CLOCKS AND GLOBES: PROLEGOMENA FOR AN HISTORICAL ANALYSIS

by Anthony Turner

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From a survey of the various known types of mechanical globes, the paper offers a preliminary classification of them and some remarks on the current historiography of the subject.

Globe clocks are the poor relation of the horological family; they deserve a much higher profile (Betts 1999, 59).

Globes may be open or closed, *sphaerae solidae* or *sphaerae armillae*. This constitutes a first sub-division of the subject. Both can be traced back to Antiquity, and both can be mechanised. Clocks can be made in the form of globes or they can incorporate a globe. This is a second sub-division. But globes may be plain; they may be decorated; they may be cartographic - celestial or terrestrial. All may be either open or closed and cartographic globes can also exist in double form – celestial and terrestrial as pairs or in a single structure.

Globe-clocks, will be used here to designate those in which the mechanism is contained within the body of the globe; clocks-with-globes for those in which the globe is an element incorporated into a larger structure. Both may, and have, existed in high variety. Within it cartographic globes are only one, albeit one of major importance, of several possibilities.

Classification of the clock-globe association could be made based on external form or by the manner in which the globe is driven. Table 1 offers a classification which combines the two.

This schema could be further complicated – globe-clocks and clocks-with-globes may strike the hours or not, they may show planetary movements or not. If they do they may deploy either arms or *armillae* to show them. Other differences, perhaps less significant, can be noted such as the material of which the globe is made. They may be engraved on precious metal, gold or silver, on brass, plain or gilt even silvered, they may be of printed paper applied to a sphere of metal or the more familiar plaster and papier maché, they may be realised in porcelain or enamel. The mechanisms of these devices could also offer a classificatory and diagnostic tool. The escapements they deploy are relatively insignificant since these tend to follow the general chronology of escapement development but within specific groups of globe-clocks the solutions found for transmitting motion from the going train to the astronomical or geographical displays can form a basis for dividing them up and also for tracing

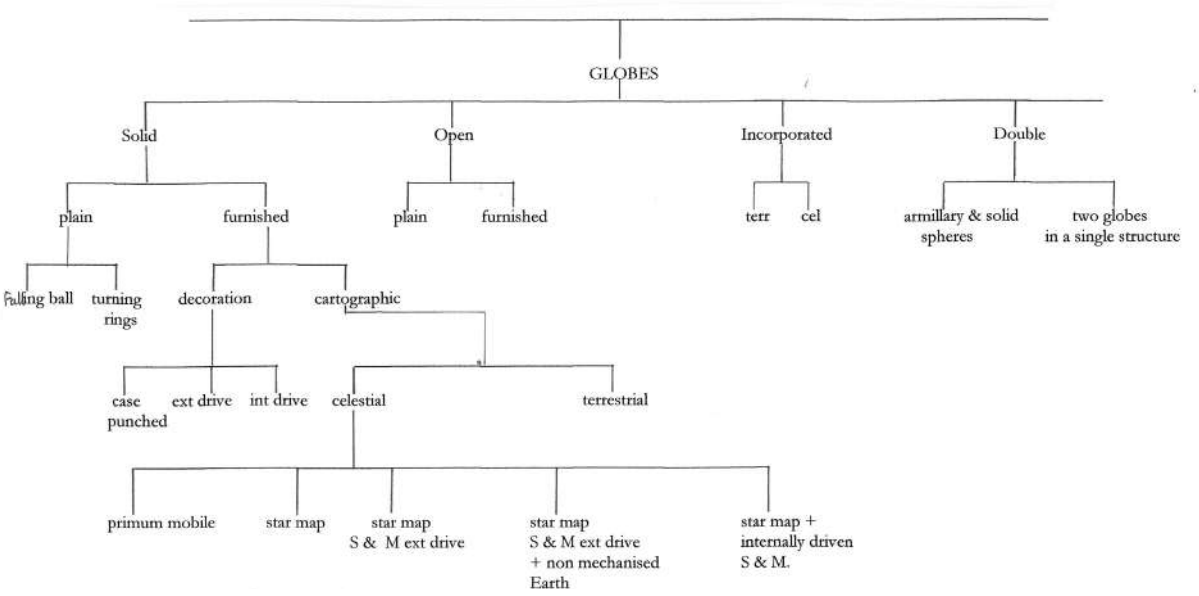

Table 1 : Classification of Globe-Clocks

					Total
Avant 1500					3
1501-10	1511-1520	1521-30	1531-40	1541-50	
1	0	1	1	5	11
1551-60	1561-70	1571-80	1581-90	1591-1600	
7	7	7	19	6	46
1601-10	1611-20	1621-30	1631-40	1641-50	
3	1	7	0	4	15
1651-60	1661-70	1671-80	1681-90	1691-1700	
12	13	4	12	2	43
1701-10	1711-20	1721-30	1731-40	1741-50	
6	2	3	2	3	16
1751-60	1761-70	1771-80	1781-90	1791-1800	
6	4	37	3	6	60
1801-10	1811-20	1821-30	1831-40	1841-50	
5	0	5	6	1	17
1851-60	1861-70	1871-80	1881-90	1891-1900	
2	4	2	0	0	8
1901-10	1911-20	1921-30			
1	4	1			6
				Total	220

Table 2 : Production of globe-clocks and clocks-with-globes by decade

influence from maker to maker. For double models combining an armillary sphere and a solid globe the distinction Ptolemaic or Copernican also needs to be made, though it is perhaps not diagnostic.

Whatever classification is adopted however, it is only useful when confronted with the historical sequence of known globe-clocks and clocks-with-globes. A preliminary attempt to do this has been made using a sample listing of some 220 known globe-clocks and clocks-with-globes. In this list, pairs of globes and double globe-clocks have been counted as single items; globes in orreries and planetaria, whether mechanised or not, have been excluded as have mechanised Moon globes such as the Selenographia of John Russell. (Ryan, *passim).* The first, and obvious, exercise is to look at the pattern of production by date

In most decades production of mechanical globes ranged from between 0 and 10, the decades when this was largely outstripped being 1581-1590 when Georg Roll (1546-1592), Jost Burgi (1552-1632), and Johann Reinhold (1586-1639), were active; 1651-60 and 1661-70 where such crucifix clocks with revolving globes as have been noted have been placed, although certainly many more were produced in the decades preceding and following this; 1771-80 when the extraordinarily prolific Philip Mathäus Hahn (1739-1790), was working, although some of his clocks should certainly be located in the following decade.

A more exacting exercise is to attempt to distribute our sample into the classification presented above. Full details are not available for all the machines noted and placement is sometimes arbitrary. For the sake of simplicity only the ten main divisions and sub-divisions are used.

The first, small group is entirely separate from the others as it is the only type to be weight driven. Virtually all the other globe-clocks or clocks-with-globes considered here are spring driven with only a few exceptions such as globes incorporated in a larger weight-driven clock for example the celestial globe in the second astronomical clock in Strasbourg cathedral.[1] In this group a sphere containing the motion-work descends a chain (fig. 1), or a rack, the drive for the clock being provided by its own combined weight of sphere and movement. The spheres of the eight known examples are all plain except for the hour scale

1 The Strasbourg globe offers a good example of the difficulty of definition and classification. Although the clock was only completed in 1571, the globe had been built in 1546 by Hans Ersten, who re-opened it to insert its arbor in 1549. At this stage it was a geographical, terrestrial globe, but it was transformed at the behest of Dasypondius into the celestial globe that survives today. Bach, Rieb and Wilhelm, 1992, 97-105.

Type	Number
Solid globes, gravity driven	8
Solid globes, internally or externally driven	33
Solid globes, decorated	10
Solid globes, cartographic: terrestrial	27
Solid globes, cartographic: celestial	36
Open globes: skeleton or armillary, plain	3
Open globes: celestial (sphères mouvantes)	31
Globes incorporated in a larger horological structure	36
Double model: armillary surrounding a fixed solid globe	12
Double model: two globes incorporated in a larger horological structure: pairs of globes	24

Table 3 : Numbers of globe-clocks and clocks-with-globes by category

and the index for it. The earliest known dates from the mid-15th century, one, possibly two, being described in notes by Henri Arnaut, physician and mechanician at the court of Burgundy.[2] Thereafter nothing is known of such clocks until the third quarter of the 17th century whence six examples, all German, have survived. The variant form, in which the spherical clock body descends a solid rack rather than a chain, is a minor variant of rack-clocks in general, but these too are usually of German or Austrian origin.

In hanging clocks a moving index indicates time on the fixed hour-scale. In the second group of plain solid spheres driven either by a spring-movement placed inside the sphere, or geared off an external movement, the pointer is usually fixed, the sphere moving round against it. (fig. 2), although there are exceptions (fig. 3)**.** This, the second largest group and further searching will probably augment it, is primarily characteristic of the late 16th and 17th centuries. Internally illuminated night-clocks, in which a glass sphere carrying an hour scale is driven round against a fixed pointer, which were popular in the later 19th century (fig. 4)**,** are, however, typologically related even if remote in style and material. And, it is to be noted, in using a transparent medium they are prefigured by at least two crystal globes in the early 17th century.

Furnished solid spheres, the third group, may carry either decoration or a set of hour-lines/meridians. They may have hour circles, like the previous group, or a full dial. Known examples range from the 16th to the 18th centuries but extant examples seem to fall into three groups and to belong to different manufacturing traditions. The first offers only one example, a sphere with an external dial and a movement signed 'Jacques de la Garde, Bloys 1551' (Migeon 1917, 13-14; fig. 5). The second is composed of three movements fitted with an horizontal verge and pendulum (following Huygens) with dial, weighted and mounted on gimbals inside a fully spherical case which has to be opened to read the time. All three examples date from *c*. 1680; one, signed 'Madelainy à Paris' (figure 6 is presumably French, the other two German, one signed 'Halleycher Augsburg' (Guye & Michel 1970, 85), the other anonymous. They are clearly the result of investigating the possibilities of Huygens application of the pendulum to clocks in the context of small and portable mechanisms. It is to be noted that all three, are approximately the same size as the de la Garde instrument, *c*. 50mm diameter. A future investigation needs to compare the one French and two German examples to establish whether they might have a common source of manufacture. The third group is composed of small table clocks similar in principle to crucifix and other pillar clocks, but in which the fixed index is held by a recumbent figure. These again are primarily 17th century.

The odd clock out in group three, that by Jacques de la Garde, is nonetheless that which supplies a bridge to the fourth group, that of terrestrial cartographic globes. Two globe-clocks of very similar form, albeit somewhat larger, signed by de la Garde (in 1552 and 1554) are known and a third can reasonably be attributed to him (fig. 7). Globe-clocks similar in form can therefore be indifferently engraved with decoration or a world map. The latter should perhaps not be considered as a class apart. One other terrestrial globe clock is known from the 16th, but a far more elaborate model supported by a winged Atlas on an elaborately relief engraved hexagonal base, and with the globe itself turning against a fixed index held by Chronos who suitably surmounts the globe. From the entire 17th

2 BnF Paris ms Lat 7295.

Figure 1. Falling ball clock by J. Schlemmer, Schleswig, c. 1670.
Source : formerly in the Time Museum, Rockford Illinois ; Sotheby's New York 19 June 2002, n°103.

Figure 2. Plain revolving globe with fixed pointer in an automaton clock, early 17th century. Source : formerly in the Time Museum, Rockford Illinois ; Sotheby's New York 13 October 2004, n°515.

Figure 3. Plain globe with revolving pointer Georg Schmidt, Augsburg, early 17th century. Source : formerly in the Time Museum, Rockford Illinois ; Sotheby's New York 19 June 2002, n°98.

century no terrestrial globes have been noted, but the model reappears early in the 18th century, increasing in numbers up to the 1830s. Thereafter there is a lull until new examples appear from the mid-1860s onwards maintaining a sequence of production, though with a break between 1880 and 1910, until the 1930s when the ATO company produced a transparent, illuminated, electric world globe-clock, the 'Maplux' (fig. 8).

Development of the terrestrial globe-clock was paralleled in the 16th century by that of the most important group of globe-clocks – numerically, aesthetically and mechanically - the solid celestial globe. Nonetheless it is noteworthy that the earliest of these known, the now lost example by Christian Heiden of 1560, post-dates the appearance of the solid terrestrial globe, exception made of the solid celestial globe driven by sand described by al-Khazinî in the early 12th century (Lorch 1980). Such globes, which in the hands of Eberhard Baldewein (*c* 1525-1593), Georg Roll, Johann Reinhold and above all, Jost Burgi (fig. 9, Leopold 1997), attained an exceptional level of mechanical sophistication matched only by the conception and the execution of their decoration, clustered in the decades from 1560 to 1640. Thereafter few if any were produced until the model was revived by Reginald Outhier and Jean Baptiste Cattin in the 1720s (fig. 10). Thereafter however it languished, although some six internally driven, mechanised Chinese globes are known from *c*. 1830 (fig. 11; Combridge 1987).

This is not however to say that celestial models were not created during these later centuries. Examining the next two categories of globe-clocks, skeleton or armillary models either plain or only with decoration and the same but with celestial indications shows a situation that is almost the reverse of that which prevailed for terrestrial models. The three skeleton globe-clocks noted are all late 19th century (fig. 12). Of the thirty-one armillary celestial equivalents only eight can be dated to the 16th or 17th centuries. The remainder all stem from before 1820 with only one, that described by Pierret (1885, 9-12), from the mid-century. Most of the 18th century examples are French, for this was the development period of the *sphères mobiles* or *spheres tournantes,* which would culminate in the complex constructions of Antide Janvier (fig. 13). Most of them are externally driven, and since most sit on top of the time-showing mantel-clock which contains the movement they could arguably be considered as belong to the following category of globes or spheres incorporated in a larger horological structure. Since in many cases however the sphere is almost of the same size as the clock that serves as its base, and most surround planetaria, it has seemed best to count them separately.

Globes, whether open or closed, incorporated into a larger horological structure however constitute the largest of the groups identified with some thirty-six examples. Chronologically they are relatively evenly distributed across the period 1530 to 1830 as across the regions of Europe. Of the eleven double globes that constitute the next group - clocks in which a fixed terrestrial globe is surrounded by a celestial armillary sphere - all with one exception and one possible exception - are French (fig. 14).[3] They were all, with one exception, made in the 16th century. Since in principle, the *primum mobile* turning around a central sphere, they are not different from the later *spheres tournantes* they can be considered as their precursors although the 16th century models are all Ptolemaic, most of the later models Copernican; the surviving Ptolemaic Martinot sphere provides a link between the two forms (fig. 15).

While French clock and sphere makers held faithful to the armillary model, the last category that of pairs of mechanical globes either presented separately or built into a single machine are more widely spread across Europe with examples known from German regions, France and Britain but once again largely concentrated in the 18th century, although several of the pieces by Reinhold and Roll that have been counted as solid moved celestial spheres since this is the predominant element in them, could also be added here when a small terrestrial globe was incorporated**.** Here an interesting question arises. Reinhold's machines incorporate two solid spheres, a celestial and a terrestrial as did that by Christof Tresler built in 1679. Separately made, free-standing pairs of globe-clocks seem to be no earlier than the early 18th century (Van der Krogt) over a century after the introduction of the globe pair by Schoener, Gemma Frisius and Mercator and still half a century after the establishment of the concept with the printed globes of de Mongenet, Van Lengren, Molyneux, Blaeu and Hondius. A reason for this delay may have been economic. Separate pairs of globes would have been more expensive not only because of the duplication of the mounts (already costly because usually made in decorated gilt brass as opposed to the wood stands of printed paper globes), but also because

3 The possible exception is the Jagellonian globe which has been thought to be of North Italian manufacture. The non-French example, only half of which survives, is by Reinhold 1577-80. See Edward H. Dahl & Jean-François Gauvin, Sphæra Mundi : early globes in the Stewart Museum, Quebec 2000,

Figure 4. Plain revolving globe, 19th century. Source : formerly in the Time Museum, Rockford Illinois ; Sotheby's New York 14 October 2004, n°882.

Figure 5. Solid sphere with decoration, Jacques de La Garde, 1551.

Figure 6. Gimbaled globe watch signed Madelainy à Paris, c. 1680. Source : former Time Museum, Rockford Illinois ; Sotheby's New York 19 Juin 2002, n°12.

Figure 7. Terrestrial globe clock attributed to Jacques de la Garde, mid 16th century. Source : A. Kugel, Sphères, l'art des mécaniques célestes*, Paris, Kugel, 2002, T1, p. 46-49.*

Figure 8. 'Maplux' globe-clock par ATO. Source : Private collection, Paris.

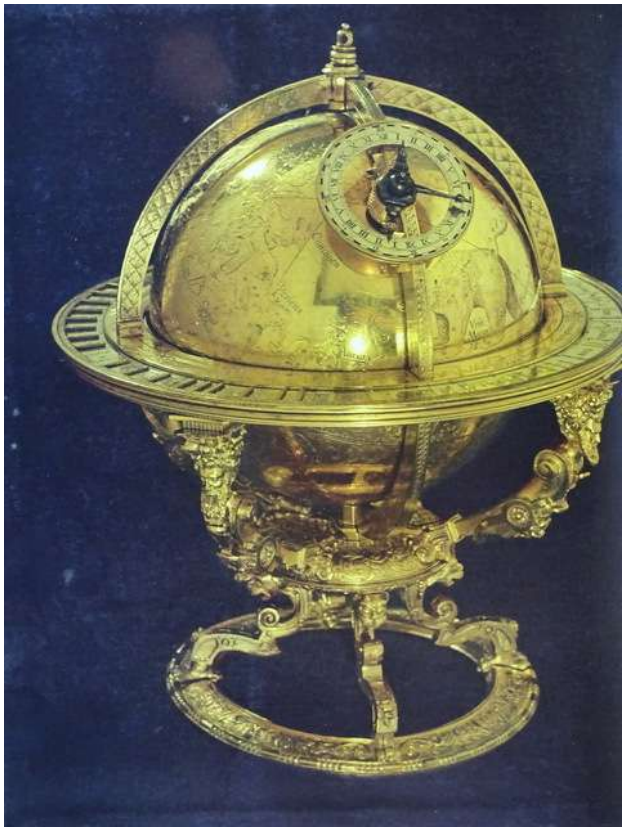

Figure 9. The small celestial globe by Jost Bürgi, 1594. Source : J. H. Leopold & K. Pechstein, Der kleine himmelsglobus 1594 von Jost Bürgi, *Lucerne, 1977, frontispice.*

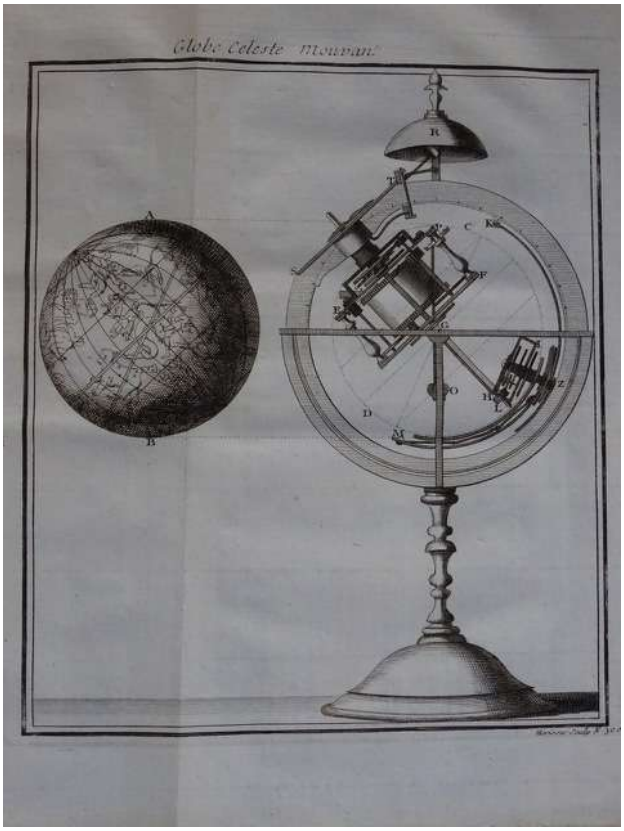

Figure 10. Celestial globe clock by Reginald Outhier and Jean Baptiste Cattin, 1727, in J. G. Gallon, Machines et inventions approuvées par l'Académie des Sciences, *1727, vol. V, before p. 19. Source : BnF, Paris.*

Figure 11. Clockwork driven Chinese celestial globe, c. 1830. Source : Chayette – Cheval 24 novembre 1980, lot 154.

Figure 12. Skeleton or armillary globe clock, late 19th century.
Source : former collection Albert Odmark, Seattle ; Christie's London 11 March 2005, n°371.

Figure 13. Pair of armillary time-pieces by Antide Janvier, 1796. Source: Private collection, New York ; formerly in the Time Museum, Rockford Illinois ; Sotheby's New York 2 décembre 1999, lot 65.

two mechanisms would be required. Only perhaps, when the globe pair had become the norm for the production of printed paper globes, did the fashion spread to the different artisan world of mechanical globe makers and only then when clockmakers began to work in collaboration with the specialised globe makers in the mid-18th century (fig. 16).

And this collaboration perhaps provoked another change. Until well into the mid-18th century globe-clocks were generally made of metal. The earliest globe-clock with paper gores seems at present to be one of the five surviving examples of the Outhier-Cattin devices. Only in the second half of the century would they become more prevalent. Questions such as these require further investigation, but that they can be formulated is a consequence of this preliminary classifying of types and the chronological listing of surviving specimens.

Already from the tentative data presented here some revisions can be made to received wisdom. It has been said, using a strict definition of mechanical globes as those that turn on themselves, that these in the 16th and early 17th century were invariably celestial. By broadening the subject to globes containing clockwork whether or not this is used to turn the globe it becomes evident that even in the 16th century terrestrial globe clocks existed and in the work of De La Garde the equivalence of the plain globe clock and the cartographic globe clock becomes apparent. But that 16th century globe clocks on the strict definition are invariably celestial is disproved by a surviving French moving terrestrial globe clock carried by an Atlas (Kugel 2002, 50-56) (fig. 17). This raises further questions. Mechanising a terrestrial globe is far less obviously useful than mechanising a celestial one. If the globe is arranged to turn in mean solar time once in twenty-four hours then, if an hour scale is marked along the equator, it can show local time throughout the world. If a Sun is placed at the twelve o'clock position then this will indicate noon at the successive meridians that pass. Not much else however can be gained from the movement except a demonstration of the Earth's diurnal motion. If this can be seen as worth demonstrating in the 16th, it is far less obviously useful to show in the 18th century when terrestrial globe-clocks become more frequent. What purpose did they serve? Indicating local times? But if so for pedagogic purposes only, for few people needed to know local time in an age innocent of aeroplanes and telephonic communication. Establishing the prolegomena of the subject opens many paths for investigation.

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Figure 14. The Jagellonian globe, c. 1510 or earlier. Source : Muzeum Uniwersytetu Jagiellonskiego, Cracovie.

Figure 15. 'Sphère mouvante' by Jérome Martinot, Paris, early 18th century. Source : Bibliothèque nationale de France, département des Cartes et plans, Ge A-355 (Rés)

Figure 16. Globe pair by Ferdinand Berthoud and Didier Robert de Vaugondy, Paris, vers 1785. Source : Musée du Temps, Besançon, inv. 2003.1.2.

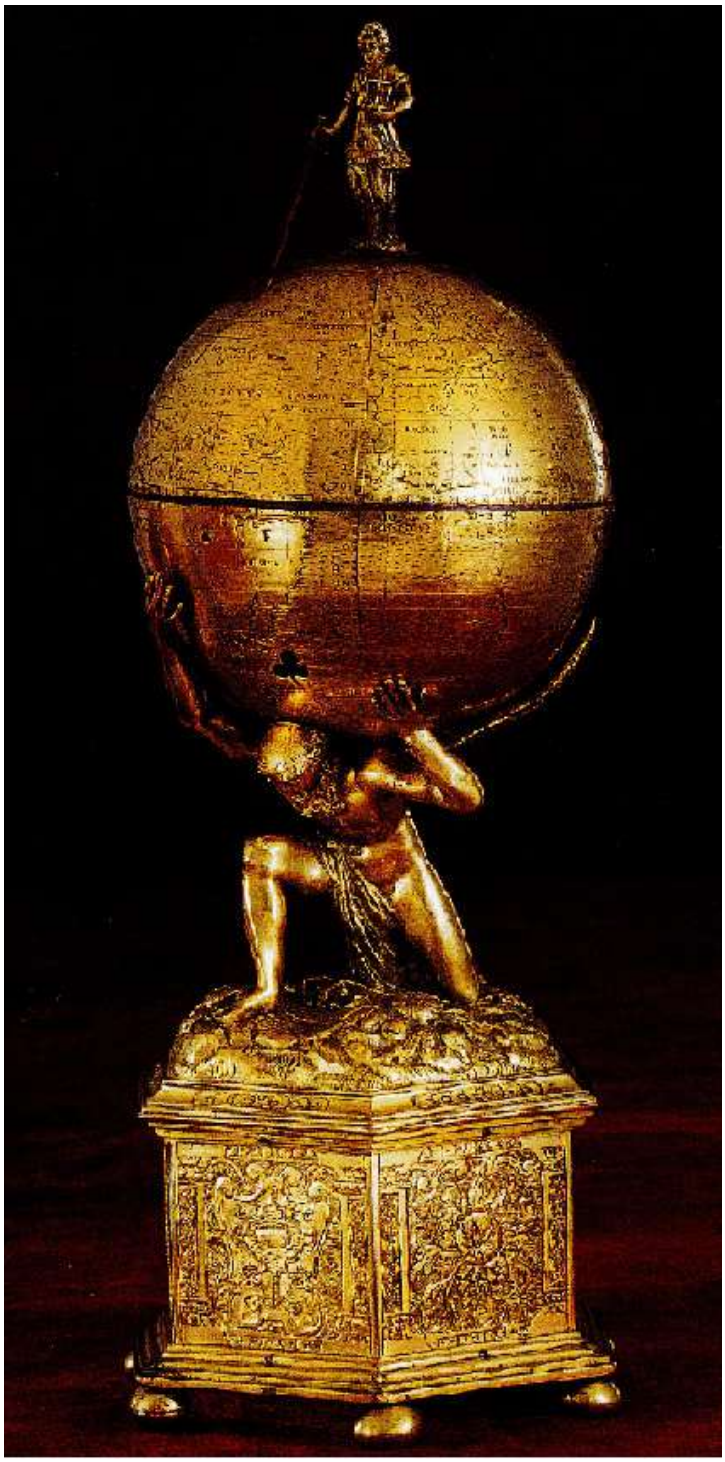

Figure 17. French moving terrestrial globe clock carried by an Atlas, c. 1570.
Source : A. Kugel, Sphères, l'art des mécaniques célestes, *Paris, Kugel, 2002, T2, p. 50-55.*