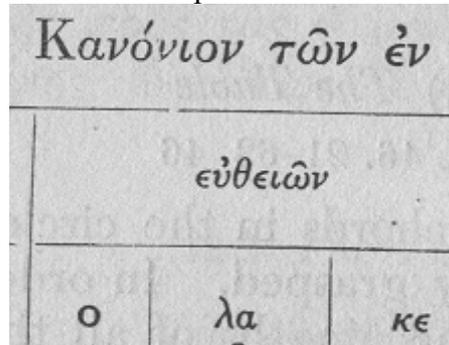
The number is 0;31,25. written in the way that is now commonplace for sexagesimal numbers.

Elsewhere a larger circle is used for zero, which may be compared with the upper case omicron (p.422)

p.440
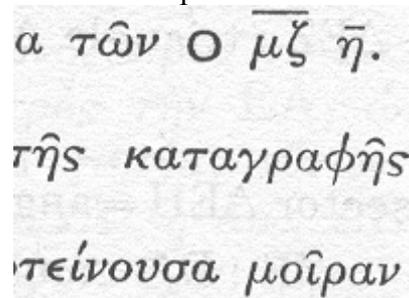
p.422
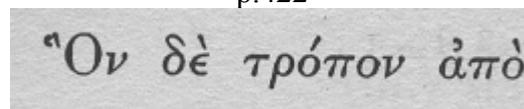
These show that although the editor has not been entirely consistent in the form of zero, he has always used a character differing from the lower and upper case omicron. On the other hand the Latin letter O in Arial font, is very close to this 'zero'. The number is 0;47,8.

Ancient Greek Numbers
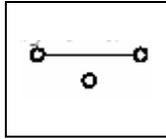
 1018A

GREEK ZERO SIGN

Georges Ifrah, *Histoire universelle de chiffres*, Paris : Robert Lafont, 1994.

A. Jones, *Astronomical Papyri from Oxyrhynchus (P. Oxy. 4133–4300a)*, American Philosophical Society, 1999.

Erik J.Knudtzon, O.Neugebauer, 'Zwei astronomische Texte', *Bulletin de la Société Royale de Lettres de Lund* (*Kungl. Humanistiska Vetenskapssamfundet i Lund*) 1946-7, 77-88, 2 Plates.

F. X. Kugler, *Babylonische Mondrechnung*, Freiburg im Breisgau, 1900.

R. Labat, *Manuel d'Épigraphie Akkadienne*, Paris, 1948.

Ivor Thomas, *Greek Mathematics*, volume II, Loeb Classical Library, London & Cambridge Mass.,1951.