TRANSACTIONS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA
FOR PROMOTING USEFUL KNOWLEDGE

NEW SERIES—VOLUME 64, PART 7
1974

with best wishes
and Thanks!
Derek J. de Solla Price

GEARS FROM THE GREEKS

THE ANTIKYTHERA MECHANISM—A CALENDAR COMPUTER FROM *ca.* 80 B.C.

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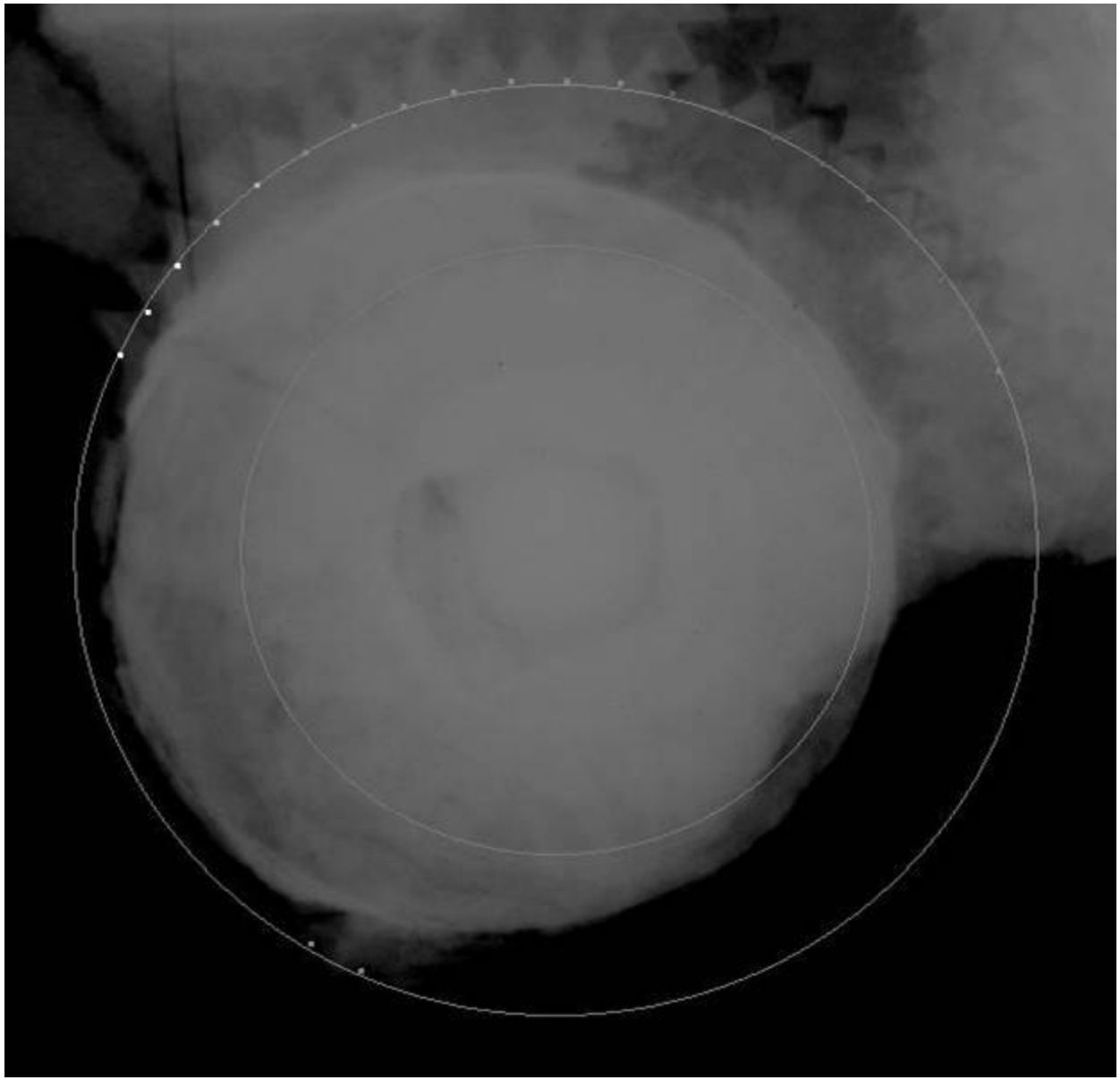
THE AMERICAN PHILOSOPHICAL SOCIETY
INDEPENDENCE SQUARE
PHILADELPHIA

November, 1974

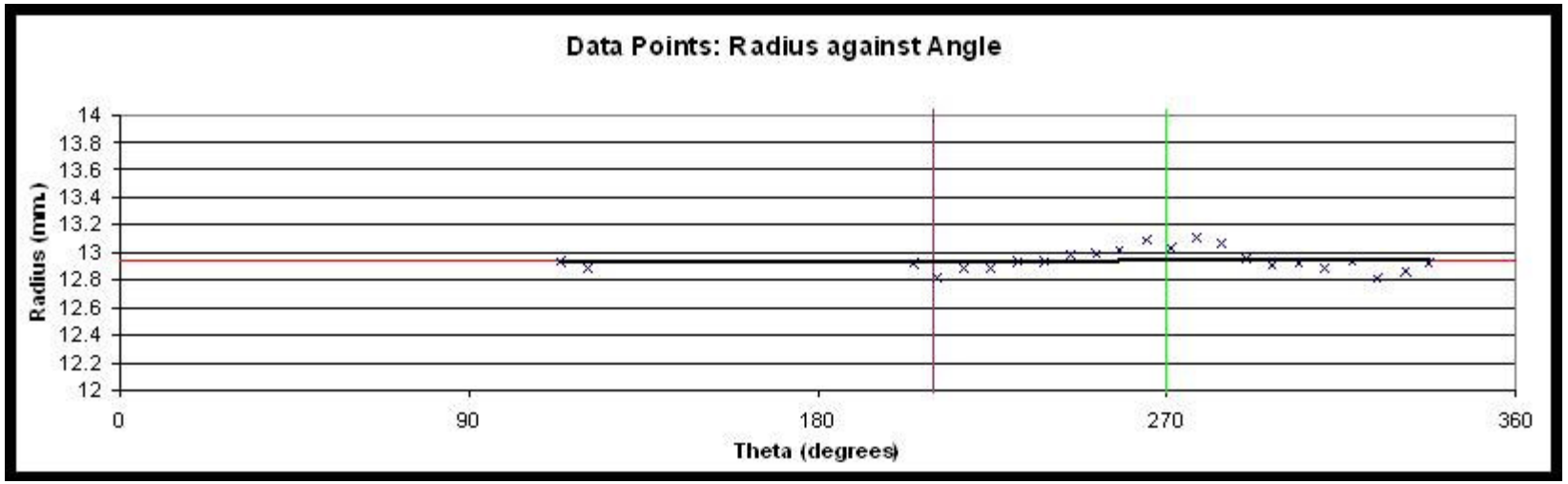
M.T. Wright on the Antikythera Mechanism

to November 2006

- **"Simple X-ray Tomography and the Antikythera Mechanism", *PACT (Révue du groupe européen d'études pour les techniques physiques, chimiques, biologiques et mathématiques appliquées à l'archéologie* or *Journal of the European Study Group on Physical, Chemical, Biological and Mathematical Techniques Applied to Archaeology)*, vol.45 (1995), pp. 531 – 543. (The issue, entitled Archaeometry in South-Eastern Europe, was devoted to the proceedings of the 2nd. Conference under that title, held in Delphi, 19th – 21st April, 1991.)**
- **(jointly with A.G. Bromley and H. Magou.)**
-
- **"Current Work on the Antikythera Mechanism", Proc. Conf. *Αρχαία Ελληνική Τεχνολογία* (*Ancient Greek Technology*), Thessaloniki, 4 – 7 September 1997, pp. 19 – 25.**
- **(jointly with A.G. Bromley)**
- **"A Planetarium Display for the Antikythera Mechanism", *Horological Journal*, vol. 144 no. 5 (May 2002), pp. 169 – 173, and vol. 144 no. 6 (June 2002), p. 193.**
- **"Towards a New Reconstruction of the Antikythera Mechanism", ed. S.A. Paipetis, Proc. Conf. *Extraordinary Machines and Structures in Antiquity* (Ancient Olympia, August 2001), Peri Technon, Patras 2003, pp. 81 – 94.**
- **"In the Steps of the Master Mechanic", Proc. Conf. *Η Αρχαία Ελλάδα και ο Σύγχρονος Κόσμος* (*Ancient Greece and the Modern World*) (Ancient Olympia, July 2002), University of Patras 2003, pp. 86 – 97.**
- **"Epicyclic Gearing and the Antikythera Mechanism, part 1", *Antiquarian Horology*, vol. 27 no. 3 (March 2003), pp. 270 – 279.**
- **Eds. N. Easterbrook et al., *Master Seafarers: the Phoenicians and Greeks* (vol. 2 of *Encyclopaedia of Underwater Archaeology*), Periplus, 2003.**
- **A short contribution concerning the Antikythera Mechanism.**
- **"The Scholar, the Mechanic and the Antikythera Mechanism" (Printed digest of the S.I.S. annual Invitation Lecture, delivered November 2003), *Bulletin of the Scientific Instrument Society*, no. 80 (March 2004), pp. 4 – 11.**
- **"The Antikythera Mechanism: a New Gearing Scheme", *Bulletin of the Scientific Instrument Society*, no. 85 (June 2005), pp. 2 – 7.**
- **"Ο Μηχανισμός των Αντικυθήρων" (The Antikythera Mechanism), *Αρχαιολογία & Τεχνές* 95 (June 2005), pp. 54 – 60.**
- **"Il meccanismo di Anticitera: l'antica tradizione dei meccanismi ad ingranaggio" (The Antikythera Mechanism: evidence for an ancient tradition of the making of geared instruments), in: E. Lo Sardo (ed.), *Eureka! Il genio degli antichi* (catalogue of an exhibition of that name, National Archaeological Museum, Naples, July 2005 – January 2006), Electa Napoli 2005, pp. 241 – 244.**
- **"Epicyclic Gearing and the Antikythera Mechanism, part 2", *Antiquarian Horology*, vol. 29 no. 1 (September 2005), pp. 51 – 63.**
- **"Counting Months and Years: the Upper Back Dial of the Antikythera Mechanism", *Bulletin of the Scientific Instrument Society*, no. 87 (December 2005), pp. 8 – 13.**
- **"The Antikythera Mechanism and the early history of the Moon Phase Display", *Antiquarian Horology*, vol. 29 no. 3 (March 2006), pp. 319 – 329.**
- **"Understanding the Antikythera Mechanism" *Proc. Conf. Αρχαία Ελληνική Τεχνολογία* (*Ancient Greek Technology*) (Athens, October 2005), Τεχνικό Επιμελητήριο Ελλάδας (TEE) Athens 2006, pp. 49 – 60.**
- **A preprint version of this paper is available at the following website: http://www3.imperial.ac.uk/portal/page?_pageid=73,7692654&_dad=portallive&_schema=PORTALLIVE#MrMichaelWright**
-
- **Other papers in preparation.**

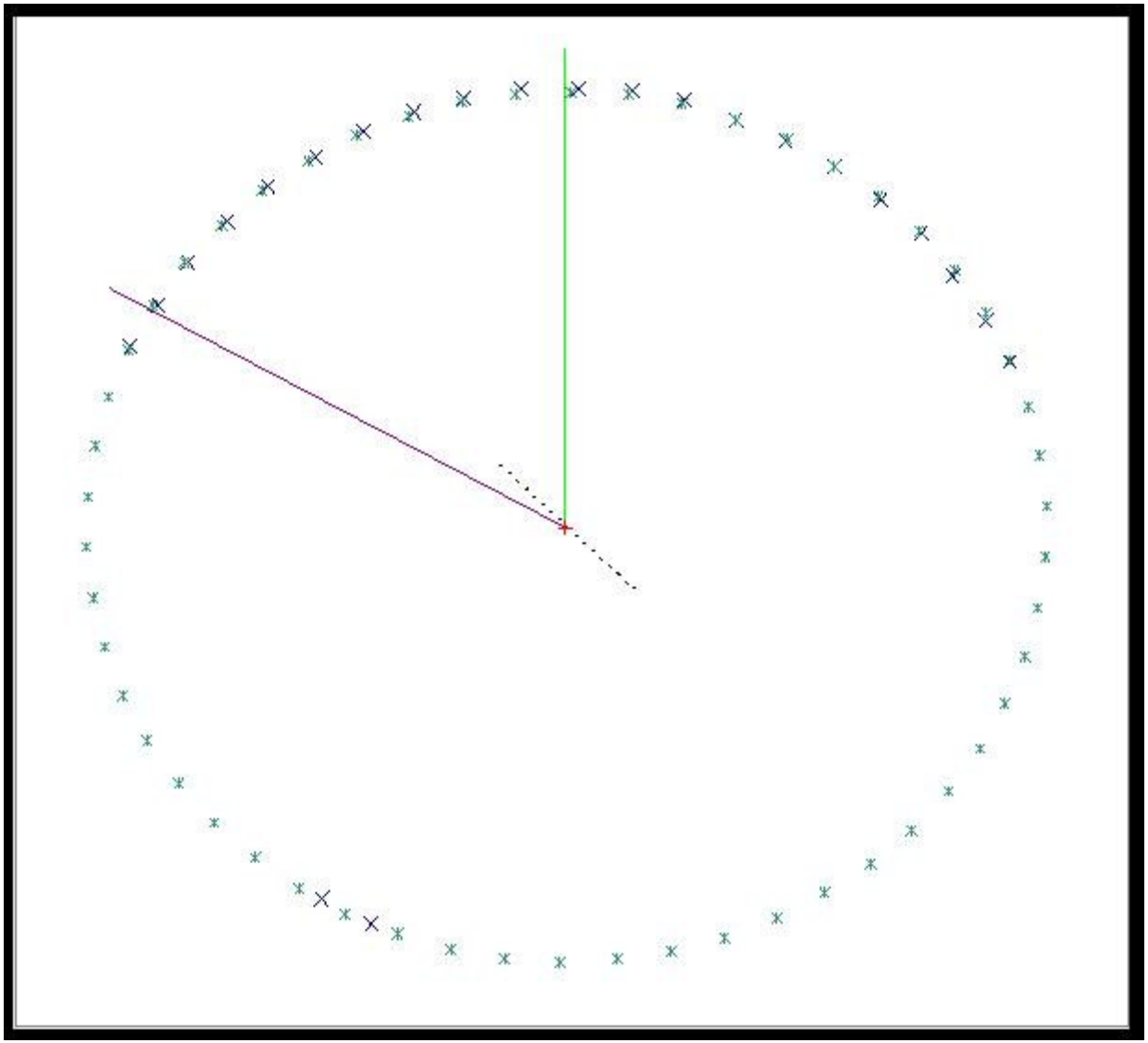


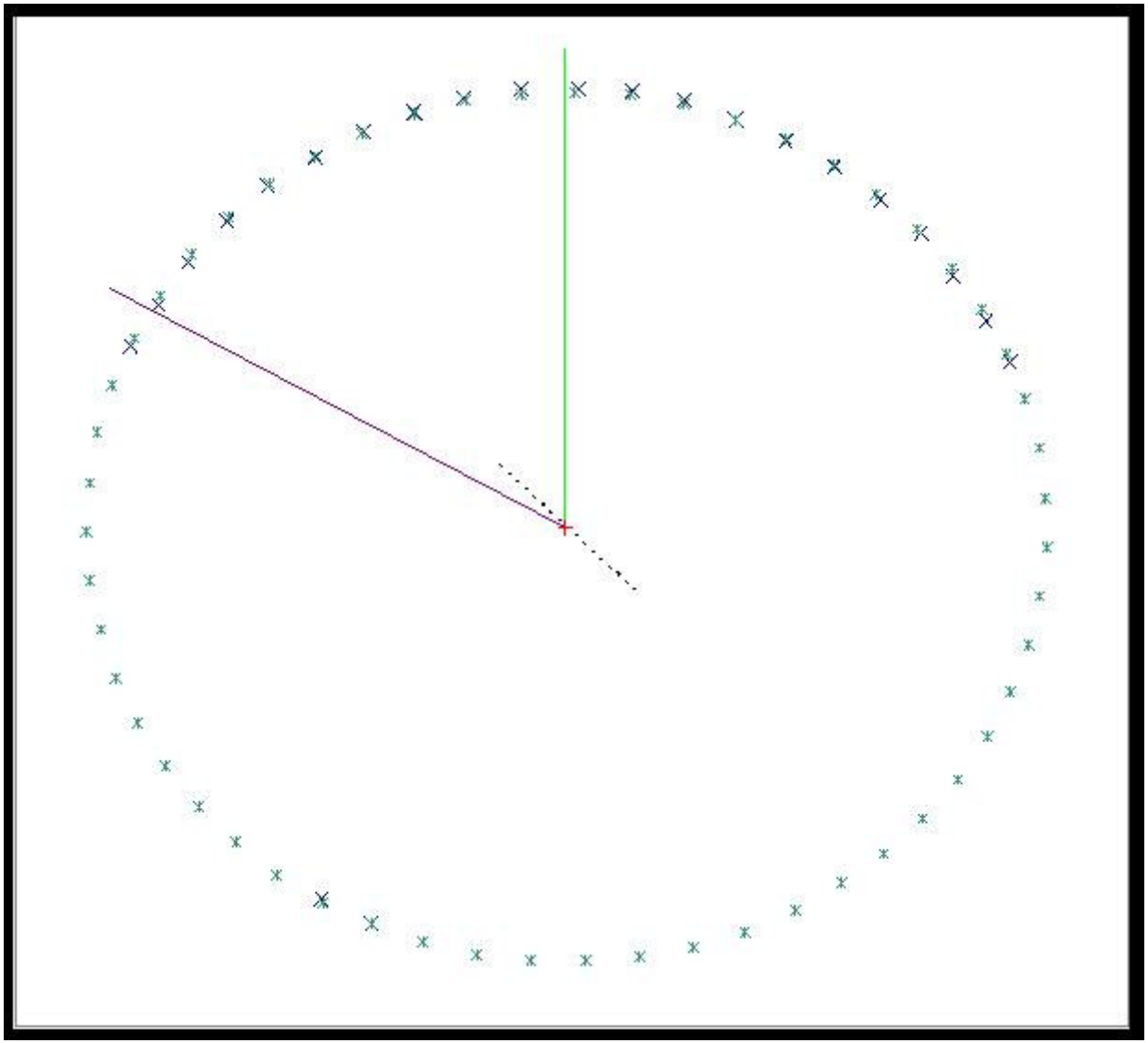
Finding Centre, and testing for Roundness:
centre is adjusted to make trend line horizontal.



Data point	X	Y	θ	dθ	Mean teeth	Suggested	Toothcount
23	9.6	27	113.9489949	136.3677032	20.48	20	**20**
22	8 25	26.25	120.803649	6 854654067	1.03	1	**21**
1	3.1	9 8	204.6017333	83.79808436	12 58	13	**34**
2	3 85	8 6	210.8870965	6 285363105	0 94	1	**35**
3	4 65	7 3	217.6878451	6.800748685	1 02	1	**36**
4	5.7	6.1	224.7799953	7.092150211	1.07	1	**37**
5	6.8	5.05	231.5269124	6.746917049	1.01	1	**38**
6	8.1	4.15	238.5347282	7.007815839	1.05	1	**39**
7	9.4	3.4	245.1724472	6.637719017	1.00	1	**40**
8	10.75	2.85	251.6068831	6.434435835	0.97	1	**41**
9	12.1	2.45	257.8099907	6.203107652	0.93	1	**42**
10	13 65	2.15	264.7381783	6 928187579	1 04	1	**43**
11	15 15	2 15	271 318933	6 580754731	0 99	1	**44**
12	16.6	2 2	277.6784767	6 359543643	0 96	1	**45**
13	18	2.5	283.9511561	6.272679364	0.94	1	**46**
14	19.4	3.05	290.5612215	6.610065404	0.99	1	**47**
15	20.75	3.7	297.2003214	6.639099925	1.00	1	**48**
16	22.05	4.45	303.8622372	6.661915815	1.00	1	**49**
17	23.3	5.45	310.9726197	7.110382526	1.07	1	**50**
18	24.4	6.45	317.568439	6.595819234	0.99	1	**51**
19	25 25	7 7	324.2751497	6.706710771	1 01	1	**52**
20	26 15	9.05	331.5211482	7 245998509	1 09	1	**53**
21	26.8	10.25	337.5812917	6.06014344	0 91	1	**54**

Centre	14 15	15.18



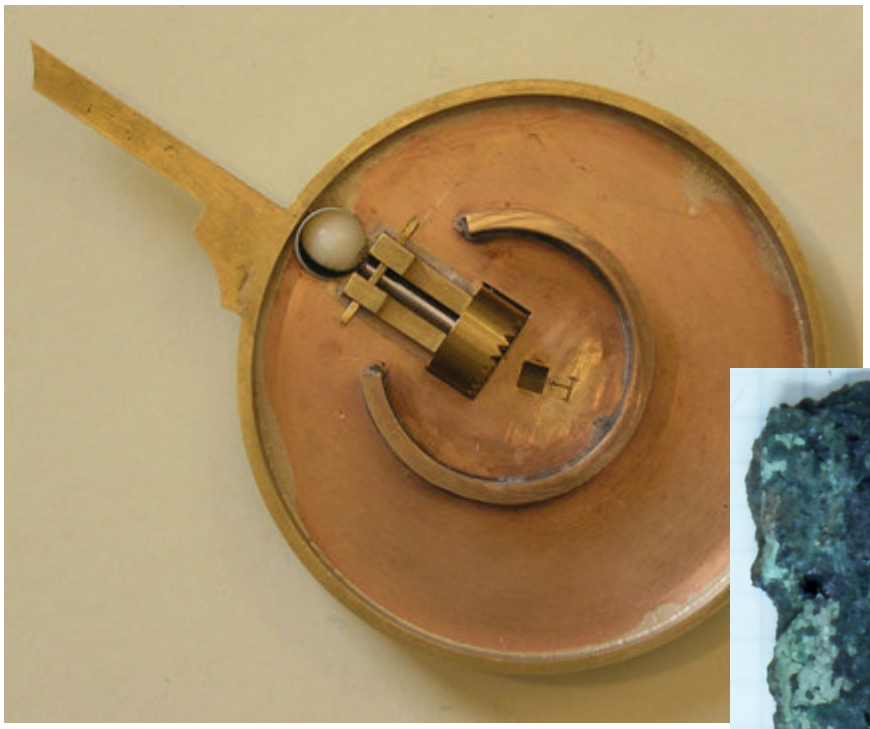


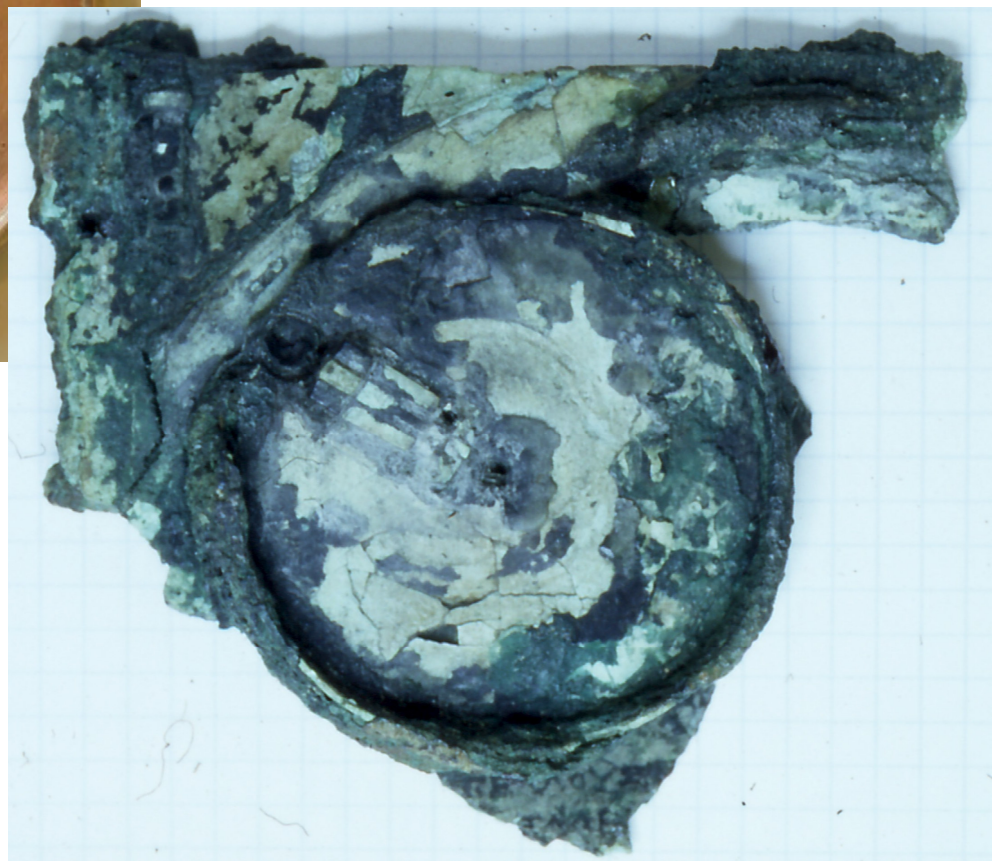
from: **Provisional Wheel Counts** …

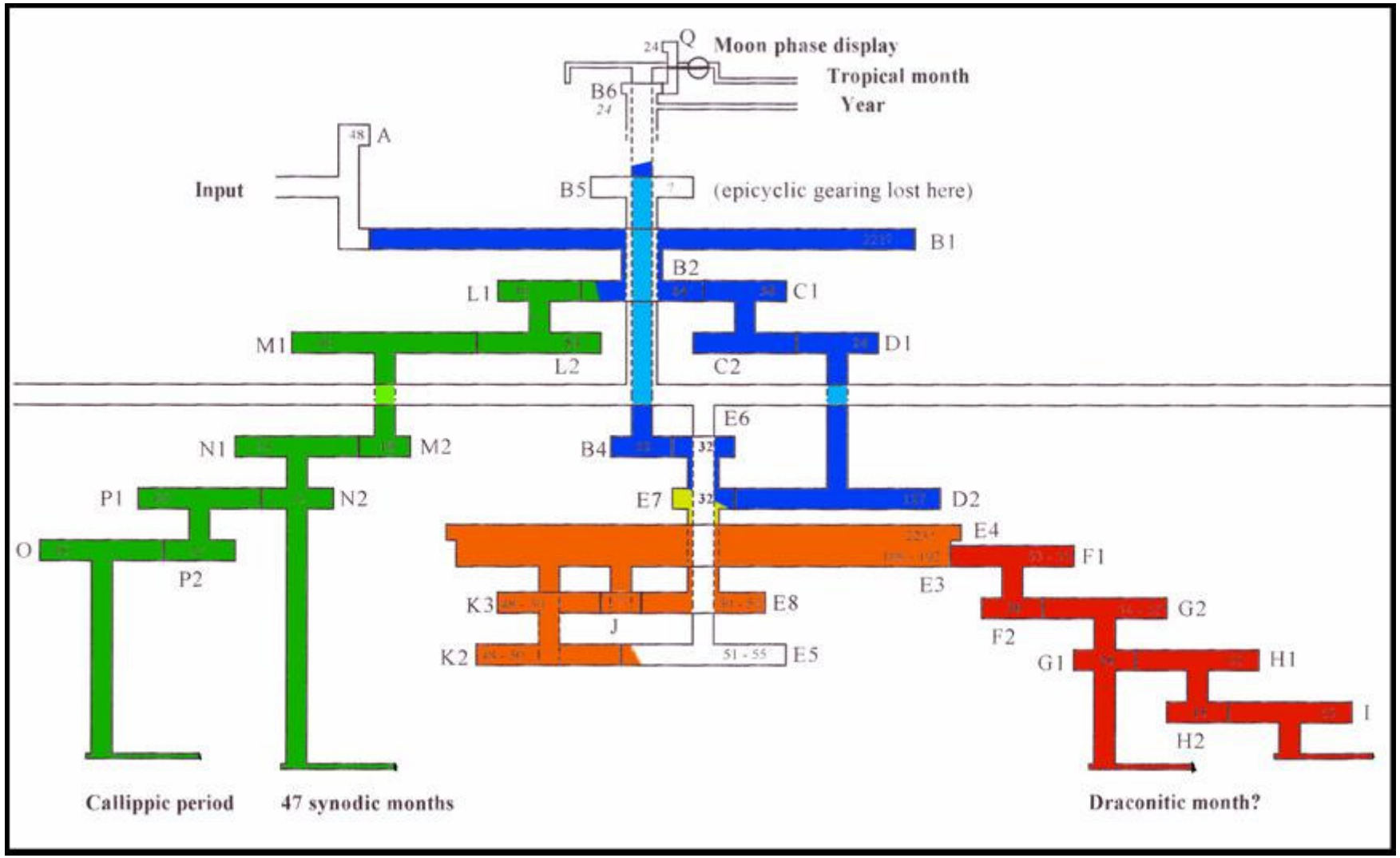
F1 Latest analysis F1 26vii03. Table gives 54, with lacunae of 12.58 and 20.48. There is a pair of adjacent points, otherwise isolated, between these two gaps. On the plot, 54 is seen to fit these two points rather badly, and 55 fits them better while also fitting the other points reasonably well. The lacunae lead to an uncertainty of ±3. Hence: limits 51, 58; preferred value 54 or 55. 9ix03.

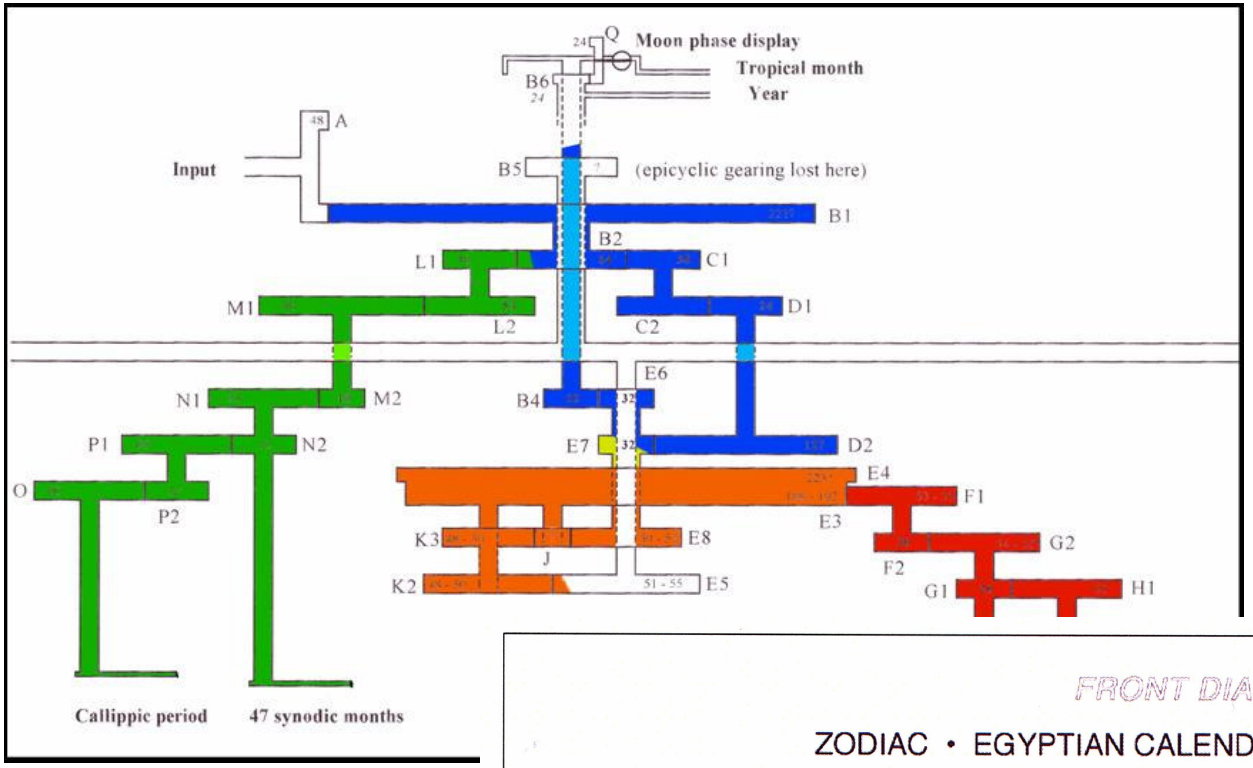
F2 Certainly 30 teeth; all seen. Analysis 18vii03.

and so on …






Q
24
Moon phase display
Tropical month
Year
B6
24
A
48
Input
B5
(epicyclic gearing lost here)
B1
B2
L1
C1
M1
L2
C2
D1
E6
N1
M2
B4
32
P1
N2
E7
32
D2
O
P2
E4
F1
E3
K3
E8
J
F2
G2
K2
51 - 55
E5
G1
H1
I
H2
Callippic period
47 synodic months
Draconitic month?


Q
Moon phase display
Tropical month
Year
B6
A
Input
B5
(epicyclic gearing lost here)
B1
B2
L1
C1
M1
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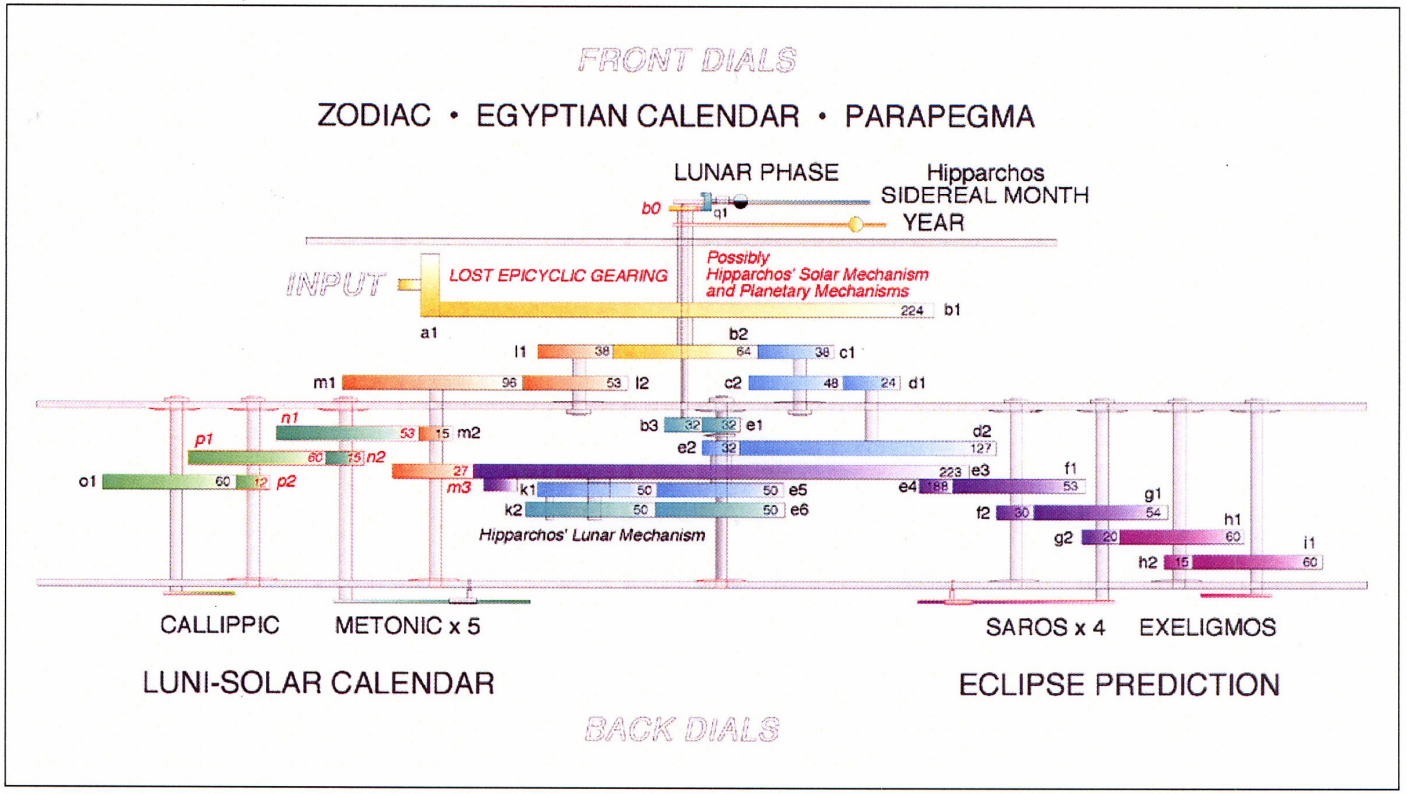
E6
N1
M2
B4
P1
N2
E7
D2
E4
O
P2
F1
E3
K3
E8
G2
F2
J
K2
E5
G1
H1
Callippic period
47 synodic months


FRONT DIALS
ZODIAC • EGYPTIAN CALENDAR • PARAPEGMA
LUNAR PHASE
Hipparchos
SIDEREAL MONTH
YEAR
b0
q1
INPUT
LOST EPICYCLIC GEARING
Possibly
Hipparchos' Solar Mechanism
and Planetary Mechanisms
224 b1
a1
b2
l1 38 64 38 c1
m1 96 53 l2
c2 48 24 d1
n1
53 15 m2
b3 32 32 e1
d2
p1
60 75 n2
e2 42 127
27 223 e3
f1
o1 60 12 p2
m3
k1 50 50 e5
e4 188 53
g1
k2 50 50 e6
f2 30 54
h1
Hipparchos' Lunar Mechanism
g2 20 60
i1
h2 15 60
CALLIPPIC
METONIC x 5
SAROS x 4
EXELIGMOS
LUNI-SOLAR CALENDAR
ECLIPSE PREDICTION
BACK DIALS

231·90
space between
region ranges from
was between

231·90 4

space between [illegible] & base plate in this region ranges from 8 to 10·5 mm; but I think it was between 9·5 & ~~[illegible]~~ 10·5, probably above 10.

Bridge under the dead wings bent from strip c 2mm thick – can't measure width but c 4 mm, might be

towards edge, wooden bar in [illegible], prob. continues [illegible] that seen further up, green crystalline structure to its left. similar to right & then another wood strip going past edge of base plate towards front. Sighting from the other side, inner face lines up w/ edge of base plate

turning front side up, is there a bead in 2nd groove (?) [illegible] [illegible]

front back again, above E4 (id 120's) is a

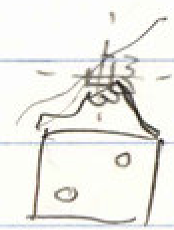
M strip running up toward the oblique break ~~[illegible]~~ aligned to / and M. which shows as a sq. This is [illegible] shows in radiographs; it is made of 2 pieces, not touching

unreached depth prob. because E4 overseals this.

A behind front side towards gear A.

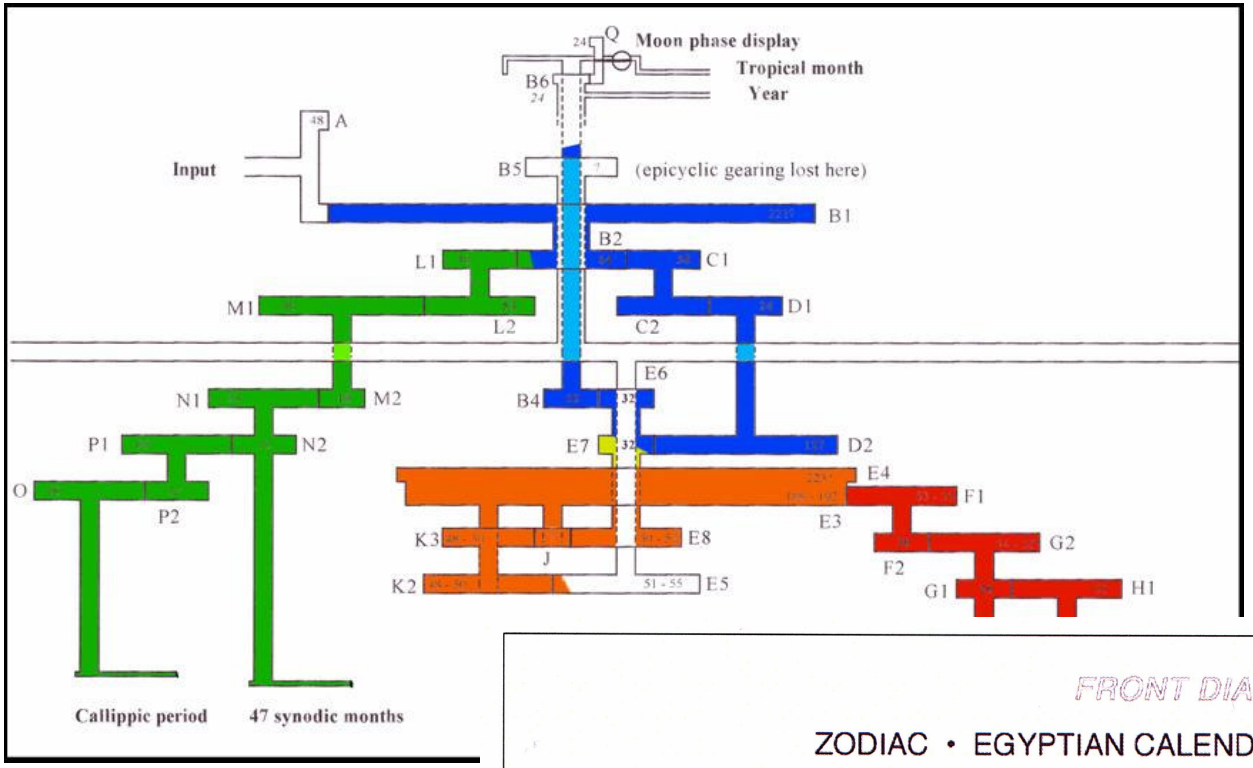
[illegible] agreed [illegible] thickness 13–15 [illegible] part of check [illegible] B1 has rounded [illegible] or perhaps cut to clear (missing) wooden strip "saddle" for A is bent up. gear has been forced up out of it by corrosion or "binding" assembly. Can't see rivets to hold saddle to [illegible]

a sq. This is
made of



E4


ION
OFFICE
ED


Q
Moon phase display
Tropical month
Year
B6
A
Input
B5
(epicyclic gearing lost here)
B1
B2
L1
C1
M1
L2
C2
D1
E6
N1
M2
B4
P1
N2
E7
D2
E4
O
P2
F1
E3
K3
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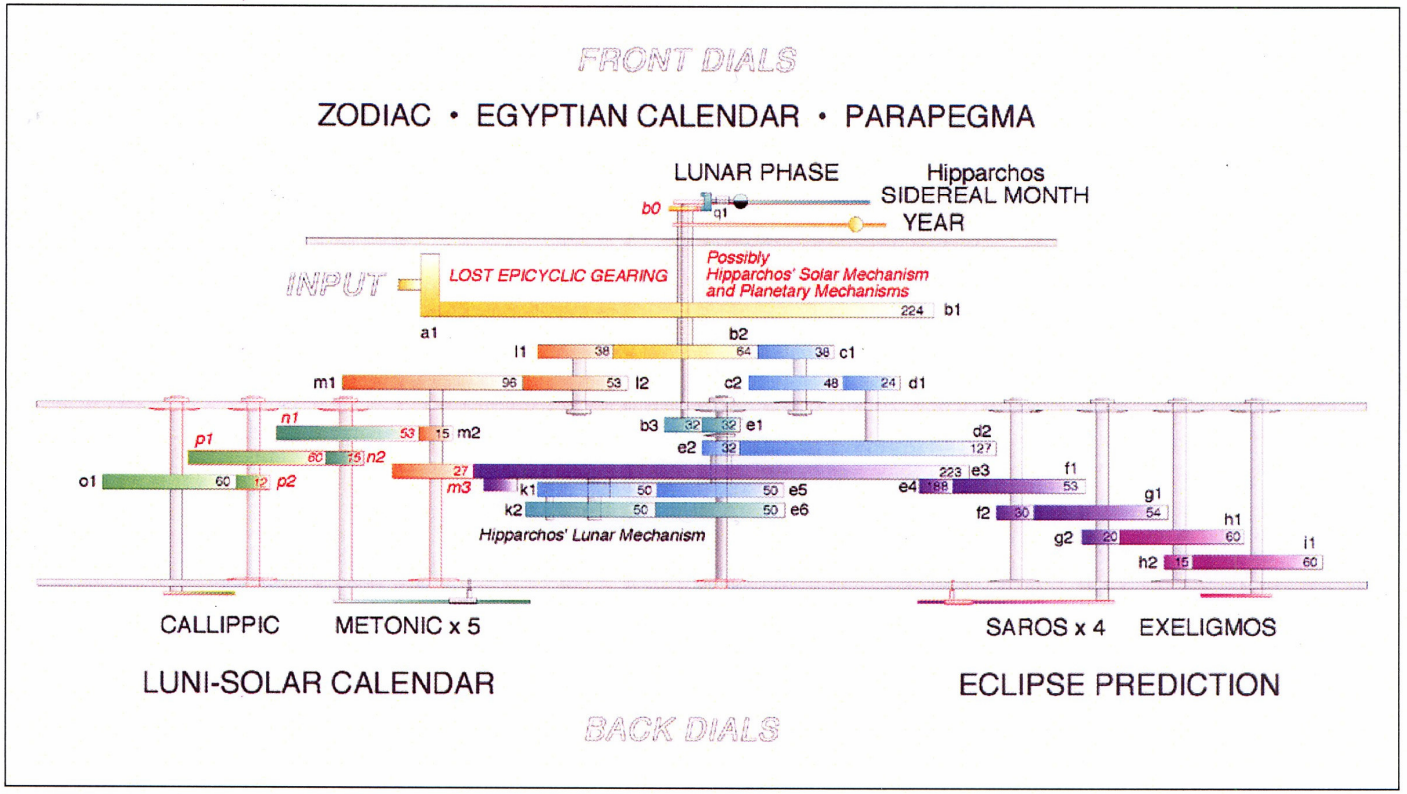
G2
F2
J
K2
E5
G1
H1
Callippic period
47 synodic months


FRONT DIALS
ZODIAC • EGYPTIAN CALENDAR • PARAPEGMA
LUNAR PHASE
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SIDEREAL MONTH
YEAR
b0
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INPUT
LOST EPICYCLIC GEARING
Possibly
Hipparchos' Solar Mechanism
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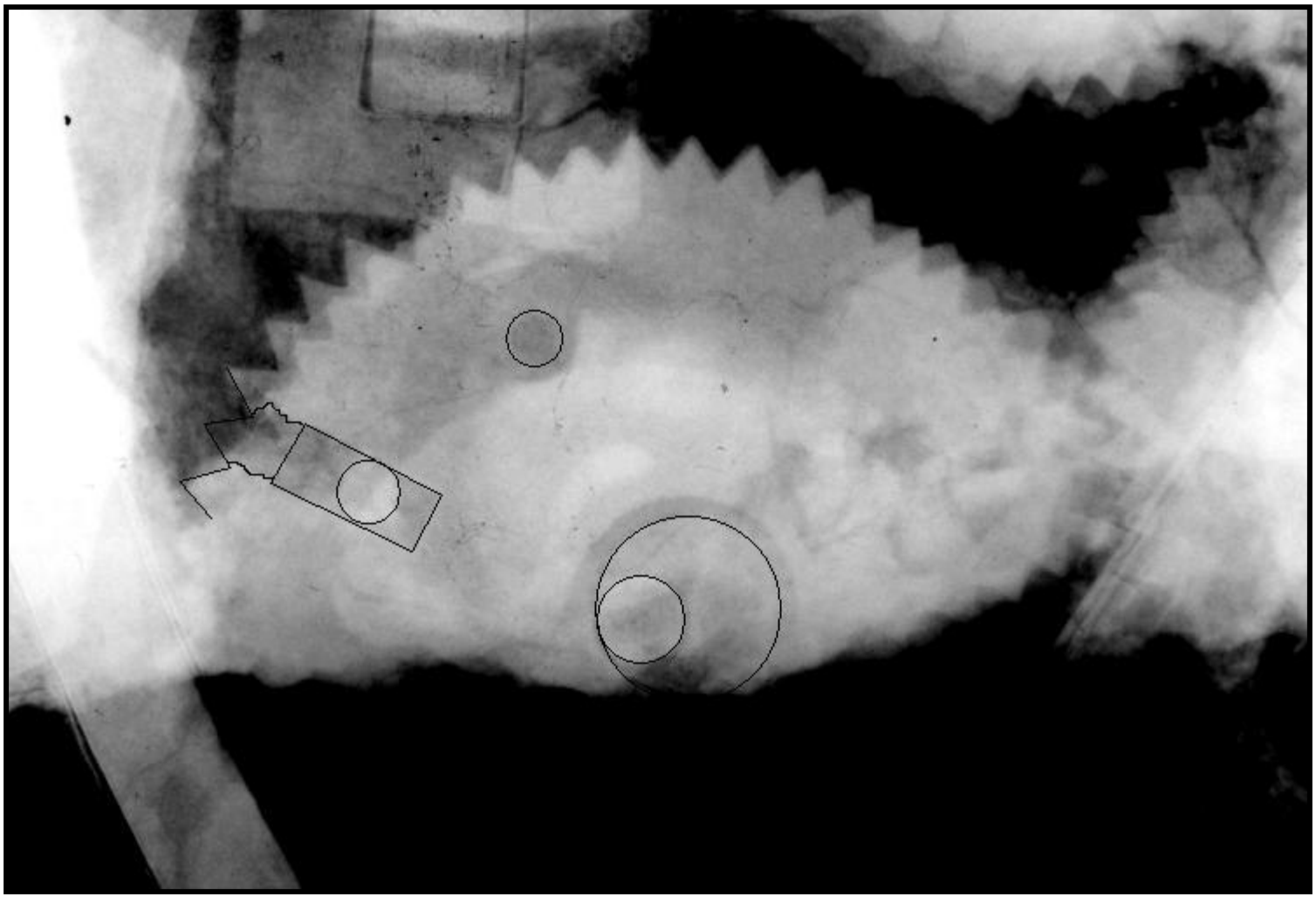
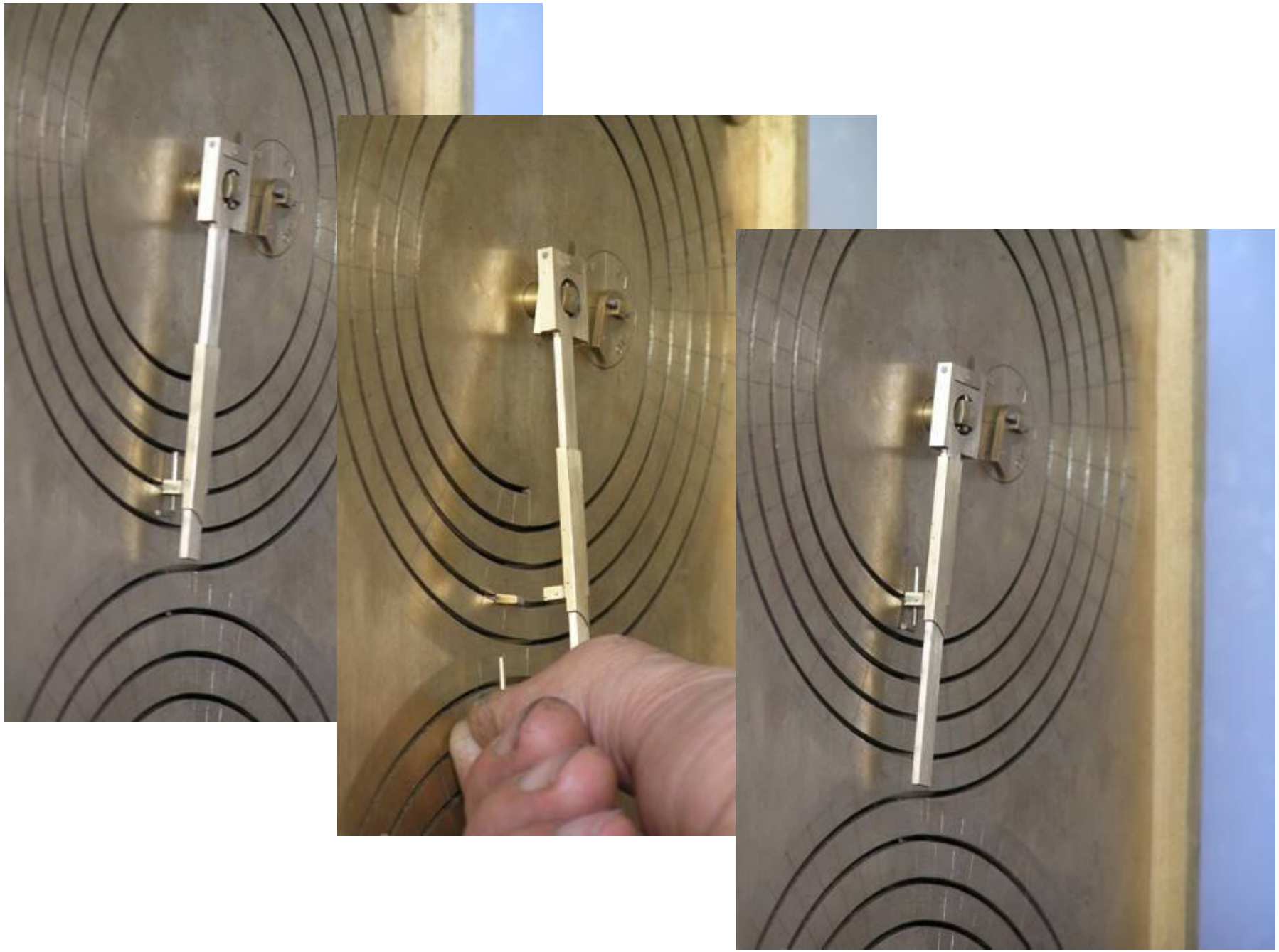
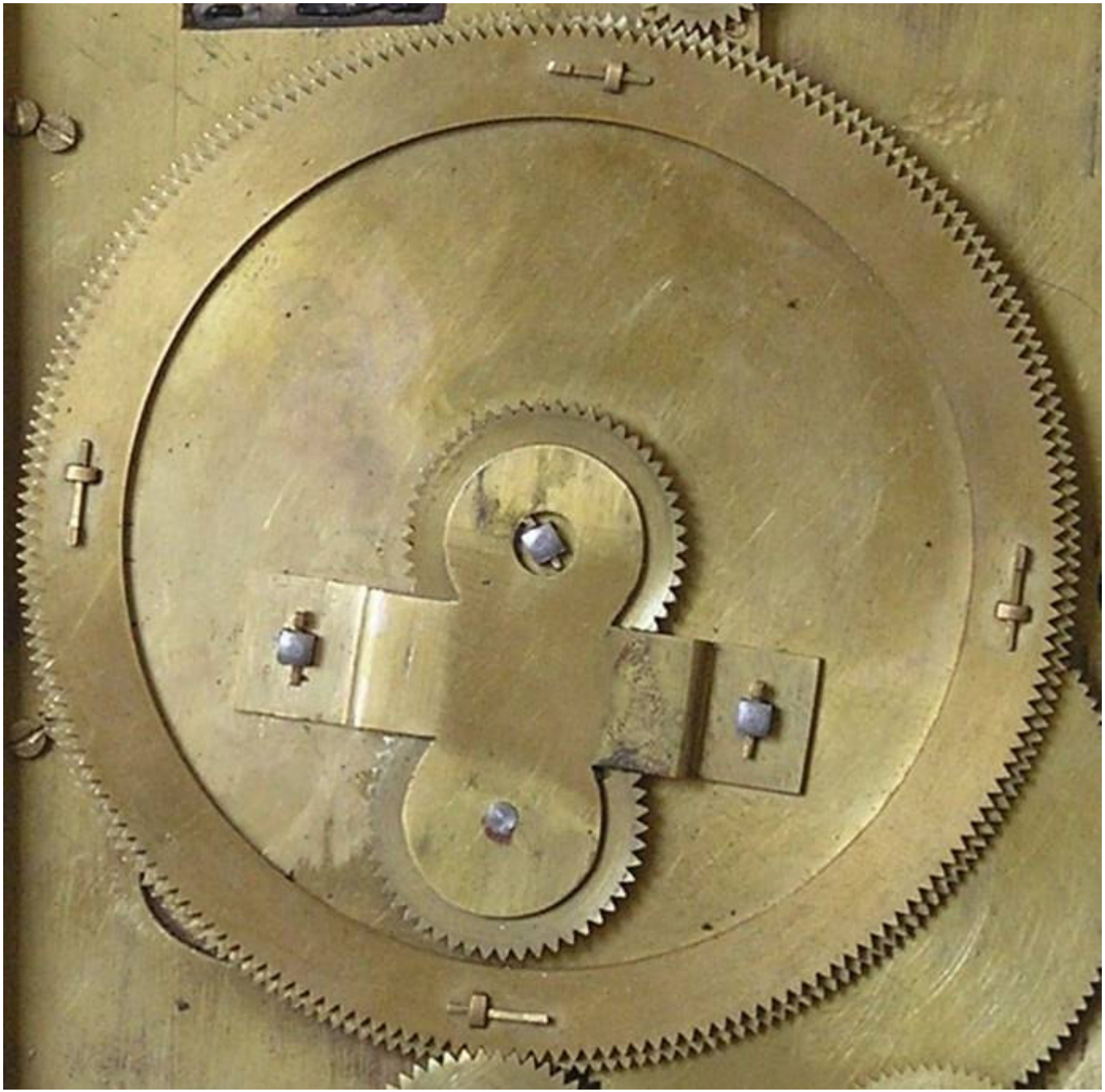
n1
53 15 m2
b3 32 32 e1
d2
p1
60 75 n2
e2 42 127
27 223 e3
f1
o1 60 12 p2
m3
k1 50 50 e5
e4 188 53
g1
k2 50 50 e6
f2 30 54
h1
Hipparchos' Lunar Mechanism
g2 20 60
i1
h2 15 60
CALLIPPIC
METONIC x 5
SAROS x 4
EXELIGMOS
LUNI-SOLAR CALENDAR
ECLIPSE PREDICTION
BACK DIALS

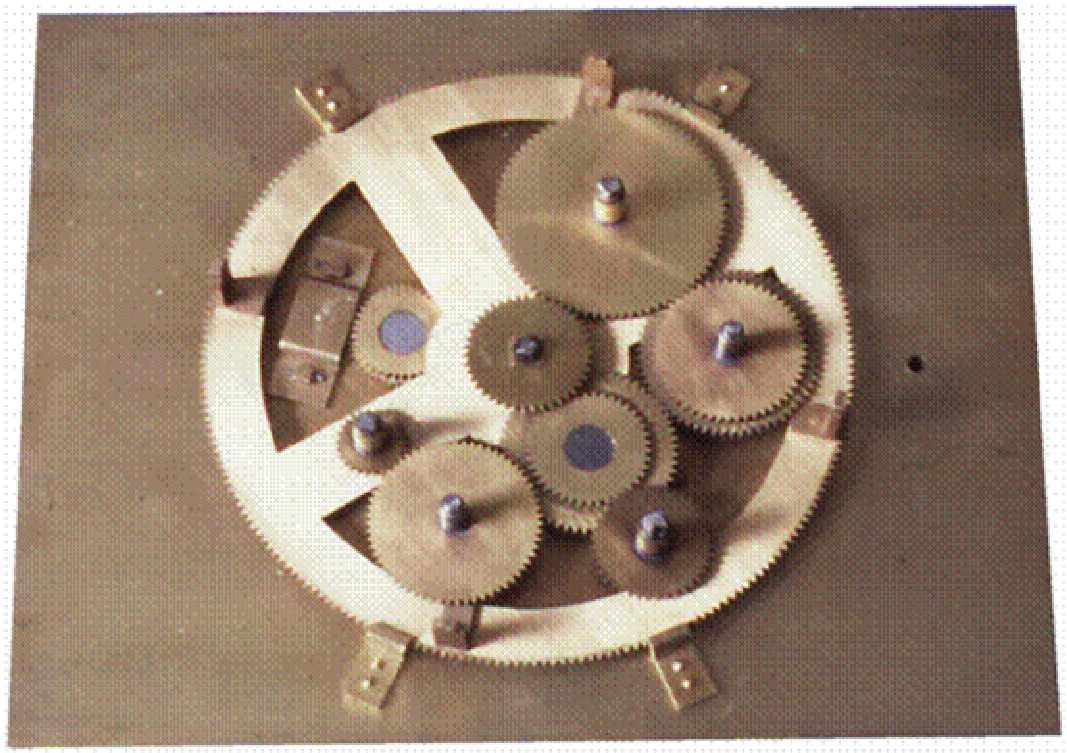


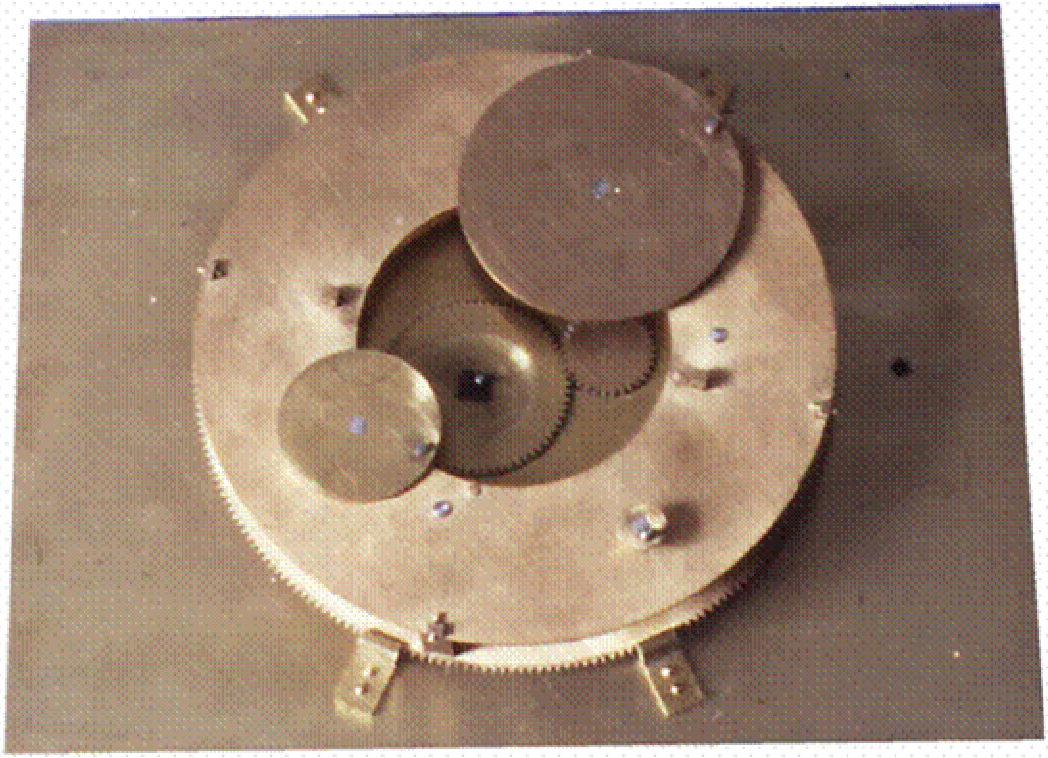

R ION
TERED OFFICE.

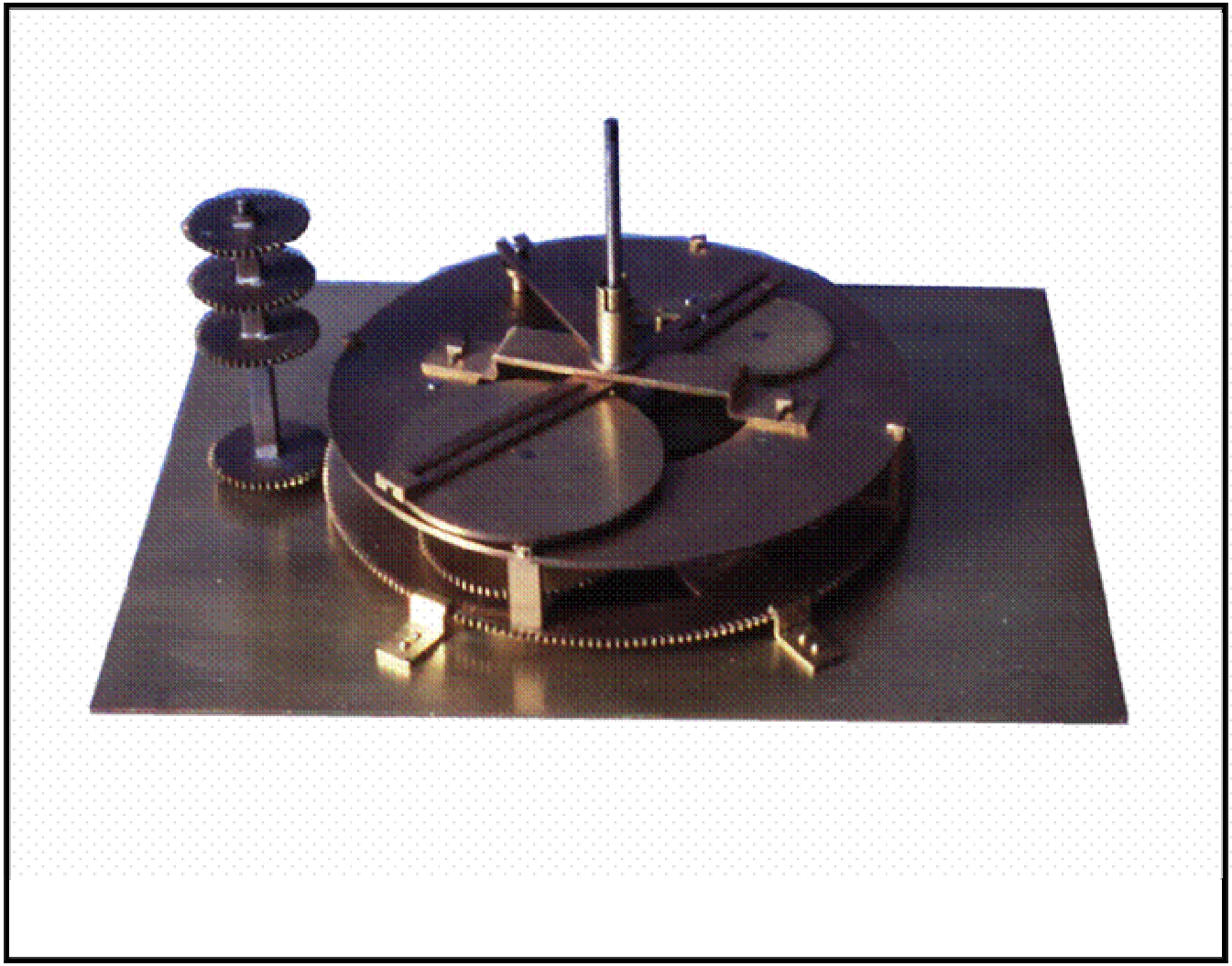

HV
NZ
OD

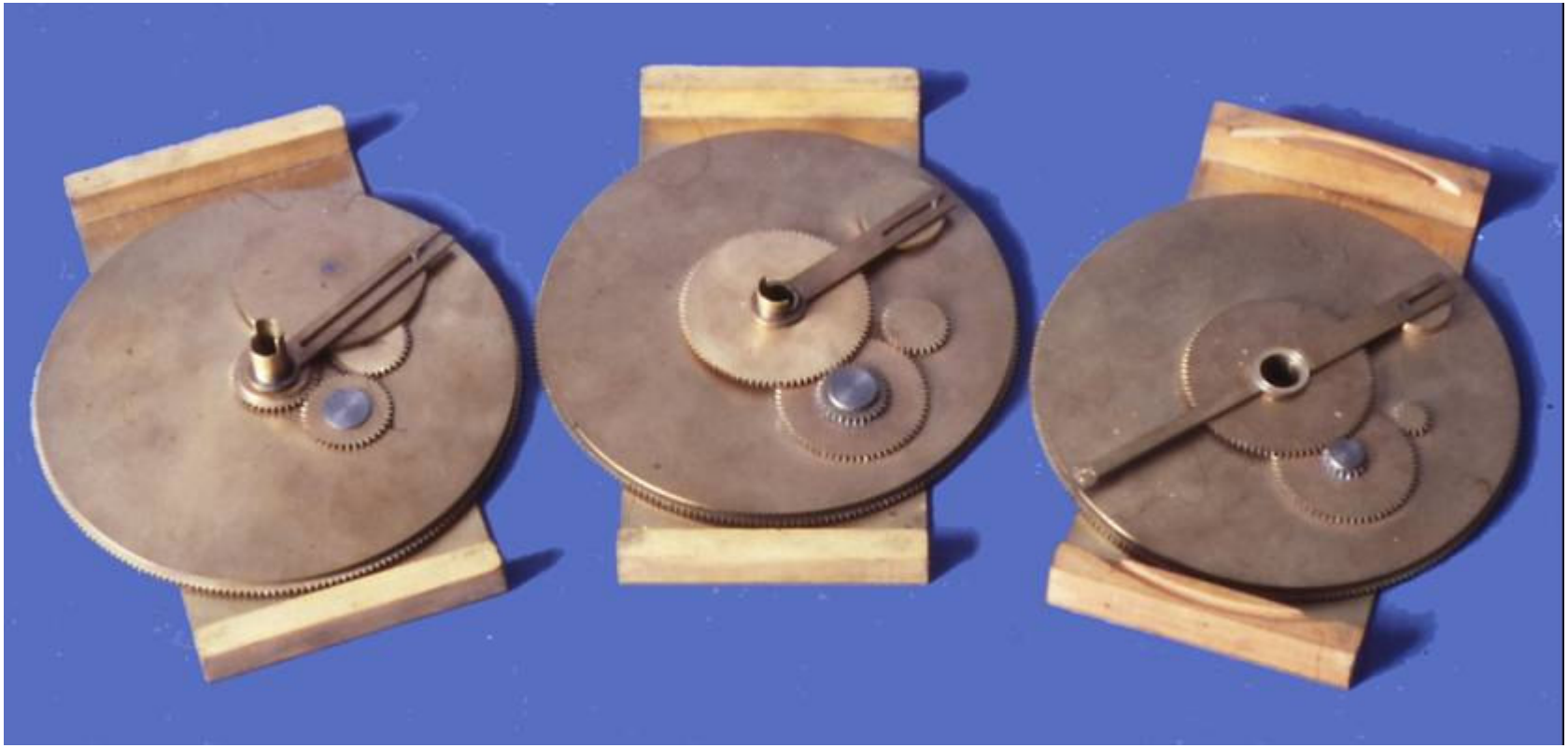


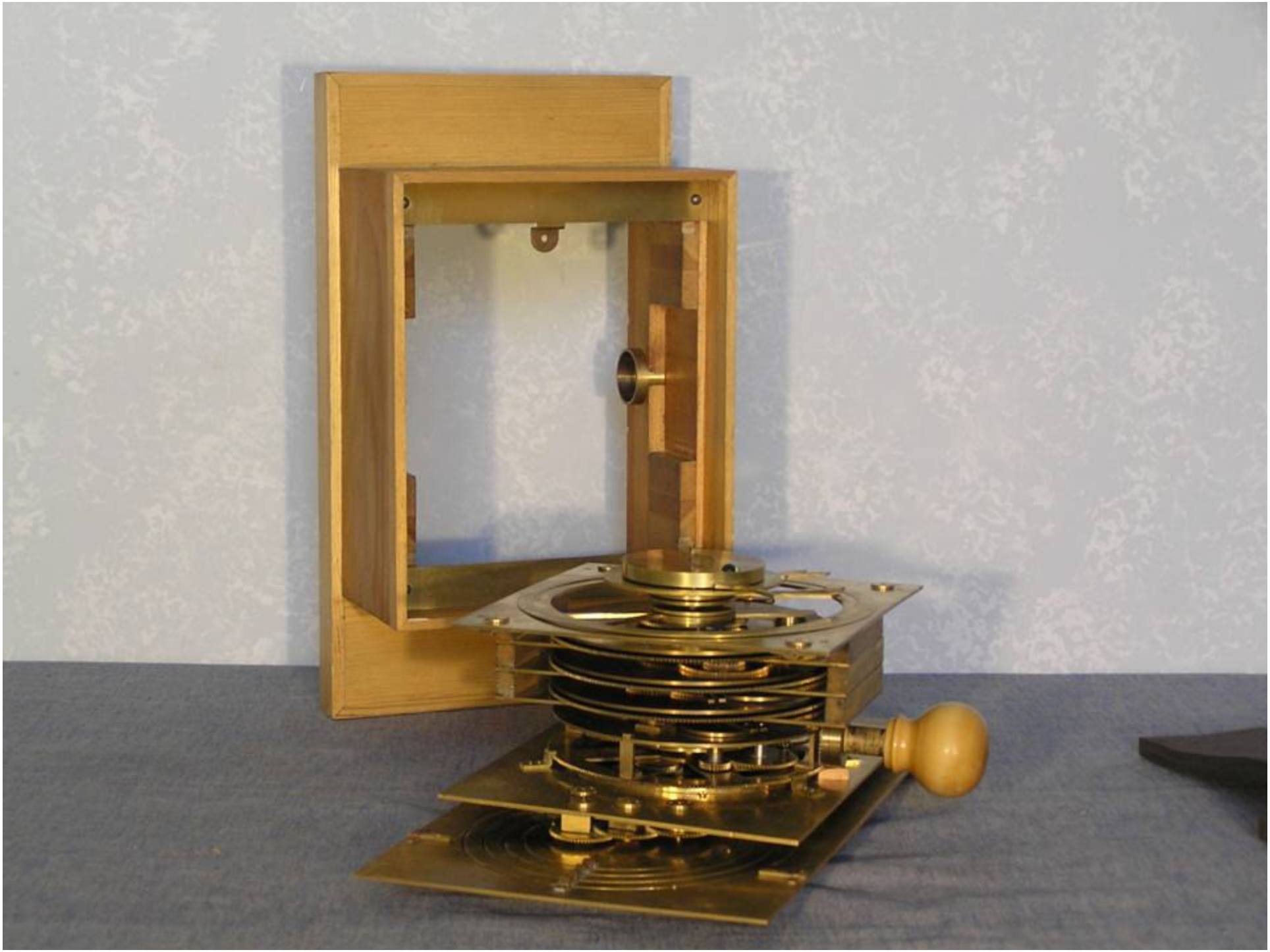


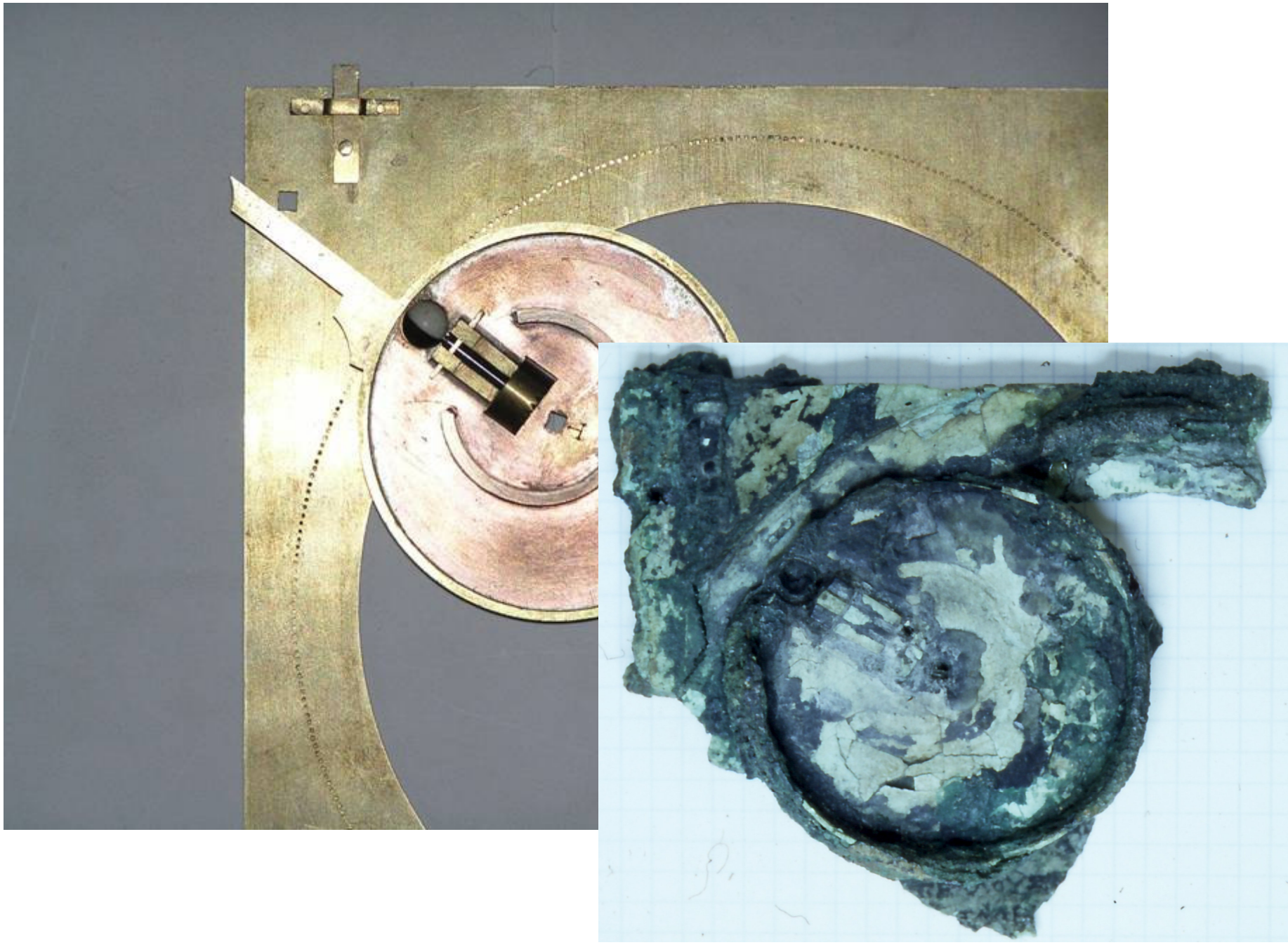


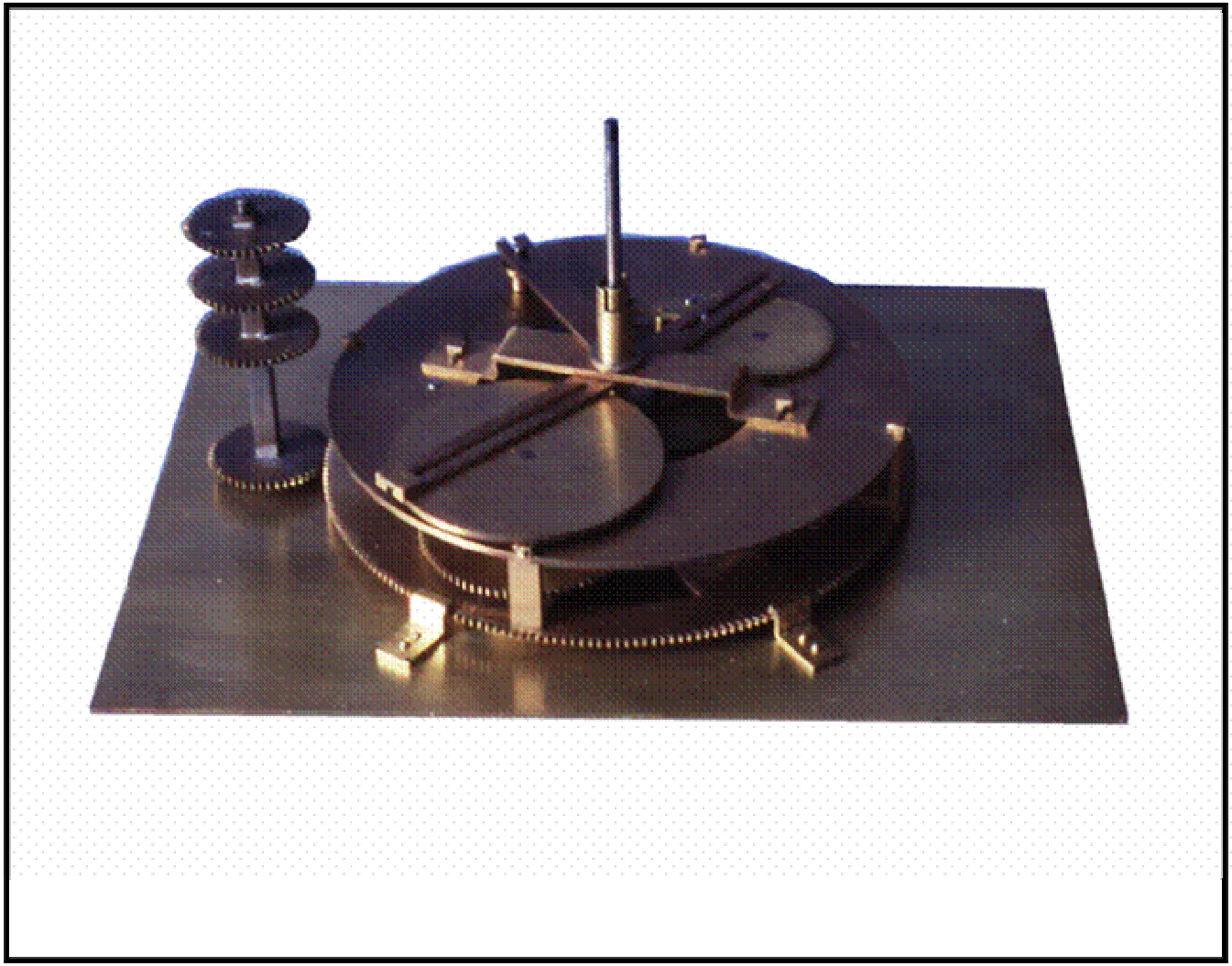


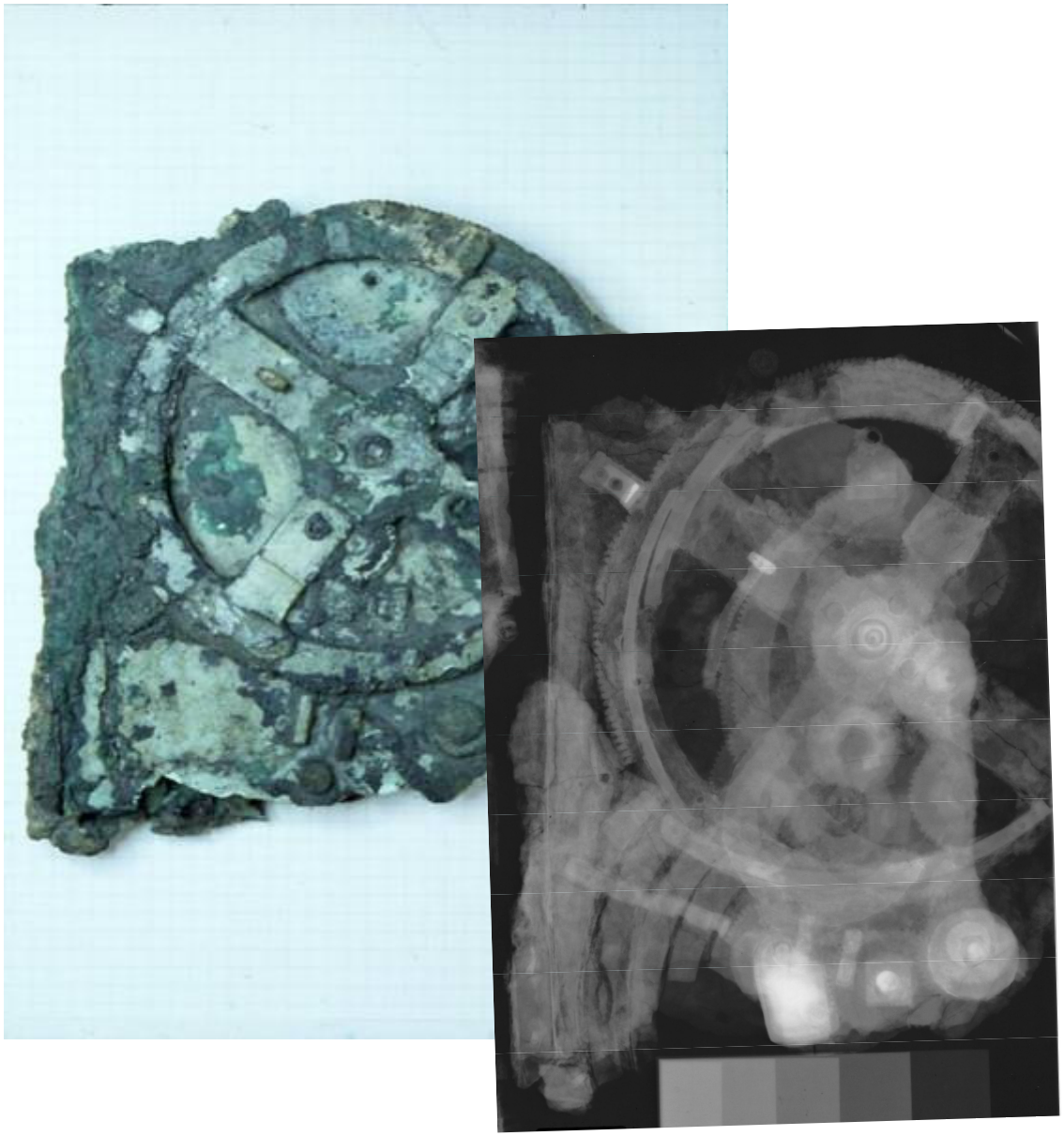




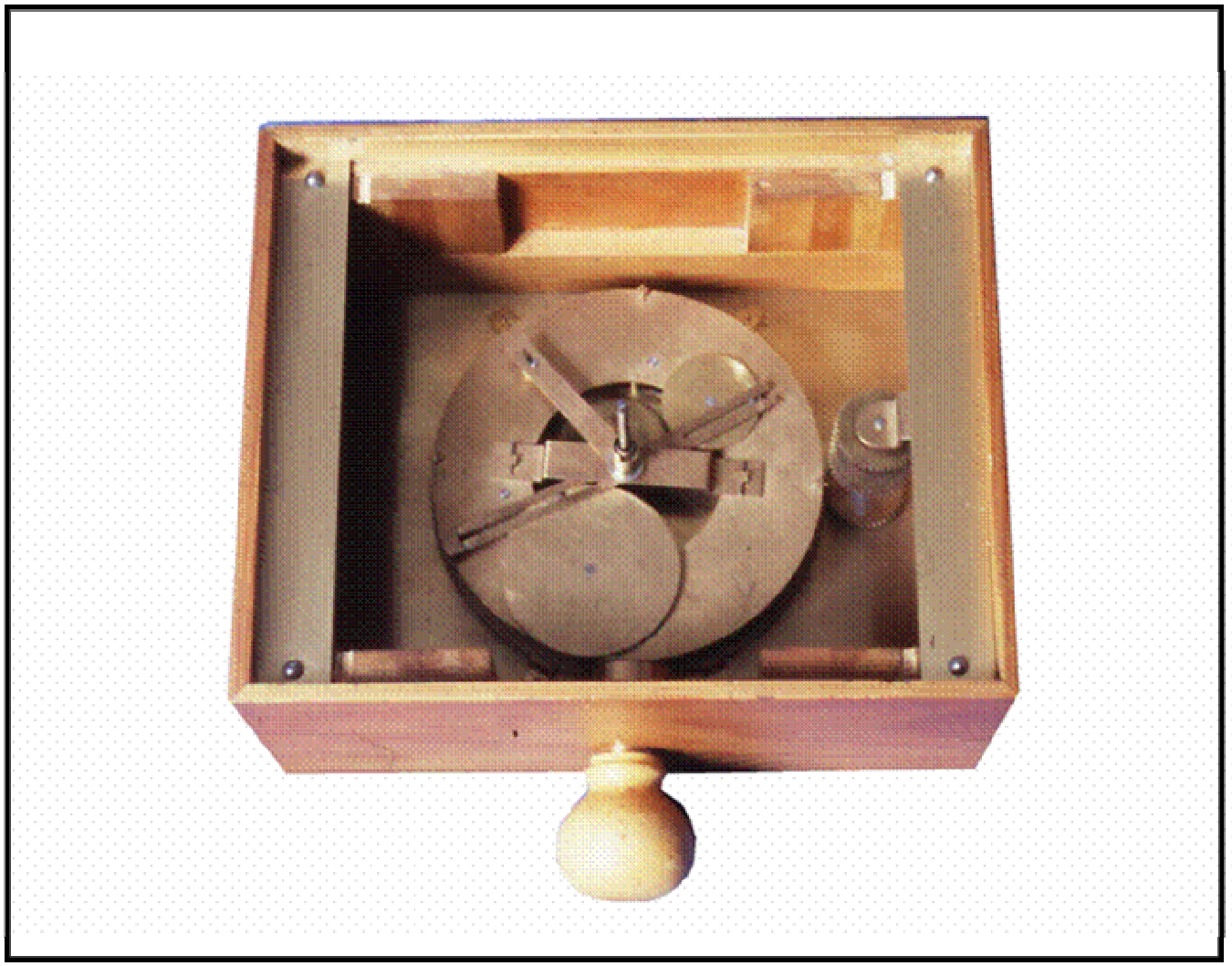


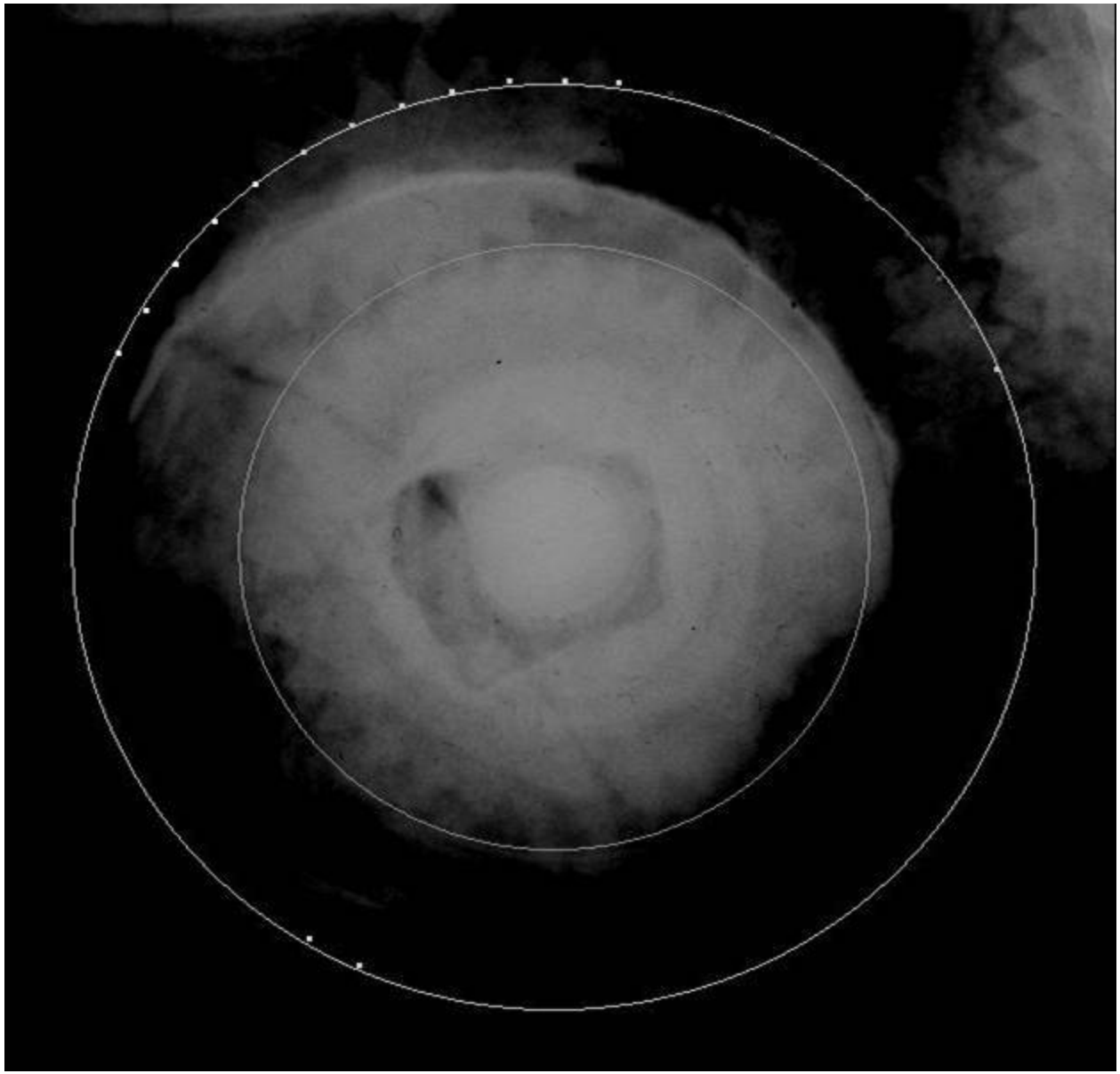


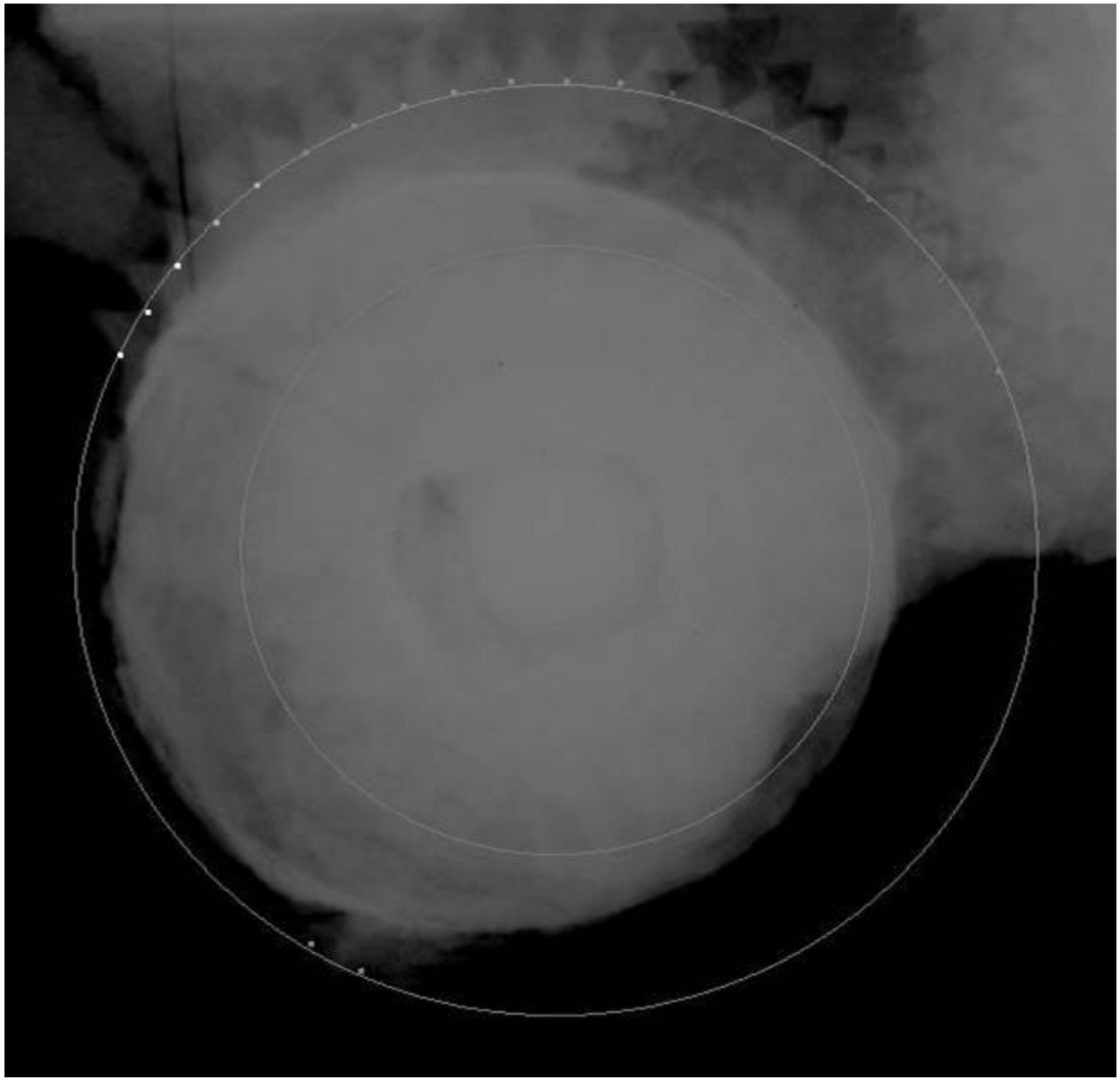




ARIES
TAURUS
GEMINI
CANCER
LEO
VIRGO
LIBRA
SCORPIO
SAGITTARIUS
CAPRICORNUS
AQUARIUS
PISCES







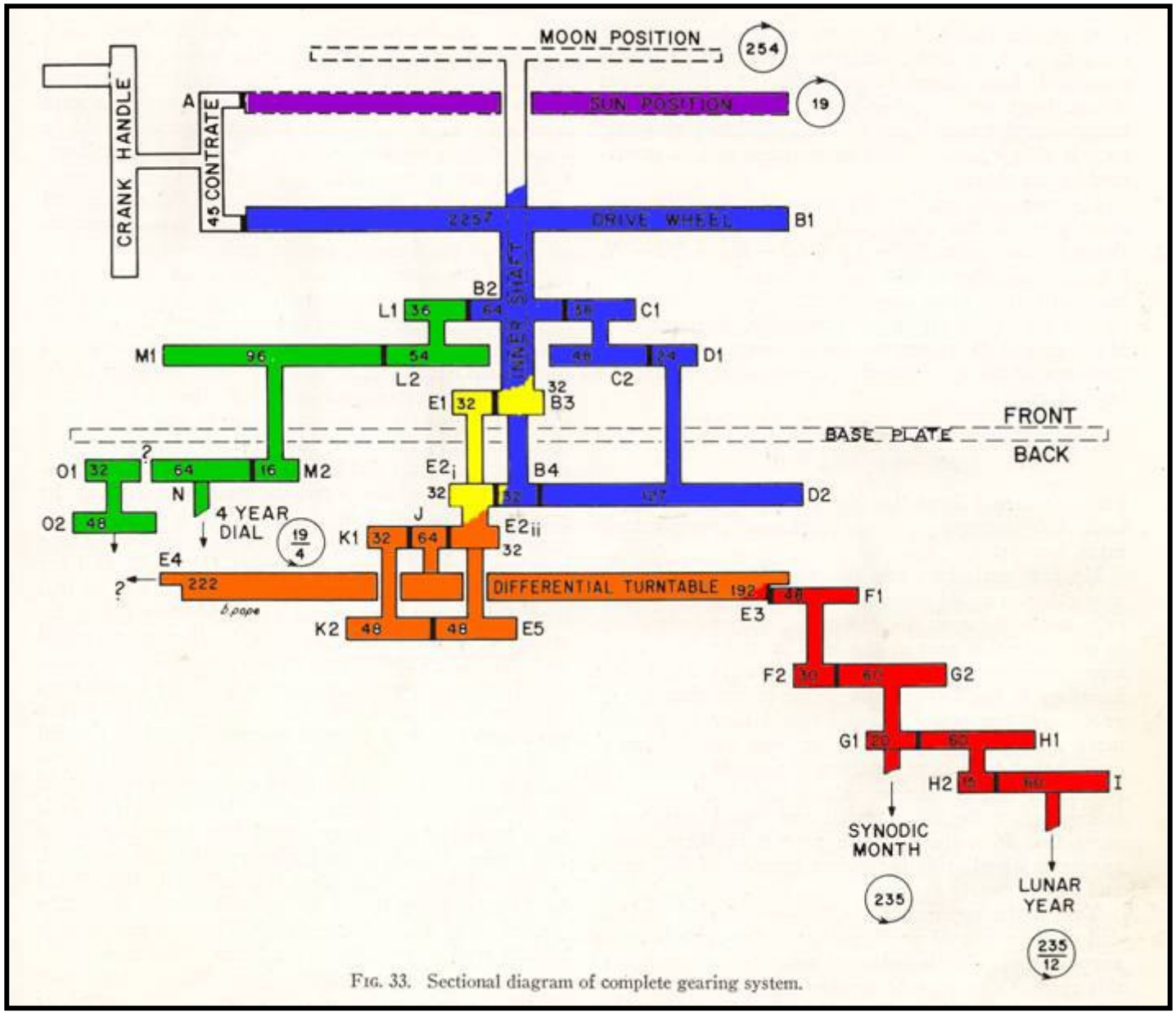


FIG. 33. Sectional diagram of complete gearing system.