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TIME AND THE ATHENIAN CITIZEN

TIME AND THE ATHENIAN CITIZEN:
THE PRACTICAL ASPECT OF TIME IN ANCIENT ATHENS

By

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ABSTRACT

This thesis discusses the practical role of time in the lives of the citizens of ancient Athens. The theory proposed is that, from the fifth to the first centuries B. C., methods of and devices for marking time intervals were of growing importance to them. The literary and archaeological evidence for timekeeping in ancient Athens is presented and the conclusion reached is that the Athenian populace apparently became more conscious of the advantages of exploiting time in its daily activities.

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INTRODUCTION

What role did time play in the society of ancient Athens? Scholars have differing opinions on this question, yet most of them agree that the role of time was much less important in the lives of the ancients than it is in modern society. D. J. Price would have us believe that the ancients were less interested in marking time with their sundials and water clocks than in satisfying their aesthetic and religious urges.[1] On the other hand, Robert S. Brumbagh is of the opinion that "by about 360 B. C. Athens had become 'modern' in its sense of time."[2] I take a stand somewhere in the middle ground between these two extreme points of view. I disagree with what I feel to be the majority view, that the ancient Greeks did not appreciate and exploit the practical uses of time for their own purposes. However, I do not think that the archaeological and literary evidence will allow us to say that the Athenian sense of time, by 360 B. C., was what we would consider modern. Modern man is a creature whose daily activities are, for the most part, governed by the dictates of time--up at seven, work from nine to five, lunch at noon, supper at six, and so on. Every facet of life today seems to be controlled by the clock. Ancient Athenians were

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[1] D. J. Price, Science Since Babylon (enl. ed., New Haven: Yale University Press, 1975), p. 55.

[2] R. S. Brumbagh, Ancient Greek Gadgets and Machines (New York: Crowell, 1966), p. 70.

not this dependent upon time. However, when timekeeping devices became known to the Athenians, I do not think that they were slow to find uses for them. Using the literary and archaeological evidence from Classical fifth century Athens, through the Hellenistic Age and into the period of Roman occupation, I think that it is possible to show that clock time had a growing importance for the Athenian citizen.

If we look, for example, at Western society after the Industrial Revolution, we see that the increasing complexity of life has led to an increased awareness of the passage of time and a corresponding desire to mark this passage more accurately. While we cannot talk about an industrial revolution in ancient Athens, life undoubtedly became more complex with the passing years. In the following pages, I shall attempt to show that the Athenian interest in time could be said, in a lesser way, to parallel its modern counterpart.

My thesis will consist of three chapters. In the first chapter, I shall discuss the ancient Greek concept of the day and hour, and also describe the timekeeping devices available to the ancient Athenian--the water clock and the sundial. The second chapter will contain the literary and archaeological evidence for time-keeping in Athens from the mid fifth century B. C. to approximately the birth of Christ. The third and final chapter will contain my conclusions, based on the evidence in the second, about the role of time in the society of ancient Athens. In summation, I shall discuss the practical aspect of time as it affected the Athenian citizen.

I

THE DIVISION OF THE DAY AND TIMEKEEPING DEVICES

It would be foolish to attempt to discuss the practical aspect of time in ancient Athens without knowing what kind of measuring devices were available in the Graeco-Roman world during the last five hundred years before Christ. Therefore, I shall devote the second part of this chapter to a description of the methods of marking time known to the ancient Greeks during this period, most specifically, water clocks and sundials. The first part of this chapter will be a discussion of the ancient day and its division into hours.

The Day and the Hour

In his Natural History (II. LXXIX. 188), the Elder Pliny provides for us an account of the different ways that different peoples in antiquity measured the period of the day.

> Ipsum diem alii aliter observavere, Babyloni inter duos solis exortus, Athenienses inter duos occasus, Umbri a meridie ad meridiem, vulgus omne a luce ad tenebras, sacerdotes Romani et qui diem diffiniere civilem, item Aegypti et Hipparchus, a media nocte in mediam. minora autem intervalla esse lucis inter occasus et ortus solis iuxta solstitium quam aequinoctia apparet quia positio signiferi circa media sui obliquior est, iuxta solstitium autem rectior.

> The actual period of a day has been differently kept by different people: the Babylonians count the period between two sunrises, the Athenians that between two sunsets, the Umbrians from midday to midday, the common people everywhere from dawn to dark, the Roman priests and the authorities who fixed the official day, and also the Egyptians and Hipparchus, the period from midnight to midnight. But it is obvious that the breaks in daylight between sunset and sunrise are smaller near the solstice than at the equinoxes, because the position of the zodiac is more slanting around its middle points but straighter near the solstice.
>
> (H. Rackham translation)

From the above passage we learn that the ancient Athenians counted their days, that is, the time it took for the Earth to revolve once on its axis, from sunset to sunset. This would be the day used by the State for calendrical purposes. However, as Pliny notes, the common people counted their days from sunrise to sunset. This would be the time when most Athenians conducted their daily affairs.

The dawn to dusk day was divided into twelve equal parts, or hours, the first and twelfth hours beginning at sunrise and ending at sunset respectively. Herodotus II. 109. 3, a passage which I shall treat in more detail in the next chapter under evidence for Athenian sundials, states that knowledge of the πόλος and the γνώμων (both words used in connexion with sundials) and of the twelve divisions of the day came into Greece via Babylonia. Although, in commentaries on Herodotus, this passage usually excites no more than a brief note concerning sundials,[3] J. E. Powell believes that

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[3] W. G. Waddell, ed., Herodotus: Book II (London: Methuen, 1939), p. 218, n. 109. 10; W. How and J. Wells, A Commentary on Herodotus, Vol. I (1912; rpt. Oxford: Clarendon Press, 1961), pp. 221-222, n. 109. 3.

"it was interpolated by someone not earlier than Alexandrine times".[4] He feels that it is out of place, since it occurs in the midst of a section dealing with Egyptian matters, and, because he dismisses the evidence of later ancient authors, he sees an "almost complete lack of evidence for sun-dials, let alone a twelve-hour day, in the classical period".[5] However, Powell's view is not widely held amongst scholars studying the topic of time in antiquity, and D. S. Robertson, in an article in the same volume of _Classical Review_, in which he cites some of the evidence against Powell's opinion, comments that:

> In proposing, like Krueger in 1855, to cut out as an interpolation the famous passage on _polos_ and _gnomon_ in Herodotus, ii. 109, 3, Professor J. E. Powell understates the strength of the literary evidence for Greek sundials (in the widest sense) in classical times. . . . the evidence for the fifth and fourth centuries cannot be lightly dismissed.[6]

He also states, with reference to Powell's assertion that Herodotus II. 109. 3 appears in the text "apropos of nothing",[7] that "it is not, however, unlike Herodotus to append in this manner a qualification to a too sweeping assertion (in this case the Egyptian origin of Greek geometry), and the difficulty of motive is not, in any case, wholly removed by the assumption of interpolation."[8]

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[4] J. E. Powell, "Greek Timekeeping," _Classical Review_, 54 (1940), p. 70.

[5] _Ibid_.

[6] D. S. Robertson, "The Evidence for Greek Timekeeping," _Classical Review_, 54 (1940), p. 180.

[7] Powell, p. 70.

[8] Robertson, p. 181.

Although Herodotus says that the Greeks acquired the twelve divisions of the day from the Babylonians, Otto Neugebauer and Richard Parker, as Sharon Gibbs mentions,[9] show that "the division of the day into 12+12 seasonal hours," which eventually became the twenty-four equinoctial hours of our day, probably originated with the Egyptian decanal system of dividing the night.[10] The Egyptian decanal system is too complicated to be described in any detail in this paper. I shall, therefore, simply note that it utilized the positions that a series of thirty-six constellations held in the night sky throughout the Egyptian "civil year of 12 months of three decades each."[11] By noting the positions of the decanal constellations, an individual "would know the 'hour' of night."[12] This system constituted a sort of star clock.[13] Neugebauer and Parker state that "the first evidence for the 12-division of the night is provided by the diagonal star

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[9] S. L. Gibbs, Greek and Roman Sundials (New Haven and London: Yale University Press, 1976), p. 6.

[10] O. Neugebauer and R. A. Parker, Egyptian Astronomical Texts, Vol. I (Providence: Brown University Press, 1960), pp. 116-121.

[11] O. Neugebauer, The Exact Sciences in Antiquity (2d ed., Providence: Brown University Press, 1957), p. 82.

[12] Ibid., p. 83.

[13] For a more detailed description of the Egyptian decanal system of dividing the night see: O. Neugebauer, The Exact Sciences in Antiquity, pp. 81-86.

clocks of the Ninth and Tenth Dynasties (2154-1436 B. C.)."[14] They give as an example of the division of daylight hours into twelve, a shadow clock from the time of Thutmose III (1490-1436 B. C.).[15] A papyrus of about 1300 B. C. provides "evidence for a total of 24 apparently equal hours".[16]

What might be called the first Egyptian contribution to astronomy was their calendar, and Neugebauer notes that:

> A second Egyptian contribution to astronomy is the division of the day into 24 hours, though these "hours" were originally not of even length but were dependent on the seasons. These "seasonal hours", twelve for daylight, twelve for night, were replaced by "equinoctial hours" of constant length only in theoretical works of Hellenistic astronomy. Since at this period all astronomical computations were carried out in the sexagesimal system, at least as far as fractions are concerned, the equinoctial hours were divided sexagesimally. Thus our present division of the day into 24 hours of 60 minutes each is the result of a Hellenistic modification of an Egyptian practice combined with Babylonian numerical procedures.[17]

The ancient Athenians used the seasonal hours of which Neugegbauer spoke in the preceding quotation. These hours were called ὧραι καιρικαί in Greek and horae temporales in Latin. As Neugebauer also remarked, the length of these hours, as their name indicates, fluctuated with the seasons. When we consider that the

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[14] Neugebauer and Parker, Vol. I, p. 116.

[15] *Ibid.*, p. 118.

[16] *Ibid.*, p. 121.

[17] Neugebauer, *The Exact Sciences in Antiquity*, p. 81.

twelve hours of day and night consisted of the equal division of daylight and darkness respectively, we realize, in the case of the day, that there were longer hours in summer and shorter hours in winter. This circumstance reflected the relative amounts of daylight for the respective seasons. Gustav Bilfinger, in a work on the ancient hour, has calculated the length of the day in Athens during the summer solstice as 14 hours and 40 minutes. This amount of daylight results in a temporal hour of 73 minutes and 20 seconds. For the winter solstice his daylight calculation was 9 hours and 20 minutes, which yields a 46 minute, 40 second temporal hour.[18] In a more recent work, Joe E. Armstrong and John McK. Camp II note that there were 9 hours and 31 minutes of sunlight or a 47 minute and 35 second temporal hour for the winter solstice of 1974 in Athens, and a 74 minute, 5 second temporal hour or 14 hours and 49 minutes of sunlight for the summer solstice.[19] The hours between the winter and summer solstices would gradually become longer and conversely, those between the summer and winter solstices would gradually become shorter.

A long day meant a correspondingly short night and vice versa. Thus when the length of the hours of daylight increased, the length of the hours of darkness decreased. The length of these seasonal

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[18] Gustav Bilfinger, Die Antiken Stundenangaben (Stuttgart: Kohlhammer, 1888), p. 158.

[19] J. E. Armstrong and J. McK. Camp II, "Notes on a Water Clock in the Athenian Agora," Hesperia, 46 (1977), p. 159, n. 15.

hours would remain constant for a given day or night, but only during the equinoctials were the hours of both day and night equivalent. These hours were equal to our standard or equinoctial hour of 60 minutes. The equinoctial hour became the standard measure of time for Hellenistic astronomers[20] and other men of science, but for the average citizen, the seasonal hour remained the unit of time used to divide the day. According to G. J. Whitrow, "the invention of the mechanical clock was the decisive step that led to the general use of the system of time reckoning in which day and night together are divided into twenty-four equal hours."[21] Since mechanical clocks, as we know them today, did not make their appearance until the fourteenth century,[22] seasonal hours were in use for a long time.

Timekeeping Devices

In the ancient world there were two categories of "clock," each fundamentally different from the other. They were the klepsydra, or water clock and the sundial, or shadow clock. The average individual could also use the length of his own shadow to give him a rough estimate of time. Gibbs mentions this practice in passing,[23] yet the examples she gives of its use are all related to comic

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[20]Gibbs, p. 10.

[21]G. J. Whitrow, The Nature of Time (New York: Holt, Rinehart and Winston, 1972), p. 73.

[22]*Ibid*.

[23]Gibbs, p. 7, pp. 94-95, n. 15.

literature. Philip Pattenden, in a review of Gibbs' book, informs us that: "The use of a man's own shadow length as a means of stating the time of day is not restricted to comic use, and a key to the method is given in Palladius' Opus Agriculturae for each month, where it is intended as a practical means for men in the fields to find the time of day at all times of the year."[24] The use of the human shadow to estimate the hour would be most common amongst the peasantry, especially those in the countryside, where public sundials would be unlikely.

However, returning to klepsydras and sundials, the basic difference between them lay in the fact that the water clock was a mechanical device which could measure time day or night, rain or shine, while the sun was the necessary component of the sundial. On a cloudy day the sundial ceased to function, as was also the case during the night hours. A. G. Drachmann tells us that "this is why the water-clock is called also a winter-clock, horologium hibernum, or night clock, ὡρολόγιον νυκτερινόν",[25] cloudy days being a frequent occurrence during the winter.

The origins of both these varieties of chronometers predate the Classical Greeks. However, it is with the ancient Greek astronomers,

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[24] P. Pattenden, "Sundials," rev. of Sharon L. Gibbs, Greek and Roman Sundials (New Haven and London: Yale University Press), Classical Review, N. S., 28 (1978), p. 338.

[25] A. G. Drachmann, Ktesibios Philon and Heron: A Study in Ancient Pneumatics, Acta Historica Scientiarum Naturalium et Medicinalium, Vol. IV (Copenhagen: Munksgaard, 1948), p. 16.

especially those of the Hellenistic Age, that their forms became more refined. The ancient Egyptians, as noted above, had shadow clocks as early as the second millenium B. C. These shadow clocks, consisting of a perpendicular component placed atop an L-shaped member, in no way resembled Graeco-Roman sundials, yet they were based on the same principle.[26]

Water clocks designed to measure the hours of night were also a common feature of Egyptian life. The earliest intact example of one of these outflow devices, an alabaster vessel discovered at Karnak in 1904, dates to the reign of Amenhotep III (1397-1360 B. C).[27]

When we talk about water clocks or klepsydras we must be careful to distinguish between the two basic types: the simple outflow variety and the more complex inflow model. The word klepsydra means literally "water-thief" and we first hear of it in connexion with a siphon-type device used to draw wine and water.[28] It was also the name of a spring in Athens referred to by Aristophanes

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[26]René R. J. Rohr, Sundials: History, Theory, and Practice, trans. Gabriel Godin (Toronto: University of Toronto Press, 1970), p. 5; Neugebauer and Parker, Vol. I, pp. 117-118.

[27]S. West, "Cultural Interchange Over a Water-Clock," Classical Quarterly, N. S., 23 (1973), p. 63; Neugebauer and Parker, Vol. I, P. 119, Vol. III, p. 12; A. Pogo, "Egyptian Water Clocks," Isis, 25 (1936), pp. 403-425.

[28]J. V. Noble and D. J. Price, "The Water Clock in the Tower of the Winds," American Journal of Archaeology, 72 (1968), p. 346; Suzanne Young, "An Athenian Clepsydra," Hesperia, 8 (1939), p. 275, n. 5. For more information on domestic klepsydras see: H. Diels, Antike Technik (Leipzig und Berlin: Teubner, 1920), pp. 192-193.

(Lysistrata V. 909) and subsequent writers.[29] Perhaps the best known type of simple outflow klepsydra is that used in the Athenian law courts, an example of which was found in the excavations of the Agora at Athens.[30] It had the same flower-pot shape as its Egyptian predecessors and operated in the same manner. A fixed amount of water flowed through a hole near the base of the pot and time was measured by how long it took to empty. As Drachmann has noted, it "was not a clock as we understand it."[31]

The outflow klepsydra had several drawbacks and these difficulties limited its usefulness predominantly to the law courts. One of the basic problems was of a technical nature. Given a fixed amount of water in a straight-sided vessel with a single sized opening at the base, the rate of flow of the escaping liquid will constantly decrease because of the diminishing pressure.[32] Using "conical or pyramidal containers[s], truncated so that approximately the upper twenty percent is used, whose sides are at an angle of seventy degrees to the horizontal."[33] will partially compensate for this problem. The flower-pot shape of Egyptian and Greek klepsydras reflects this fact. "In a simple out-flow klepsydra one must change the scales frequently

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[29] J. Stuart and N. Revett, The Antiquities of Athens, Vol. I (1762; rpt. New York: Benjamin Blom, 1968), pp. 15-16, notes b and c, provide a comprehensive list of references to this spring by ancient authors.

[30] Young, pp. 274-284.

[31] Drachmann, Ktesibios Philon and Heron, p. 16.

[32] Armstrong and McK. Camp, p. 154.

[33] Ibid., n. 9.

to account for the changing lengths of the temporal hours."[34] This fact meant that "for all purposes except the law court, where it indicated a fixed time interval, this type was soon superseded by the inflow clepsydra."[35] "With the change to an in-flow clock, . . . rather than changing scales, one can have a fixed scale and adjust the flow-rate, so that less water flows in summer and more in winter. Done properly, this method is more efficient and provides greater accuracy than that of the out-flow klepsydra. In addition, the fixed scale would permit a ready means of attaching mechanisms designed to sound the hours."[36]

One example of the old giving way to the new is observable in a large water clock discovered in excavations in the Athenian Agora by the American School of Classical Studies at Athens.[37] As Armstrong and McK. Camp convincingly show, the remains of this device, constructed next to a building that has been identified as the Heliaia,[38] were once part of a monumental outflow klepsydra, dateable to the end of the fourth century B. C. "Technical advances made in Alexandria in

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[34] Armstrong and McK. Camp, p. 159.

[35] Noble and Price, p. 350.

[36] Armstrong and McK. Camp, p. 159.

[37] Homer A. Thompson, "Excavations in the Athenian Agora: 1953," Hesperia, 23 (1954), pp. 37-38; Mabel Lang, Waterworks in the Athenian Agora, Excavations of the Athenian Agora Picture Book No. 11 (Princeton, N. J.: American School of Classical Studies at Athens, 1968); Homer A. Thompson and R. E. Wycherley, The Athenian Agora: Volume XIV (Princeton, N. J.: American School of Classical Studies at Athens, 1972), pp. 64-65, 202; Homer A. Thompson, The Athenian Agora Guide (3rd ed. rev., Athens: American School of Classical Studies at Athens, 1976), Armstrong and McK. Camp, pp. 147-161.

[38] Thompson, "Excavations in the Athenian Agora: 1953," pp. 33ff.

the 3rd century rendered the clock old-fashioned, if not obsolete, and the structure underwent a major renovation, designed to keep pace with new methods of controlling the rate of flow."[39] In other words, sometime during the third century B. C., the outflow klepsydra was transformed into an inflow model. The construction, early in the second century B. C., of the Middle Stoa, effectively rendered the water clock useless, since its foundations cut through the drainage channel.[40]

While the outflow klepsydra marked time by measuring how long it took water to run out of a container, the inflow type, as the name implies, performed the same function by reckoning how long it took for water to flow into a container. Vitruvius (IX. VIII. 4) attributes the invention of the inflow klepsydra to Ktesibios, the son of a barber, an Alexandrian living approximately 300-230 B. C.[41] He gives a description of this device in De Architectura (IX. VIII. 4-7). We know from Vitruvius (I. I. 7; X. VII. 5) that Ktesibios wrote a book dealing with his experiments and inventions. Drachmann believes that Vitruvius was in actual possession of a copy of this book and drew from it the information he included in De Architectura.[42]

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[39] Armstrong and McK. Camp, p. 161.

[40] Ibid., p. 151.

[41] Vitruvius De Architectura IX. VIII. 2; Drachmann, Ktesibios Philon and Heron, p. 3; Drachmann, "On the Alleged Second Ktesibios," Centaurus, 2 (1951), pp. 1-10.

[42] Drachmann, Ktesibios Philon and Heron, p. 1; "On the Alleged Second Ktesibios," p. 3.

As I mentioned above, a fixed amount of water escaping from a single holed vessel will run off at an ever decreasing rate. In other words, as Drachmann points out: "The rate of flow from the klepsydra depends upon the size of the hole and the height of the water above it."[43] What Ktesibios did was to maintain the height of the water in the klepsydra by having it run into the vessel faster than it ran out. An overflow channel would insure a constant water level in the klepsydra.[44] He constructed the hole of this container from a gem or gold,[45] substances which would not rust or be worn away through prolonged use.[46]

The inflow klepsydra necessitated the use of three receptacles. Arranged in order from top to bottom, they were: a vessel from which the water ran into the klepsydra; the klepsydra itself; and a vessel containing a float into which the water ran at an even rate.[47] The float was not necessary because, as the lower container filled, "the time could be read on a scale inside the container, . . . but Ktesibios, being of an inventive and mechanical turn of mind, preferred something more elaborate."[48] A pipe from a spring or an aqueduct could replace

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[43] Drachmann, Ktesibios Philon and Heron, p. 18.

[44] Ibid.

[45] Vitruvius De Architectura IX. VIII. 4.

[46] Drachmann, Ktesibios Philon and Heron, p. 18.

[47] Ibid.; Noble and Price, p. 350.

[48] Drachmann, Ktesibios Philon and Heron, p. 18.

the upper vessel.[49] Once the lower container was filled, it had to be emptied or "rewound." A drain was therefore necessary in this lower vessel. When the receptacle was drained, it was once again ready to indicate the time.[50]

Vitruvius (IX. VIII. 5) described how the water flowed into the container, raising a rod and float, which both had the same number of teeth. They in turn meshed together causing connecting rods and drums to revolve and activate various gadgets: statues, pillars, stones or eggs, trumpets, etc., which marked the passing time. Drachmann points out that: "It seems reasonable to conclude that the first clock had no scale of hours at all, but only made signals to be seen and heard at the end of each hour. The statues were probably puppets coming out of doors, the obelisks half black, half white, making half a turn, the pebbles or eggs were balls thrown into a bronze bowl, and the trumpets direct descendants of Platon's whistle.[51] . . . How Ktesibios in this form of clock contrived to make the hours long or short according to the season we do not know."[52]

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[49] Drachmann, Ktesibios Philon and Heron, p. 118.

[50] It is interesting to note that while today we wind "up" our clocks, the ancients could be said to wind "down" their inflow klepsydras, that is to say, the container must be empty, the water level lowered, in order to give the time. Time could be said to stand still only in the sense that it does today when our watches are not wound. The clock would be restarted at dawn.

[51] The philosoper Plato purportedly invented a night clock with an alarm that sounded to awaken his colleagues for work in the morning. Athenaeus Deipnosophists IV. 174. c; H. Diels, Antike Technik, pp. 161, 198-202.

[52] Drachmann, Ktesibios Philon and Heron, p. 119.

As Vitruvius remarks (IX. VIII. 6), Ktesibios improved upon this first type of inflow klepsydra, He added a figure holding a pointer to the top of the rod. As the float rose, the figure pointed out the hours which were marked on a column or pillar. Altering the rate of flow of the water or changing the scale would adjust for the seasonal hours. In a second, more effective method (Vitruvius IX. VIII. 7), the flow of the water remained constant. The twelve hours of the shortest day and of the longest day were marked on a cylinder and joined by sloping lines. Consequently, by turning the cylinder a little every day, the clock would always register the right time.[53] Drachmann sums up the whole process thus:

> I think that we must imagine the whole story of the invention of the first clocks in this way: First Ktesibios invented the klepsydra with constant flow and made it work the _parerga_;[54] then he added the figure to show the hours. Next he tried to make the clock show local hours; first by regulating the flow, so as to have both the scale and the _parerga_; then, when he found that the valve would not work properly, he invented the universal scale, but then he had to discard the _parerga_.[55]

Returning to the subject of the Agora clock, Armstrong and McK. Camp used the remains of a similar klepsydra at Oropos to reconstruct the outflow device.[56] The remains of the Agora clock

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[53] For a more detailed explanation of the above procedures see: Drachmann, _Ktesibios Philon and Heron_, pp. 17-21.

[54] The _parerga_ were the automated gadgets and other side-show effects which marked the hours.

[55] Drachmann, _Ktesibios Philon and Heron_, pp. 20-21.

[56] For a description of the device at Oropos see: A. Leonardos, Ἀρχ. Ἐφ., 1918, pp. 110-113, and B. X. Petrakou, Ὁ Ὠρωπὸς καὶ τὸ Ἱερὸν τοῦ Ἀμφιαράου, Athens, 1968, pp. 113-116, cited by Armstrong and McK. Camp, p. 152, n. 6.

were more indicative of the inflow phase of its existence. The original outflow hole had been blocked off and replaced by a larger pipe, which allowed for more rapid drainage of the tank.[57] The inside of the tank was cut back to straighten the sides, which had been necessarily sloped for an outflow klepsydra, and traces of two reservoirs were preserved above it.[58] The condition of the remains of the water clock did not permit Armstrong and McK. Camp to state with any certainty what kind of scale was used to mark the hours. However, they did theorize, based on the structural remains, that the variable-water-flow, pointer and column system, described by Vitruvius (IX. VIII. 6), could well have been in use.[59]

Vitruvius describes two other types of water clock mechanisms, both of which were based on the principle of the inflow klepsydra. The first device (Vitruvius IX. VIII. 8-10) is known as the anaphoric clock. The second (Vitruvius IX. VIII. 10-15), actually only a description of a regulating mechanism, I shall term the zodiac clock, following A. G. Drachmann.[60]

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[57] Armstrong and McK. Camp computed that the water would be completely drained away within 40 minutes. "Notes on a Water Clock in the Athenian Agora," p. 157, n. 11.

[58] For other apparent modifications see: Armstrong and McK. Camp, pp. 147-161.

[59] Armstrong and McK. Camp, pp. 160-161.

[60] Drachmann, Ktesibios Philon and Heron, p. 26.

The anaphoric clock is closely related to the astrolabe, "(a sort of circular star-finder map also used for simple observation)"[61] and indeed, Drachmann believes that this clock was the forerunner of the instrument.[62] Price even asserts that:

> The anaphoric clock is not only the origin of the astrolabe and of all later planetary models, it is also the first clock dial, setting a standard for "clockwise" rotation, and leaving its mark in the rotating dial and stationary pointer found on the earliest time-keeping clocks before the change was made to a fixed dial and moving hand.[63]

It was perhaps invented by Hipparchos (140 B. C.),[64] who is also associated with the invention of the astrolabe.[65]

In the anaphoric clock the constant flow of the water once again raised a float, but this float was connected, via a soft bronze chain wrapped around an axle turning on a horizontal axis, to a sandbag which acted as a counter-poise. This axle rotated once during a 24 hour period. Mounted on one end of the axle was a large bronze disc, upon which was engraved a celestial map of the Northern

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[61] D. J. Price, "An Ancient Greek Computer," Scientific American, 200 (1959), p. 62.

[62] A. G. Drachmann, "The Plane Astrolabe and the Anaphoric Clock," Centaurus, 3 (1954), p. 187.

[63] D. J. Price, "On the Origin of Clockwork, Perpetual Motion Devices and the Compass," Contibutions from the Museum of History and Technology, U. S. National Museum Bulletin, 218 (1959), paper 6, pp. 91-92.

[64] Drachmann, Ktesibios Philon and Heron, p. 26; "The Plane Astrolabe and the Anaphoric Clock," p. 185; Noble and Price, p. 351.

[65] O. Neugebauer, "The Early Astrolabe," Isis, 40 (1949), pp. 248-249.

hemisphere, from the North Pole at the centre, to the tropic of Capricorn at the outer edge. The rotating axle turned the star map around one full rotation in 24 hours. Also engraved on this map was a circle representing the zodiac or the ecliptic.[66] Around the ecliptic there were 365 holes into which could be fastened a representation of the sun. A network of bronze wires hung before the disc; seven concentric circles representing the zodiacal months, the tropics of Cancer and Capricorn and the Equator; a diameter placed vertically through all the circles, representing the meridian; a horizon line based on the latitude of the clock; and a series of hour lines, above and below the horizon, for the hours of day and night, constructed by means of an analemma.[67]

As the disc rotated, the image of the sun moved through the network of wires, indicating the hours. As long as the sun was always placed in the hole corresponding to the actual day and the clock was restarted every sunrise, the seasonal hours of the day and the watches of the night would be marked with a fair degree of accuracy

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[66] The ecliptic is "the apparent path of the sun around the celestial sphere." Funk and Wagnalls Standard College Dictionary: Canadian Edition (Toronto: Fitzhenry and Whiteside, 1976).

[67] "The analemma [was] the basic two-dimensional projection of the Celestial Sphere used by the ancients to construct dials." P. Pattenden, "Sundials," p. 337. For an account of the analemma, and also a diagram, as described by Vitruvius De Architectura IX. VII, see: Gibbs, Greek and Roman Sundials, pp. 105-109; pp. 109-117 give an account of the analemma by Ptolemy (Περὶ Ἀναλήμματος).

for the latitude for which the clock was designed.[68]

Noble and Price envisaged this type of horological device in their reconstruction of the water clock in the interior of the Tower of the Winds in Athens.[69] "Parts of two such discs from anaphoric clocks have been found, one at Salzburg and one at Grand Vosges, both of them dating from the 2nd century A. D."[70]

The anaphoric clock was one answer to the problem of regulating the klepsydra in order to mark the seasonal hours. The water flowed at a steady rate turning the axle at a constant speed. It was the moveable sun and the scales that insured accuracy.[71] However, Vitruvius next described a method of marking seasonal hours with the klepsydra by varying the rate of flow.

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[68] Differences in the amount of daylight on a given day occur between places of different latitudes. The longest day of the year is longer farther from the equator than nearer to it, as is the shortest day of the year shorter, the farther away from the equator one goes. Consequently, the network of seasonal hour lines is different for every latitude, just as there is an analemma for every latitude. The result of these circumstances is that the anaphoric clock showing seasonal hours will operate accurately only for the latitude for which it was designed. The same is also true of ancient sundials.

[69] Noble and Price, pp. 345-355.

[70] Price, "On the Origin of Clockwork," p. 91. For a discussion of the Salzburg disc fragment see: O. Benndorf, E. Weiss, and A. Rehm, Jahreshefte des österreichischen archäologischen Institutes in Wien, 1903, vol. 6, pp. 32-49, cited by Price, "On the Origin of Clockwork," p. 91, n. 14.

[71] For a more detailed account of the anaphoric clock see: Drachmann, Ktesibios Philon and Heron, pp. 21-26; For the relationship between the plane astrolabe and the anaphoric clock see: Drachmann, "The Plane Astrolabe and the Anaphoric Clock," pp. 183-189.

As I mentioned above, the height of the water and the size of the hole in the klepsydra determine the rate of flow. In the zodiac clock the water level in the container remained constant. It was the placement of the drip hole that varied. In an effort to present an easily understandable account of this device, I shall use the words of A. G. Drachmann:

> The hole of the klepsydra is placed excentrically [eccentrically] in a bronze disc, which can be turned in its setting, so that the hole changes its position in relation to the surface of the water in the klepsydra. As the height of the water above the hole changes, the rate of flow will change also, and the container with the float will take more or less time to be filled to the same extend [extent]; so the scale will do for everytime of year.[72]

The device, as presented by Vitruvius, had several drawbacks and impracticalities, which have prompted at least one pair of scholars to question whether it was indeed ever constructed. "One doubts whether the device was ever much more than a pipe dream, for the difficulty of engineering such a turning plate or similar device, and of calculating its size, are very considerable and probably near the the margin of Greek competence in science and technology."[73] However, if it was in fact ever constructed, we hear, once again from Drachmann, that as long as it was used either only during the daytime or the nightime "it must have been a very effective clock-- before the introduction of the Julian calendar."[74]

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[72] Drachmann, Ktesibios Philon and Heron, pp. 26-27.

[73] Noble and Price, p. 351.

[74] Drachmann, Ktesibios Philon and Heron, p. 31. For a more detailed explanation of the zodiac clock and a list of its defects and merits, see the above Drachmann, pp. 26-31.

Let us now turn to a description of that other device for telling time in antiquity, the sundial. The sundial was a commoner implement for marking the hour, than its more elaborate cousin, the water clock. I have already stated that the Egyptians used sundials, of a sort, long before there was a Greek or Roman Empire. However, it is with the Graeco-Roman tradition of dialling that I shall be dealing.[75]

Archaeological and literary evidence about the early development of sundials in the Graeco-Roman world is scarce. To quote from Gibbs:

> On the whole, the literary evidence seems to suggest that there were few, if any, sundials marking the seasons and seasonal hours in Greece before the third century B. C. Archaeological evidence confirms this hypothesis. We do know that the notion of seasonal hours has a long history, and we know that classical astronomers used instruments which marked seasonal changes in the position of the sun. These practices may well have combined to inspire the design of the sundial, perhaps as early as the sixth century, but preserved examples thought to date even from Hellenistic times are few. However, Vitruvius indicates that many types of dials were invented in the post classical period.[76]

Quoting Favorinus (second Century A. D.), Diogenes Laertius (third to fourth century A. D.)[77] assigns the invention of the gnomon to Anaximander (611-546 B. C.), who, he says, erected it as a sundial or "shadow catcher" at Sparta. However, as we have already seen,

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[75]The best source of information on Greek and Roman sundials is the book by Sharon L. Gibbs, <u>Greek and Roman Sundials</u>.

[76]Gibbs, pp. 7-8.

[77]Diogenes Laertius II. I. 1.

Herodotus (II. 109. 3) attributes the gnomon to the Babylonians. Gibbs suggests that perhaps this device of Anaximander did not mark the hours, but only functioned for observing solstices and equinoxes.[78] Anaximander, according to Laertius, also constructed ὡροσκοπεῖα, apparently timekeeping devices of a sort. Quite probably the word refers to some form of sundial.[79]

The same activities, regarding sundials and the science of gnomics, are also described by Pliny (<u>Natural History</u> II. LXXVIII. 187). However, he assigns them not to Anaximander, but to his pupil Anaximenes of Miletus.

> Umbrarum hanc rationem et quam vocant gnomonicen invenit Anaximenes Milesius, Anaximandri (de quo diximus) discipulus, primusque horologium quod appellant sciothericon Lacedaemone ostendit.

> This theory of shadows and the science called gnomonics was discovered by Anaximenes of Miletus, the pupil of Anaximander of whom we have spoken; he first exhibited at Sparta the time-piece they call 'Hunt-the-Shadow.'
> (H. Rackham translation)

As Gibbs notes,[80] the theory has been forwarded that Pliny in fact confused the two names, Anaximander and Anaximenes,[81] yet "his account lends credence to the report that some kind of scientific instrument was erected in Sparta in the sixth century B. C."[82]

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[78] Gibbs, p. 6.

[79] <u>Ibid</u>., p. 7.

[80] <u>Ibid</u>., p. 94, n. 11.

[81] G. S. Kirk and J. E. Raven, <u>The Presocratic Philosophers</u> (Cambridge: University Press, 1963), p. 103.

[82] Gibbs, p. 94, n. 11.

A scholiast on Aristophanes, Birds 997, noted that the (fourth or third century B. C.) historian Philichorus recorded that a sundial was erected on the Pnyx at Athens by Meton the astronomer in 433/2 B. C. Homer Thompson and K. Kourouniotes suggest that a limestone cutting, discovered by them in excavations on the Pnyx, represents the remains of the base of Meton's sundial.[83]

Apparently Dionysius I had a ἡλιοτρόπιον erected at Syracuse because Plutarch, in his Life of Dion (XXIX. 2), has that personnage deliver an address to the citizens mounted upon the aforementioned horological device.

Γνώμων, πόλος, σκιοθήρης (shadow catcher), ὡροσκόπιον and ἡλιοτρόπιον are all words which are connected with timekeeping devices, most especially sundials. However, while, by the time of Vitruvius, these terms had taken on specific meanings, for instance the πόλος was a concave, hemispherical 'dial' and the γνώμων was the shadow casting pointer of the dial, in earlier times, say pre-third century B. C., we cannot be sure what the devices, to which these terms refer, looked like. Referring to the passage of Diogenes Laertius (II. I. 1), Gibbs says that here "the two terms γνώμων and σκιοθήρης may be used synonymously."[84]

Unfortunately, much of the literary evidence that we do

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[83] K. Kourouniotes and H. A. Thompson, "The Pnyx in Athens," Hesperia, 1 (1932), p. 207.

[84] Gibbs, p. 6.

have concerning these early implements is of a secondary or even tertiary nature. It is obvious that we suffer from a lack of preserved original material. The same thing can be said of the archaeological remains. In the case of archaeological material, part of the problem may indeed be, as Philip Pattenden has suggested,[85] in the inability of excavators to identify horological remains which may have turned up in the course of their excavations.

Returning to our earlier quotation from Gibbs, I would prefer the alternative of "few" sundials in pre-third century B. C. Greece, to that of none. I think that the evidence does not warrent the latter conclusion. Combining the evidence for sundials with that for water clocks, for instance the Athenian court klepsydra and the fourth century B. C. Agora water clock, I think we must admit the existence, from at least as early as the end of the fifth century B. C., of at least an elementary awareness of and interest, on the part of some Greeks, in marking the passage of time.

I think at this point, a brief explanation of some of the basic principles of the ancient sundial is in order. Ancient sundials differ in several respects from their more modern counterparts. For instance, the former mark the seasonal hours, while the latter record the equinoctial hours. Thus, like anaphoric clocks, ancient sundials were only accurate for the latitude for which they were constructed.

[85] Pattenden, "Sundials," p. 336.

Pliny the Elder, in his Natural History, makes several references to the circumstance of varying amounts of daylight for different latitudes (II. LXXVIII. 186), and also to the effects of this phenomenon on sundials. In one passage (II, LXXIV. 182), he remarks on its relevance to portable sundials.[86]

> Vasaque horoscopica non ubique eadem sunt usui, in trecenis stadiis, aut ut longissime in quingentis, mutantibus semet umbris solis. itaque umbilici (quem gnomonem appellant) umbra in Aegypto meridiano tempore aequinocti die paulo plus quam dimidiam gnomonis mensuram efficit, in urbe Roma nona pars gnomonis deest umbrae, in oppido Ancona superest quinta tricesima, in parte Italiae quae Venetia appellatur iisdem horis umbra gnomoni par fit.

> Travellers' sundials are not the same for reference everywhere, because the shadows thrown by the sun as they alter alter the readings at every 300 or at farthest 500 stades. Consequently in Egypt at midday on the day of the equinox the shadow of the pin or 'gnomon' measures a little more than half the length of the gnomon itself, whereas in the city of Rome the shadow is 1/9th shorter than the gnomon, at the town of Ancona 1/35th longer, and in the district of Italy called Venezia the shadow is equal to the gnomon, at the same hours.
> (H. Rackham translation)

Another striking example of this problem is related by Pliny in Book VII of his Natural History (VII. LX. 214). Commenting upon what he says Varro asserted to be the first public sundial erected in Rome, a dial taken from Catania, a Greek colony in Sicily, sometime during the third century B. C., he says:

> nec congruebant ad horas eius liniae, paruerunt tamen ei annis undecentum, donec Q. Marcius Philippus qui cum L. Paullo fuit censor diligentius ordinatum iuxta posuit; idque munus inter censoria opera gratissime acceptum est.

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[86] Several examples of portable sundials have been identified in modern times. See: D. J. Price, "Portable Sundials in Antiquity," Centaurus, 14 (1969), pp. 242-266.

> The lines of this dial did not agree with the hours, but all the same they followed it for 99 years, till Quintus Marsius Philippus who was Censor with Lucius Paulus placed a more carefully designed one next to it, and this gift was received as one of the most welcome of the censor's undertakings.
>
> (H. Rackham translation)

Gibbs remarks that the error was greatest for calendrical purposes and it was probably this error which prompted the correction. "The greatest error in the time of day would have been only about .07 Roman summer hours, certainly an error small enough to go unnoticed."[87] Yet this incident does indicate that the Romans of this early period did not consider this problem particularly important, for while they received the gift of the new sundial with open arms, they had been content to follow the incorrect one for 99 years. As Gibbs says: "The realization that the appearance of all solar phenomena is affected by changes in latitude apparently did not come as easily to the Romans as it did to the Greeks."[88]

The gnomon is the part of the sundial whose shadow marks the hours. "On modern dials a number of hours of equal length throughout the year are usually marked on a horizontal surface by the shadow of the edge of a gnomon which lies parallel to the axis of the earth. . . . On a Greek or Roman dial, the shadow of a gnomon's

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[87]Gibbs, p. 96, n. 25.

[88]*Ibid.*, p. 10.

point, not its edge, marked the seasonal hours. The base of the gnomon could be placed in any convenient position."[89] Gibbs also notes that it appears Greek and Roman sundial makers "preferred conical and spherical dial surfaces."[90]

As one author has remarked, "ancient sundials are far more mathematical and calendrical",[91] than their modern counterparts. Another author, D. J. Price, comments on Greek and Roman sundials that:

> on the whole their design and intention seems to have been the aesthetic or religious satisfaction derived from making a device to simulate the heavens. Greek and Roman sundials, for example, seldom have their hour-lines numbered, but almost invariably the equator and tropical lines are modeled on their surfaces and suitably inscribed. The design is a mathematical tour de force in elegantly mapping the heavenly vault on a sphere, a cone, a cylinder, or on specially placed planes.[92]

Undoubtedly, sundials served an important calendrical function, marking solstices and equinoxes for festivals and other religious purposes, just as did anaphoric clocks. Yet, to say, as Price does, that since the hour lines were seldom numbered, the indication of time was only an incidental function of sundials, is, I think, an overstatement of the situation. Some of the fragmentary remains of sundials do distinctly show numbers for the hour lines, notably

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[89] Gibbs, p. 4.

[90] Ibid.

[91] D. de B. Beaver, Rev. of Sharon L. Gibbs, Greek and Roman Sundials (Yale University Press), Isis, 70 (1979), p. 174.

[92] Price, Science Since Babylon, p. 55.

numbers 3086G, 5003G and 5018G in Gibbs' catalogue of sundials. Many of our dials are in such fragmentary conditions that one cannot say for certain whether there were actual numbers on them marking the hours or not. In any event, the numbers of the hours on the sundial, ΑΒΓΔΕΣΖΗΘΙΙΑΙΒ , were sufficiently well known to have inspired an anonymous epigram.[93]

43.—ΑΔΗΛΟΝ

Ἓξ ὧραι μόχθοις ἱκανώταται· αἱ δὲ μετ' αὐτὰς
γράμμασι δεικνύμεναι ΖΗΘΙ λέγουσι βροτοῖς.

43.--ANONYMOUS

Six hours are most suitable for labour, and the four that follow, when set forth in letters, say to men "Live."
(W. R. Paton translation)

"As in Greek the numerals are represented by letters of the alphabet, it so happens that those letters which indicate the hours from noon to 4 p. m. also spell the word ζῆθι = "live."[94] It would seem then, that it was not necessary to actually physically mark the numbers on the hour lines of the sundial. They were well known without so doing.

Vitruvius (IX. VIII. 1) identifies several inventors of sundials and mentions thirteen different types of dial. Not all of these dial types have been identified with actual remains and not all remains have been satisfactorily assigned to one of Vitruvius'

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[93] Greek Anthology X. 43.

[94] Margaret Gatty, The Book of Sundials, ed. H. K. F. Eden and Eleanor Lloyd (London: Bell, 1900), p. 8.

classifications. Cetius Faventinus, in chapter 29 of his De Diversis Fabricis Architectionicae,[95] gives a detailed description of two types of dial mentioned by Vitruvius, the pelecinum and the hemicyclium. Philip Pattenden tells us that:

> From this evidence it might be thought that Faventinus, writing perhaps in the early third century A. D., is following the Augustan writer, Vitruvius. As Soubrian and Plommer point out this is not possible, and another source must be postulated. However, the poor technical quality of Faventinus' description shows that he was in fact describing two actual timekeepers, whose construction and calibration he did not really understand.[96]

Thus we have in Faventinus a layman's description of two dials, the pelecinum, shaped like a double-axe, and the hemicyclium, which Vitruvius described as a semicircular dial hollowed out of a square block and cut according to the latitude, invented by Berosus the Chaldaean; Hemicyclium excavatum ex quadrato ad enclimaque succisum Berosus Chaldaeus dicitur invenisse.[97]

Twice in Faventinus we are told that there is no need for extreme accuracy in the construction of sundials since "nearly always men are in a hurry and merely inquire what hour of the day they are in."[98] A need in daily life for knowledge only of what hour one was in is probably one reason why the sexagesimal division of the hour into minutes and seconds, a Babylonian development, was confined,

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[95] H. Plommer, Vitruvius and Later Roman Building Manuals (Cambridge: University Press, 1973), pp. 80 ff.

[96] P. Pattenden, "Sundials in Cetius Faventinus," Classical Quarterly, N. S., 29 (1979), p. 201.

[97] Vitruvius De Architectura IX. VIII. 1. For a discussion of types of sundials in Vitruvius see: Gibbs, pp. 59-65.

[98] C. Faventinus 29, translated H. Plommer = H. Plommer, pp. 83 and 85.

in antiquity, on the whole, to the theoretical computations of astronomers and mathematicians.[99]

Before I return to the main focus of this paper, the practical aspect of time in ancient Athens, I shall repeat, by way of summation of this chaper, the important points of Graeco-Roman timekeeping which we should bear in mind as we continue our discussion.

In antiquity there were two classes of device for measuring time, the water clock or klepsydra, and the sundial. A rough estimate of time could also be obtained by the use of one's own shadow. Daylight was divided into twelve equal portions, seasonal or temporal hours, so called because their length changed throughout the year. Similarly, the night was divided into twelve hours or watches. Only at the equinoxes were the hours of day and night of similar length. These were equinoctial hours. The division of the hour into smaller segments was of interest only to astronomers, and most people only wanted to know what hour they were in. Sundials could be constructed on all manner of surfaces, but ancient diallers appear to have had a penchant for conical and spherical surfaces. Ancient sundials marked the seasonal hours and were only accurate for the latitude for which they were designed. Sundials served calendrical purposes, such as recording solstices and equinoxes, as well as telling time, and some scholars, such as D. J. Price, believe that to have been their primary function. In any case,

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[99] For the development of the sexagesimal system of notation see: O. Neugebauer, The Exact Sciences in Antiquity, pp. 10-23.

when we talk about the development of time in antiquity, we must realize that astronomical observations and the concept of the day are closely allied, since the latter ultimately evolved from the discoveries of the former.

II

THE EVIDENCE

In this chapter, I shall present the archaeological and literary evidence for the practical aspect of time and timekeeping specifically for ancient Athens. In the preceding chapter, I remarked that "I think we must admit the existence, from at least as early as the end of the fifth century B. C., of at least an elementary awareness of and interest, on the part of some Greeks, in marking the passage of time."[100] Beginning with the evidence from this period then, I shall outline the literary and archaeological material concerning horology in ancient Athens through to approximately the time of the birth of Christ, when Athens was very much under the control of Rome.

I shall comment briefly upon each piece of material as presented, and in the next chapter, I shall present my conclusions and attempt to use this evidence to show the growing importance of clock time for the Athenian citizenry from the fifth century B. C. to the birth of Christ. The evidence will be grouped into two main categories: sundials and other timekeeping methods employing the use of shadows; and water clocks, consisting of both the simple outflow klepsydra, such as that used in the law courts, and the more complicated

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[100] p. 27.

inflow klepsydra. Since our earliest extant piece of literary evidence for timekeeping in Greece and Athens is the passage of Herodotus (II. 109. 3) where he mentions shadow measuring devices, I shall begin my examination of the evidence for timekeeping in Athens with sundials.

Sundials and Other Shadow Methods for Telling Time

As I just stated, Herodotus II. 109. 3, which I mentioned in chapter one in connexion with the division of the day, is the earliest extant source on ancient Greek time. The text of this passage is as follows:

> *πόλον μὲν γὰρ καὶ γνώμονα καὶ τὰ δυώδεκα μέρεα τῆς ἡμέρης παρὰ Βαβυλωνίων ἔμαθον οἱ Ἕλληνες.*

> for knowlege of the sundial and the gnomon and the twelve divisions of the day came into Greece from Babylon.
> (Aubrey de Sélincourt translation)

Sélincourt translates the word πόλος as sundial. However, while this word is connected with the measurement of the sun and shadows, we do not know precisely what form it took in mid fifth century Greece; therefore, the word sundial tends to be misleading.

As I briefly noted in the first chapter, there is some dispute about the authenticity of this passage. J. Enoch Powell sees it as an Alexandrine interpolation.[101] However, he bases his interpretation on the fact that he himself does not believe there

[101] J. E. Powell, "Greek Timekeeping," pp. 69-70.

to be any concrete evidence for the gnomon and the polos in Greece before, at the earliest, the third century B. C. He arrives at the third century B. C. because that is the date of Berosos the Chaldaean, who he says is the earliest inventor of the sundial that Vitruvius mentions (IX. IX. 1). He also finds the evidence of later authors, who mention Greek sundials in classical times, to be back projection, on the part of these writers, of the ideas and interpretations prevalent in their own time. Yet, as I also noted, D. S. Robertson rebuts Powell's arguments and tells us that the evidence "for Greek sundials (in the widest sense) . . . for the fifth and fourth centuries cannot be lightly dismissed."[102] He also asserts that "the old argument that the τῆς ἡμέρης instead of ὥρας suggests that the Herodotean passage is pre-Alexandrine is not without force."[103] By the second century B. C. "ὥρα was used in the limited sense of 'hour'."[104]

In view of Robertson's evidence, I think we should look upon this passage as Herodotean. However, what specifically Herodotus is referring to with the words <u>polos</u> and <u>gnomon</u>, is open to conjecture. Stephanie West informs us that: "γνώμων in Greek is not much more specific than 'gauge,' 'indicator,' or 'marker' in English."[105]

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[102] Robertson, "The Evidence for Greek Timekeeping," p. 180.

[103] <u>Ibid</u>., p. 182.

[104] Waddell, <u>Herodotus: Book II</u>, p. 218, n. 109. 11.

[105] S. West, "Cultural Interchange Over a Water Clock," <u>Classical Quarterly</u>, N. S., 23 (1973), p. 62.

As Sharon Gibbs remarks, with reference to this passage of Herodotus: "Mentioned in connection with the twelve parts of the day, the πόλος and γνώμων could very well be timekeepers. Unfortunately we have no clear description of their appearance or use."[106]

The next piece of evidence, this time referring specifically to Athens, is the passage from the scholiast on Aristophanes' Birds 997. Apparently Meton, the astronomer, erected a ἡλιοτρόπιον on the Pnyx at Athens in 433/2 B. C.

> *ὁ δὲ Φιλόχορος ἐν Κολωνῷ μὲν αὐτὸν (sc. τὸν Μέτωνα) οὐδὲν θεῖναι λέγει, ἐπὶ Ἀψεύδους δὲ τοῦ πρὸ Πυθοδώρου ἡλιοτρόπιον ἐν τῇ νῦν οὔσῃ ἐκκλησίᾳ, πρὸς τῷ τείχει τῷ ἐν τῇ Πνυκί*

> Philochorus states that he (sc. Meton) set up nothing on Colonus but that in the archonship of Apseudes, who preceded Pythodorus, he placed an heliotropion in the present place of assembly close to the wall on the Pnyx.[107]

As I have already mentioned, we do not know precisely what form the early shadow measuring devices took, although Gibbs, referring to Meton's heliotropion, informs us that "the name suggests that the instrument at least marked the seasons,"[108] that is to say, solstices and equinoxes.

In the first chapter I remarked that Homer Thompson and K. Kourouniotes believe they have discovered the base of Meton's sundial. They list the objections to the suggestion that their

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[106] Gibbs, p. 6.

[107] Scholiast on Aristophanes Birds 997; K. Kourouniotes and H. A. Thompson, p. 207.

[108] Gibbs, p. 94, n. 14.

find is actually the remains of the base of an altar on the Pnyx to either Zeus Agoraios or Herakles Alexikakos,[109] and conclude that "in view of these difficulties we would suggest that this rock working served as the foundation for the podium of Meton's *heliotropion*."[110]

Powell believes that the information about timekeeping in classical times contained in later writers is unreliable, but I tend to agree with Robertson when he says that the information about Meton "should not be called 'late' because it survives only in an Aristophanic scholium."[111] Much of what we know about various aspects of antiquity is preserved for us in later writers. For that matter, when Vitruvius writes about Berosus the Chaldaean, he should be considered a 'late' writer. I think one of the main reasons that Powell dismisses the evidence for timekeeping in classical times is that it does not agree with his theories, especially about the passage of Herodotus.

Aristophanes, in the *Ekklesiazusae* (651 ff.), provides us with information on the use of the shadow to determine the hour. In Gibbs' words: "two Athenian farmers, husband and wife, discuss the time of dinner in terms of a shadow length of ten feet."[112]

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[109] Kourouniotes and Thompson, p. 210.

[110] *Ibid*.

[111] Robertson, p. 181.

[112] Gibbs, p. 94, n. 15.

One of them says as follows:

ΠΡ. οἱ δοῦλοι. σοὶ δὲ μελήσει,
ὅταν ᾖ δεκάπουν τὸ στοιχεῖον, λιπαρῷ χωρεῖν ἐπὶ
δεῖπνον.

PR. All labour and toil to your slaves you will leave;
Your business twill be, when the shadows of eve
Ten feet on the face of the dial are cast,
To scurry away to your evening repast.
(B. B. Rogers translation)[113]

Athenaeus, a native of Naucratis Egypt, living in Rome at the end of the second or beginning of the third century A. D., tells us, in the Deipnosophists, of two instances of guests, invited to dine at a certain hour, arriving too early because they mistook the length of morning shadows for those of afternoon shadows. Athenaeus attributes one of these stories (I. 8. b-c) to Eubulus (c. 370 B. C.).

Εὔβουλος ὁ κωμικός φησί που·
εἰσὶν ἡμῖν τῶν κεκλημένων δύο
ἐπὶ δεῖπνον ἄμαχοι, Φιλοκράτης καὶ Φιλοκράτης.
ἕνα γὰρ ἐκεῖνον ὄντα δύο λογίζομαι,
μεγάλους . . . . . μᾶλλον δὲ τρεῖς.
ὅν φασί ποτε[1] κληθέντ' ἐπὶ δεῖπνον πρός[2] τινος,
εἰπόντος αὐτῷ τοῦ φίλου, ὁπηνίκ' ἂν
εἴκοσι ποδῶν μετροῦντι τὸ στοιχεῖον ᾖ,
ἥκειν, ἕωθεν αὐτὸν εὐθὺς ἡλίου
μετρεῖν ἀνέχοντος, μακροτέρας δ' οὔσης ἔτι
πλεῖν ἢ δυοῖν ποδοῖν παρεῖναι τῆς σκιᾶς·
ἔπειτα φάναι μικρὸν ὀψιαίτερον
δι' ἀσχολίαν ἥκειν, παρόνθ' ἅμ' ἡμέρᾳ.

[113] Rogers provides the information that: "In the primitive dials of which Aristophanes is speaking the hour was determined not by the direction, but by the length of the shadow. And according to the most careful observation which I have been able to make or procure, an object casts a shadow of 'over twenty-two' times its own height at sunset, and a shadow of ten times its own height about thirty-one minutes earlier." Aristophanes Ecclesiazusae, ed. Rogers, Loeb Classical Library (Cambridge, Mass.: Harvard University Press, 1924), p. 308.

Eubulus, the comic poet, says, I believe: "There are, among our guests invited to dinner, two invincibles, Philocrates and--Philocrates! For I count him, though one, as two (and lusty too); yes, even as three . . . Once, they say, he had been asked out to dine by some friend who told him to come when the shadow on the dial measured twenty feet. So at dawn he began to measure when the sun was rising, and when the shadow was too long by more than a couple of feet he came to dine, and said that he had arrived a little late because of business engagements--though he had come at daybreak!"

(C. B. Gulick translation)

The other story (<u>Deipnosophists</u> VI. 243), Athenaeus assigns to Menander (315/14 B. C.).

Χαιρεφῶντος δὲ τοῦ παρασίτου μέμνηται Μάτρων μὲν κἀν τοῖς πρὸ τούτων, ἀτὰρ δὴ καὶ Μένανδρος αὐτοῦ μνημονεύει ἐν Κεκρυφάλῳ. κἀν τῇ Ὀργῇ δέ φησι·

διαφέρει Χαιρεφῶντος οὐδὲ γρῦ
ἄνθρωπος ὅστις ἐστίν, ὃς κληθείς ποτε
εἰς ἑστίασιν δωδεκάποδος ὄρθριος
πρὸς τὴν σελήνην ἔτρεχε τὴν σκιὰν ἰδὼν
ὡς ὑστερίζων, καὶ παρῆν ἅμ᾽ ἡμέρᾳ.

"Matron also mentions the parasite Chaerephon, in a passage quoted before, but Menander mentions him as well in The <u>Head-dress</u>. And in <u>Temperament</u> also he says: 'Not the smallest bit different from Chaerephon is the fellow, whoever he is, who was once invited to dine when the sun's shadow marks twelve feet; rising at dawn, he took a look at the shadow cast by the moon and ran full speed as though he were late, arriving at daybreak.

(C. B. Gulick translation)

We can better understand these anecdotes when we realize that the shadow lengths, that is, the number of feet per shadow, marked two hour points at intervals from noon (the sixth hour), one for the morning and one for the afternoon. There were gnomon-tables which listed the length of the shadow for the hour of the day. The distances were only approximate and varied with the seasons.

"A new [table] was needed for each month."[114]

Alciphron (second or third century A. D.), in his "Letters of Parasites," attributes to the parasites a great preoccupation with marking the hours for meals. One letter (2, III. 5), is entitled Ἑκτοδιώκτης Μανδαλοκολάπτῃ, which the Loeb edition renders in English as "Hour-of-Six-Chaser to Doorbolt-Pecker." A second letter (11, III. 47), is called Ὡρολόγιος Λαχανοθαυμάσῳ, translated, "Clock-Watcher to Greens-Grazer." However, the best example of mealtime marking in Alciphron is in letter 1, III. 4.

Τρεχέδειπνος Λοπαδεκθάμβῳ

Ὁ γνώμων οὔπω σκιάζει τὴν ἕκτην, ἐγὼ δὲ ἀποσκλῆναι κινδυνεύω τῷ λιμῷ κεντούμενος. εἶεν, ὥρα σοι βουλεύματος, Λοπαδέκθαμβε, μᾶλλον δὲ μοχλοῦ καὶ καλῳδίου ἀπάγξασθαι· εἰ γὰρ καὶ ὅλην καταβαλοῦμεν τὴν κίονα τὴν τὸ πικρὸν τοῦτο ὡρολόγιον ἀνέχουσαν, ἢ τὸν γνώμονα τρέψομεν ἐκεῖσε νεύειν οὗ τάχιον δυνήσεται τὰς ὥρας ἀποσημαίνειν, ἔσται τὸ βούλευμα Παλαμήδειον· ὡς νῦν ἐγώ σοι αὖος ὑπὸ λιμοῦ καὶ αὐχμηρός. Θεοχάρης δὲ οὐ πρότερον καταλαμβάνει τὴν στιβάδα πρὶν αὐτῷ τὸν οἰκέτην δραμόντα φράσαι τὴν ἕκτην ἑστάναι. δεῖ οὖν ἡμῖν τοιούτου σκέμματος, ὃ καταSοφίσασθαι καὶ παραλογίσασθαι τὴν τοῦ Θεοχάρους εὐταξίαν δυνήσεται. τραφεὶς γὰρ ὑπὸ παιδαγωγῷ βαρεῖ καὶ ὠφρυωμένῳ οὐδὲν φρονεῖ νεώτερον, ἀλλ' οἷά τις Λάχης ἢ Ἀπόληξις αὐστηρός ἐστι τοῖς τρόποις καὶ οὐκ ἐπιτρέπει τῇ γαστρὶ πρὸ τῆς ὥρας τοὐμπίπλασθαι.

Trechedeipnus to Lopadecthambus
("Dinnerchaser to Dish-Crazy")

The pointer doesn't mark the sixth hour yet, and I am in danger of withering away, so goaded am I by hunger, So now, Lopadecthambus,

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[114]Rohr, Sundials, p. 15.

> it's time for you to produce a scheme, or better still a crowbar and a rope to hang ouselves with. For if we throw down the whole column which supports this hateful sundial, or bend the gnomon this way when it will be able to mark the hours sooner, that will be a scheme worthy of Palamedes! As matters stand I'm parched, if you please, and dried up from hunger. And Theochares doesn't take his place on his mattress until his boy runs up and tells him that it's six. So we need some such plan as this to outwit him and upset his routine. Brought up as he has been by a severe and frowning pedagogue, he has no youthful ideas, but like a Laches or an Apolexis he is strict in his ways and doesn't let his stomach take its fill until the dinner hour has arrived.
> (A. R. Rogers Benner and F. H. Forbes translation)

Alciphron wrote during the second or third century A. D., but his letters were supposedly those of fourth century B. C. Athenians. While the evidence contained within Athenaeus tends to contradict the supposition that fourth century B. C. Athenians commonly used sundials to mark mealtimes, since the parasites he mentions rely on shadow lengths, the letters of Alciphron certainly show that by the second century A. D., when Alciphron was living, the sundial was the standard means of marking them.

The remaining evidence for sundials in ancient Athens is in the form of examples preserved for us from antiquity. These dials can all be found in Gibbs' book, Greek and Roman Sundials, and for ease of reference, I shall note Gibbs' catalogue number for each one. Most of the dials we have from Athens are examples of the conical type. These include Gibbs' catalogue numbers 3001G through 3015G and number 3044G.

Number 3001G is a dial "found in the ruins of the theater of Dionysos in Athens."[115] It is made of pentelic marble and still

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[115] Gibbs, p. 220.

has its gnomon, made from bronze, intact. No date is given for it.

Pentelic marble is also the material used to construct a conical dial, number 3002G, "found in a marble dump in the Greek Agora at Athens, April 12, 1951."[116] No date is given for this dial either. According to Gibbs, the "marble used to construct this dial is similar to that used for at least two other dials found in the Agora: 3012G and 3013G."[117] This dial and the one following, 3003G, are both unpublished.

Dial 3003G is of white marble. As for date and location of find, these facts are not mentioned.

Number 3004G is also undated and no mention is made of its original provenance. This dial is of white marble with gray streaks and bears a dedication in Greek.

Catalogue number 3005G is a conical dial of white marble, no date given, discovered in the excavations of the Theatre of Dionysos.

Dial 3006G is now in Berlin, but was originally brought from Athens. It is of pentelic marble, and M. Gatty says that "it is said to be of fairly early date B. C."[118]

Another Athenian sundial no longer in that city is now in the museum at Leiden, in the Netherlands, where it was placed in

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[116] Gibbs, p. 222.

[117] Ibid.

[118] Gatty, The Book of Sun-dials, p. 33 citing "Archeologische Zeitung," 1818, p. 37.

1826. It is number 3007 in Gibbs' catalogue. Of white marble, it was originally found near the ancient Academy in Athens. No date is given.

Dial 3008G is still _in situ_ in Athens. It is east of the Choragic "monument of Thrasyllos below the Acropolis above the Theater of Dionysos."[119] Stuart and Revett commented upon it in their _Antiquities of Athens_,[120] and Mrs. Gatty tells us that "the dial is of Pentelic marble, of the hemicycle form, and possibly may have marked the hours for the performances in the Dionysian theatre. At what period it was placed there we cannot tell."[121] However, Gatty says, it is likely that the sundial belonged to the period of the Emperor Hadrian's repairs to the theatre during the second century A. D.

The next six Athenian dials in Gibbs' catalogue, 3009G through 3014G, are all unpublished. Dials 3009G, 3011G, 3012G, 3013G, and 3014G are all made from similar pentelic marble. Dial number 3002G, as I mentioned above, is also made from similar marble. Number 3009G was "recovered from a pre-war marble pile in the Greek Agora of Athens, May, 1953."[122] Catalogue number 3010G, also of pentelic marble, at a height of only six inches, "is considerably smaller than the average conical dial."[123] It was "found in [a] well at

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[119] Gibbs, p. 227.

[120] Stuart and Revett, _The Antiquities of Athens_, Vol. II, p. 46.

[121] Gatty, p. 34.

[122] Gibbs, p. 229. [123] _Ibid_., p. 230.

6/NE in the Greek Agora at Athens, May 22, 1936."[124]

Number 3011G was "found August 4, 1970, in the upper destruction fill of a Roman house in the Greek Agora at Athens."[125] 3012G was "found June 9, 1939, in the midst of late Roman fill in the Greek Agora at Athens."[126] Also "found in a marble pile in the Greek Agora at Athens," was dial 3013G.[127] Dial 3014G was "found in [a] marble pile north of the temple of Ares in the Greek Agora at Athens, on July 2, 1951."[128] No dates are provided for these dials.

Conical dial 3015G is of white marble. No information concerning its date or location of discovery is given.

An unpublished, conical dial of pentelic marble, now in Vienna, Austria, and "found in 1896 in the region of Siebengebirge, Germany,"[129] according to Gibbs, may have originally come from Athens. "Computed parameters, material, and workmanship suggest Greek origin--possibly Athens."[130]

Dial 5003G, a vertical plane dial, was "found June 25, 1951, in a marble pile north of the Temple of Ares in the Greek Agora, Athens."[131] The dial, of hymettian marble, is unpublished.

Most of the sundial remains listed above do not provide us with very much information. However, for the sake of completeness, I have included them in this chapter.

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[124] Gibbs, p. 230.

[125] _Ibid_., p. 231.

[126] _Ibid_., p. 232.

[127] _Ibid_., p. 233.

[128] _Ibid_., p. 234.

[129] _Ibid_., p. 316.

[130] _Ibid_.

[131] _Ibid_., p. 348.

We now come to the final dial, or I should rather say, set of dials, from Athens, catalogued in Gibbs' book, number 5001, the dials from the Tower of the Winds in Athens. Some authors, such as Gatty, say that "the tower was not built with any view to the dials; they were an afterthought."[132] Rohr is of similar mind.[133] However, D. J. Price and J. V. Noble inform us that:

> There is nothing whatsoever to indicate that they may have been a later embellishment of the building as some have suggested. On the contrary, the fact that the equinoctial lines on the north and south dials run precisely, across the width of the wall from the first hour line to the eleventh, is an indication that their scale was conceived with the same geometrical economy and neatness that characterizes the plan of the rest of the building.[134]

On each of the eight walls of the tower was carved a vertical sundial and on the cylindrical tower attached to the south wall, there are remains of a ninth dial. This ninth specimen differs from the other eight in that it was marked on a convex cylinder. The tower was constructed sometime in the first century B. C., so as Gibbs tells us: "If the vertical dials on the eight sides of Andronicus's Tower of Winds in Athens were engraved at the time the tower was built, they belong to the first century B. C."[135] As the tower was made of white marble, so too were the dials. Vitruvius mentions the Tower of the Winds in De Architectura (I. VI. 4) and Varro remarks upon it in the Res Rustica (III. V. 17). However,

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[132]Gatty, p. 40.

[133]Rohr, p. 15.

[134]Noble and Price, p. 346.

[135]Gibbs, pp. 78-79.

neither author mentions either the sundials on the exterior of the building or the water clock that in all probability graced the interior of the structure and about which I shall have more to say in the next section on water clocks. Vitruvius calls the building "an octagonal marble tower" surmounted by a wind-vane. Varro names it a horologium, "a term," say Noble and Price, "which may apply equally to sundials and water clock, but hardly to a simple wind-vane."[136]

As we have seen, the majority of the sundials preserved from Athens are of the conical variety. They have been discovered in two major areas: in the Greek Agora; and around the Theatre of Dionysos. The latter, as Gatty has suggested, may have been connected with marking the time of performances at the theatre. Gibbs suggests that a manufacturing centre may have accounted for several of the dials found in the Agora.

> A number of similar conical dials made of the same material (see 3012G) have been found in the Athenian agora, and this may mean that a manufacturing center was located there.[137]

The Tower of the Winds, with its nine sundials, is in the so called Roman agora at Athens. I shall discuss the possible significance of its location after I have examined the evidence for its function as a water clock. Therefore, let us now turn to an examination of the archaeological and literary evidence for water clocks as a means of keeping time in ancient Athens.

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[136] Noble and Price, p. 346.

[137] Gibbs, p. 77.

Water Clocks

As I remarked earlier, there were two categories of water clock, the outflow and the inflow. The outflow klepsydra, which is not like a clock as we know it, is the simpler of the two and it measured the length of time it took a fixed amount of water to escape from a container. It was used predominantly in Athenian law courts and most of our evidence concerning it is in connexion with this use. The outflow klepsydra appears to be the older of our two types and therefore I shall examine the evidence, mostly literary, for its use in Athens, before citing the evidence for the inflow device.

Before listing the literary evidence for the use of the klepsydra in the law courts, of which there is, relatively speaking, a plethora, I shall discuss the remains of one such vessel, which I mentioned in passing in the first chapter. This vessel is the Athenian court klepsydra discovered in the excavations of the Athenian Agora, by the American School of Classical Studies at Athens.[138] It was discovered in "an undisturbed well-deposit of about 400 B. C.",[139] and dates to approximately this time. For the sake of clarity, I shall cite Young's description of the vessel:

> It is a substantial pail-shaped vessel with heavy flat bottom, high slightly flaring sides, and simple thickened rim. The

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[138] S. Young, "An Athenain Clepsydra," pp. 274-284.

[139] *Ibid.*, p. 275.

horizontal handles are missing, but the attachment of one is preserved, well below the rim. The fabric is that of the ordinary Athenian household mixing-bowl of the fifth century. Like them it is waterproofed by means of a dull glaze wash inside and on the rim; a thinner wash of the same sort has been rather carelessly applied to the exterior as well. Two inscriptions are painted in bold glaze letters on the wall: above, ANTIOX ____, below, XX. Close to the bottom of the pot is a carefully made clay spout, fitted with a small bronze inner tube. Centered above the spout, just below the rim, is a hole which would permit the pot to be filled to the same level each time.

These arrangements correspond to the specifications which literature provides for the clepsydra, the "water-clock" commonly used in the Athenian law courts from the end of the fifth century until at least the end of the fourth. The essential elements are the spout, which makes possible an easily controlled outflow of the pot's contents, and the overflow hole above, which supplies a visual check, on accurate filling.[140]

Young restores the inscription ANTIOX ____ on the vessel as Αντιοχ [ίδος], one of the Athenian tribes. The XX inscription can be expanded to χ(οῦς) χ(οῦς). This rendering "seems reasonable"[141] to Young, "since we know that the water used in the clepsydras was regulated by measure, and that the unit was the χοῦς."[142] Young also tells us that "by actual test, the Agora clepsydra of two choes capacity, filled with water to the overflow hole, discharges its contents in a mean of six minutes."[143]

With this introduction to an example of the actual device, let us now turn to the ancient literature concerning it and its use in Athens.[144]

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[140] Young, pp. 274-275.

[141] _Ibid._, p. 279.

[142] _Ibid._, p. 278.

[143] _Ibid._, p. 281.

[144] Most of the following references can be found in Young's ariticle. Any literary evidence that cannot be found there, will likely be found in Max C. P. Schmidt, _Kulturhistorische Beiträge zur Kenntnis des Griechischen und Römischen Altertum, Zweites Heft_:

According to Young "our earliest authority for the clepsydra is Aristophanes."[145] In the <u>Acharnians</u> 693 (425/4 B. C.), a member of the chorus, in Young's words "a Marathonian hero, grumbles that it is hardly fitting that youngsters should shame an old man's grey hairs by dragging him into litigation."[146]

> ταῦτα πῶς εἰκότα, γέροντ' ἀπολέσαι, πολιὸν ἄνδρα,
> περὶ κλεψύδραν,

> How can it be seemly a grey-headed man
> by the Water-clock's stream to decoy and to slay,
> (B. B. Rogers translation)

In the <u>Wasps</u> (93), three years later (422 B. C.), Aristophanes again alludes to the court function of the klepsydra. Xanthias, a slave, describes the "disease" from which his old master, a law court lover, suffers.

> ἢν δ' οὖν καταμύσῃ κἂν ἄχνην, ὅμως ἐκεῖ
> ὁ νοῦς πέτεται τὴν νύκτα περὶ τὴν κλεψύδραν.

> Or if he doze the tiniest speck, his soul
> Flutters in dreams around the water-clock.
> (B. B. Rogers translation)

In the same play (<u>Wasps</u> 856-858), Bdelycleon and Philocleon (the law court lover), when equipping their in-home law court, find a klepsydra a necessity.

> ΒΔ. κάλλιστα τοίνυν· πάντα γὰρ πάρεστι νῷν
> ὅσων δεόμεθα, πλήν γε δὴ τῆς κλεψύδρας.
> ΦΙ. ἡδὶ δὲ δὴ τίς ἐστιν; οὐχὶ κλεψύδρα;

<u>Die Entstehung der Antiken Wasseruhr</u> (Leipzig, 1912), cited by Noble and Price, p. 345. Unfortunately, I was unable to obtain this volume.

[145] Young, p. 276.

[146] <u>Ibid</u>.

BD. That's capital: then now methinks we have
All that we want. No, there's no water-piece.

PH. Water-piece, quotha! pray what call you this?
(B. B. Rogers translation)

Aristophanes provides us with one more reference to the klepsydra. In the Birds (414 B. C.), the chorus makes the following comment (1694):

ἔστι δ' ἐν Φαναῖσι πρὸς τῇ
Κλεψύδρᾳ πανοῦργον ἐγ-
γλωττογαστόρων γένος,

In the fields of Litigation,
Near the Water-clock, a nation
With its tongue its belly fills;
(B. B. Rogers translation)

A scholiast on Aristophanes Acharnians 694 gives us an explanation of the klepsydra:

ἡ γὰρ κλεψύδρα ἀγγεῖόν ἐστιν ἔχον μικροτάτην ὀπὴν περὶ τὸν πυθμένα, ὅπερ ἐν τῷ δικαστηρίῳ μεστὸν ὕδατος ἐτίθετο.— — —

the clepsydra is a vessel with a very small hole near the base; full of water, it was placed in court.[147]

In the speeches of the orators, we find a multitude of references to the klepsydra, or as they preferred to call it, the ὕδωρ (water).

Isocrates mentions the klepsydra in terms of the "water" in his "Special Plea Against Callimachus" (XVIII. 51), c. 400 B. C.:

νῦν δὲ περὶ μὲν τῶν ἄλλων ὅσοις ἐπιβεβούλευκε, καὶ δίκας οἵας δεδίκασται καὶ γραφὰς ἃς[1] εἰσελήλυθε, καὶ μεθ' ὧν συνέστηκε καὶ καθ' ὧν τὰ ψευδῆ μεμαρτύρηκεν, οὐδ' ἂν δὶς τοσοῦτον ὕδωρ ἱκανὸν διηγήσασθαι γένοιτο·

[147] Young, p. 277 and n. 15.

The fact is, though, that if I should try to tell of all the others who have been the objects of his plots, of the private law suits in which he has been involved, of the public suits which he has entered, of the persons with whom he has conspired or against whom he has borne false witness, not even twice as much water as has been allotted me would prove sufficient.
(Larue van Hook translation)

J. E. Sandys comments that the klepsydra "is even introduced into the artificial speech of Isocrates."[148]

> Ἀλλὰ γὰρ αἰσθάνομαι, καίπερ ὑπὸ τῆς ὀργῆς βίᾳ φερόμενος, τὸ μὲν ὕδωρ ἡμᾶς ἐπιλεῖπον, αὐτὸς δ᾽ ἐμπεπτωκὼς εἰς λόγους ἡμερησίους καὶ κατηγορίας.

But I perceive, even though my feelings carry me away, that the water in the clock is giving out, while I myself have fallen into thoughts and recriminations which would exhaust the day.
(George Norlin translation)

In two speeches, Isaeus makes direct reference to the klepsydra under the term ὕδωρ. In both instances, it is for the same purpose, to have the klepsydra stopped, i.e. plugged, for the reading of laws and depositions. The klepsydra "was stopped during the reading or speaking of evidence":[149]

On the Estate of Pyrrhus (c. 360 B. C.) III. 12.

> ἀναγίγνωσκε. σὺ δ᾽ ἐπίλαβε τὸ ὕδωρ.

Read the depositions; and you, please stop the water-clock.
(E. S. Forster translation)

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[148] Isocrates Antidosis 320; Aristotle's Constitution of Athens, rev. text and intro. by J. E. Sandys (1912; rpt. New York: Arno Press, 1973), p. 358.

[149] W. R. M. Lanb, trans., Lysias, Loeb Classical Library (London: Heinemann, 1930), pp. 508-509, n. a.

On the Estate of Menecles (c. 350 B. C.) II. 34.

> καί μοι τὰς μαρτυρίας ἀνάγνωθι ταυτασί· σὺ δ' ἐπίλαβε τὸ ὕδωρ.

Please read these depositions; and, you, turn off the water-clock.

(E. S. Forster translation)

Young informs us that "Lysias refers to the ὕδωρ five times in a single plea".[150] In each of the five instances (XXIII. 4, 8, 11, 14, 15; 387 B. C.), he uses exactly the same sentence: καί μοι ἐπίλαβε το ὕδωρ.--"Please stop the water." This is the same allusion to the klepsydra that we have just seen in Isaeus.

In the Theaetetus (c. 370 B. C.), Plato "twice refers to the ὕδωρ of the law courts, 172d and 201b."[151] Comparing the philosophic life and that of the orator or lawyer, Plato has Socrates say that "the one is the training of a freeman the other of a slave".[152] Referring to the class of lawyers, he says, 172 d-e:

> οἱ δὲ ἐν ἀσχολίᾳ τε ἀεὶ λέγουσι· κατεπείγει γὰρ ὕδωρ ῥέον, καὶ οὐκ ἐγχωρεῖ περὶ οὗ ἂν ἐπιθυμήσωσι τοὺς λόγους ποιεῖσθαι, ἀλλ' ἀνάγκην ἔχων ὁ ἀντίδικος ἐφέστηκε καὶ ὑπογραφὴν παραναγιγνωσκομένην, ὧν ἐκτὸς οὐ ῥητέον·

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[150] Young, p. 276.

[151] Sandys, Aristotle's Constitution of Athens, p. 258, n. LXVII, 1.

[152] Lewis Campbell, ed., The Theaetetus of Plato (1861; rpt. New York: Arno Press, 1973), p. 100.

> But the other sort are always pressed for time: for the ebbing water hurries on the speaker: and he has no liberty to follow whither fancy leads him, but the adversary is at hand to wield over him the resistless logic of coercion, holding a written outline of the points to which he must confine himself, which forms a running commentary to his oration.
> (Lewis Campbell translation)

The second allusion to the klepsydra in the _Theaetetus_ comes in a passage where Plato has Socrates discussing one of his favourite topics, the definition of knowledge. Socrates is disproving the theory that 'knowledge is true opinion'. He is again discussing the orators of the court (_Theaetetus_, 201 b).

> ἢ σὺ οἴει δεινούς τινας οὕτω διδασκάλους εἶναι, ὥστε οἷς μὴ παρεγένοντό τινες ἀποστερουμένοις χρήματα ἤ τι ἄλλο βιαζομένοις, τούτοις δύνασθαι πρὸς ὕδωρ σμικρὸν διδάξαι ἱκανῶς τῶν γενομένων τὴν ἀλήθειαν;

> Or do you really suppose them to be such learned and convincing doctors, that during the short time the water is flowing they can satisfactorily instruct their hearers in the truth of things and events that took place when and where they were not present, as when they plead before the judges on behalf of persons said to have been defrauded of money, or violently plundered of some other property?
> (Talyer Lewis translation)

Demosthenes frequently refers to the "water" of the court in his speeches. Young comments that: "Demosthenes, to show his good faith and fair-mindedness in a dispute, calls upon Aeschines to claim the credit for whatever benefit he has ever done the state within the time limit of his own speech".[153] This is in the _De Corona_ (XVIII. 139).

[153] Young, p. 276.

εἰ δέ φησι, νῦν δειξάτω ἐν τῷ ἐμῷ ὕδατι.

> If he claims any [patriotic act], let him cite it now while my hour-glass [water clock] runs.
> (C. A. Vine and J. H. Vine translation)

In a footnote, Young tells us that ἐν τῷ ἐμῷ ὕδατι "is a common rhetorical tag, and we meet it as early as Andocides' I, 26, 35, 55".[154] However, in Andocides' speech (399 B. C.), the expression ἐν τῷ ἐμῷ λόγῳ is used to refer to the time allotted to the speaker. Neither the word ὕδωρ nor κλεψύδρα is used. Demosthenes uses this same device in his speech against Eubulides (LVII. 61). He again employs the term ὕδωρ.

This same term appears in Demosthenes' earliest speech ("Against Aphobus" XXVII. I. 12; 364 B. C.), where the orator remarks that there is insufficient time to catalogue the wrongs his estate has suffered at the hands of his guardians.

> Καὶ τὸ μὲν πλῆθος τῆς οὐσίας τοῦτ' ἦν τὸ καταλειφθέν, ὦ ἄνδρες δικασταί. ὅσα δ' αὐτῆς διακέκλεπται καὶ ὅσ' ἰδίᾳ θ' ἕκαστος εἴληφε καὶ ὁπόσα κοινῇ πάντες ἀποστεροῦσιν, οὐκ ἐνδέχεται πρὸς ταὐτὸ ὕδωρ εἰπεῖν, ἀλλ' ἀνάγκη χωρὶς ἕκαστον διελεῖν ἐστίν.

> This, then, men of the jury, was the amount of property left by my father. How much of it has been squandered, how much they have severally taken, and of how much they have jointly robbed me, it is impossible to tell in the time allotted to one plea. I must discuss each one of these questions separately.
> (A. T. Murray translation)

In a speech in the <u>Private Orations</u> (XLIII. 8), Demosthenes

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[154] Young, p. 276, n. 12.

describes another instance when he feels he was not given enough time to plead his case.

καὶ
ἐπειδὴ ἦγεν ὁ ἄρχων εἰς τὸ δικαστήριον καὶ ἔδει ἀγωνίζεσθαι, τά τε ἄλλα ἦν αὐτοῖς ἅπαντα κατ-εσκευασμένα εἰς τὸν ἀγῶνα, καὶ τὸ ὕδωρ, πρὸς ὃ ἔδει ἀγωνίζεσθαι, τετραπλάσιον ἡμῶν ἔλαβον. ἐξ ἀνάγκης γὰρ ἦν, ὦ ἄνδρες δικασταί, τῷ ἄρχοντι ἀμφορέα ἑκάστῳ ἐγχέαι τῶν ἀμφισβητούντων, καὶ τρεῖς χοᾶς τῷ ὑστέρῳ λόγῳ. ὥστε συνέβαινεν ἐμοὶ τῷ ὑπὲρ τῆς γυναικὸς ἀγωνιζομένῳ, μὴ ὅτι περὶ τοῦ γένους καὶ τῶν ἄλλων ὧν μοι προσῆκε διηγήσασθαι τοῖς δικασταῖς ὡς ἐγὼ ἐβουλόμην, ἀλλ' οὐδ' ἀπολογήσασθαί μοι ἐξεγένετο οὐδὲ πολλοστὸν μέρος ὧν κατεψεύδοντο ἡμῶν· πέμπτον γὰρ μέρος εἶχον τοῦ ὕδατος.

And when the archon brought the case into court, and the trial was to be held, they had everything cleverly arranged for the trial, and in particular the water which was to measure their speeches was four times as much as that allowed to us. For the archon, men of the jury, was obliged to pour into the water-clock an amphora of water for each claimant, and three choes for the reply; so that I, who acted as pleader for the lady, was not only unable to explain to the jurymen the relationship and other matters as clearly as I could have wished, but could not even defend myself against the smallest fraction of the lies which they told about us; for I had but a fifth part of the water.

(A. T. Murray translation)

Aeschines comments upon the amount of water that has been allotted his defence in his speech "On the Embassy" (II. 126; 343 B. C.).

ἐνδέχεται δὲ τὸ λοιπὸν μέρος τῆς ἡμέρας ταῦτα πρᾶξαι· πρὸς ἕνδεκα γὰρ ἀμφορέας ἐν διαμεμετρημένῃ τῇ ἡμέρᾳ κρίνομαι.

There is still time enough to do it, for in the appointment of the day eleven jars of water have been assigned to my defence.

(C. D. Adams translation)

In the "Speech Against Ctesiphon" (III. 197; 330 B. C.), Aeschines gives an account of the division of the legal day.

> Τίς οὖν ἀποδέδεικται λόγος ἀνδρὶ δικαίῳ συνηγόρῳ, ἐγὼ λέξω. εἰς τρία μέρη διαιρεῖται ἡ ἡμέρα, ὅταν εἰσίῃ γραφὴ παρανόμων εἰς τὸ δικαστήριον. ἐγχεῖται γὰρ τὸ μὲν πρῶτον ὕδωρ τῷ κατηγόρῳ καὶ τοῖς νόμοις καὶ τῇ δημοκρατίᾳ, τὸ δὲ δεύτερον τῷ τὴν γραφὴν φεύγοντι καὶ τοῖς εἰς αὐτὸ τὸ πρᾶγμα λέγουσιν· ἐπειδὰν δὲ τῇ πρώτῃ ψήφῳ λυθῇ τὸ παράνομον, ἤδη τὸ τρίτον ὕδωρ ἐγχεῖται τῇ τιμήσει καὶ τῷ μεγέθει τῆς ὀργῆς τῆς ὑμετέρας.

> But I will tell you what plea is in order from the honest advocate. When an indictment for an illegal motion is tried in court, the day is divided into three parts. The first water is poured in for the accuser, the laws, and the democracy; the second water, for the defendant and those who speak on the question at issue; but when the question of illegality has been decided by the first ballot, then the third water is poured in for the question of the penalty and the extent of your anger.
>
> (C. D. Adams translation)

When Aristotle is discussing the Athenian court system, in the Constitution of Athens (LXVII. 2), he gives us, what Young calls, "our earliest description of the object which held this legal ὕδωρ."[155] This passage is fragmentary and I here reproduce two restorations of it. The first version (from Blass' edition of the Constitution as cited by Young) does not bracket the restorations. However, the second version (edited by Sandys) does bracket the restorations, and from it we can see that the key words κλεψύδραι and ὕδωρ are not in question.

[155]Young, p. 276.

Εἰσὶ δὲ κλεψύδραι αὐλίσκους ἔχουσαι ἔκρους εἰς ἃς τὸ ὕδωρ ἐγχέουσι πρὸς ὃ δεῖ λέγειν τὰς δίκας.[156]

εἰσὶ δὲ κλεψύδραι αὐλ[ούς τε] ἔχουσ[αι καὶ ἔ]-
κρους, εἰς ἃς τὸ ὕδωρ ἐγχέουσι, πρὸς ὃ δεῖ λέγειν τὰς δίκας.[157]

> and there are clepsydras which have small tubes for the outflow; into these they pour the water by which the lawsuits must be conducted.[158]
>
> (Young translation)

Aristotle also mentions the presence of an official, elected by lot, to oversee the "water" (<u>Constitution of Athens</u>, LXVIII. 3), a practice upon which I have earlier remarked.

From the evidence presented above, it is clear that the klepsydra played an important part in the Athenian law courts. I shall return to this point in my concluding chapter. There is, however, a noteable bias, on the part of the orators, against the use of the word κλεψύδρα. Concerning this point, Stephanie West states:

> The sense of 'water-clock' sounds as if it originates in slang and the orators obviously prefer expressions with ὕδωρ when they have to refer to it. The word κλεψύδρα is also conspicuous by its absence from an inscription of Iasos (Hicks, J. H. S. viii [1887], 103), dated to the early third century B. C., which gives a detailed specification for the construction of such a device.[159]

The Agora was the market place of the city and according to Athenaeus (<u>Deipnosophists</u>, XIV, 640 b-c), the comic poet Eubulus

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[156] Ἀθ. Πολ., LXVII. 2; ed. Blass, as cited in Young, p. 276, n. 14.

[157] Sandys, ed., <u>Aristotle' Constitution of Athens</u>, pp. 257-258, LXVII. 2.

[158] Young, p. 276.

[159] West, "Cultural Interchange Over a Water-Clock," p. 63, n. 2. See p. 68 of this paper.

commented upon all the things that could be bought there--including fruit and vegetables; lawsuits, witnesses, and even water-clocks.

> καὶ ὡς ὁ Εὔβουλος δ' ἐν Ὀλβίᾳ ἔφη·
>
> ἐν τῷ γὰρ αὐτῷ πάνθ' ὁμοῦ πωλήσεται[5]
> ἐν ταῖς Ἀθήναις· σῦκα, Β. κλητῆρες,[6] Α. βότρυς,
> γογγυλίδες, ἄπιοι, μῆλα, Β. μάρτυρες, Α. ῥόδα,
> μέσπιλα, χόρια, σχάδονες, ἐρέβινθοι, Β. δίκαι,
> Α. πυός, πυριάτη, μύρτα, Β. κληρωτήρια,
> Α. ὑάκινθος, ἄρνες, Β. κλεψύδραι, νόμοι, γραφαί.

Again, as Eubulus has said in The Happy Woman: "A. In one and the same place you will find all kinds of things for sale together at Athens; figs--B. policemen! A. grapes, turnips, pears, apples--B. witnesses! A. roses, medlars, haggis, honeycomb, chick-peas--B. lawsuits! A. beestings, curds, myrtle-berries--B. ballot-boxes! A. iris, roast lamb--B. waterclocks, laws, indictments!"
(C. B. Gulick translation)

The Athenian Agora Guide comments that in this passage:

> The way in which the political life of the city was not only jostled by commercial activity but perhaps unduly influenced by it is neatly put by the comic poet Eubculos.[160]

Athenaeus also remarks (Deipnosophists XIII. 567. c-d) that Eubulus wrote a play entitled Klepsydra, about a prostitute who sold her time by the water clock.

> καὶ ἄλλα δὲ πολλά, ὠναιδές, δράματα ἀπὸ ἑταιρῶν ἔσχε τὰς ἐπιγραφάς, Θάλαττα Διοκλέους, Φερεκράτους Κοριαννώ, Εὐνίκου ἢ Φιλυλλίου Ἄντεια, Μενάνδρου δὲ Θαὶς καὶ Φάνιον, Ἀλέξιδος Ὀπώρα, Εὐβούλου Κλεψύδρα. οὕτω δ' ἐκλήθη αὕτη ἡ ἑταίρα, ἐπειδὴ πρὸς κλεψύδραν συνουσίαζεν ἕως κενωθείη, ὡς Ἀσκληπιάδης εἴρηκεν ὁ τοῦ Ἀρείου ἐν τῷ περὶ Δημητρίου τοῦ Φαληρέως συγγράμματι, τὸ κύριον αὐτῆς ὄνομα φάσκων εἶναι Μητίχην.

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[160] The Athenian Agora Guide, p. 17.

> And many dramas, besides, you shameless one, have taken their titles from prostitutes: Thalatta by Diocles, Corianno by Pherecrates, Anteia by Eunicus or Philyllius, Thaïs and Phanion by Menander, Opora by Alexis, Clepsydra by Eubulus. Now this last prostitute got her name because she timed her favours by the water-clock, stopping when it was emptied, as Asclepiades, the son of Areius, records in his History of Demetrius of Phalerum, alleging that her real name was Metichê.
> (C. B. Gulick translation)

This passage shows considerable knowledge of the operation of the court klepsydra.

Aristotle also mentions the klepsydra in the Poetics (VII. 11), where he remarks that it was at one time used to regulate the length of the performance of tragedies.

> *Τοῦ μήκους ὅρος <ὁ> μὲν πρὸς τοὺς ἀγῶνας καὶ τὴν αἴσθησιν οὐ τῆς τέχνης ἐστίν· εἰ γὰρ ἔδει ἑκατὸν τραγῳδίας ἀγωνίζεσθαι, πρὸς κλεψύδρας ἂν ἠγωνίζοντο, ὥσπερ ποτὲ καὶ ἄλλοτέ φασιν.*

> The limit of length considered in relation to competitions and production before an audience does not concern this treatise. Had it been the rule to produce a hundred tragedies, the performance would have been regulated by the water clock, as it is said they did once in other days.
> (W. Hamilton Fyfe translation)

We have, however, no other reference to the use of the klepsydra to regulate the length of plays, and there is some doubt as to the interpretation of this passage.[161] Consequently, we cannot assert that the water clock was ever used to regulate the length of tragedies.

Aeneas Tacitus (mid fourth century B. C.) "recommends the use of clepsydrae to ensure the fair distribution of watches among the troop" (Πολιορκήτικα XXII. 24). "He suggests adjusting it [the

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[161] Ingram Bywater, ed. and trans., Aristotle on the Art of Poetry (Oxford: Clarendon Press, 1909), pp. 182-183; Gerald F. Else, Aristotle's Poetics: The Argument (Cambridge, Mass.: Harvard University Press, 1957), pp. 286-288.

klepsydra] to the shorter nights of summer by coating the inside with wax, which may be gradually removed as the nights grow longer", (Πολιορκήτικα XXII. 25).[162]

> Μᾶλλον δὲ αὐτῆς.
> κεκηρῶσθαι τὰ ἔσωθεν, καὶ μακροτέρων μὲν γιγνομένων τῶν νυκτῶν ἀφαιρεῖσθαι τοῦ κηροῦ, ἵνα πλέον ὕδωρ χωρῇ, βραχυτέρων δὲ προσπλάσσεσθαι; ἵνα ἔλασσον δέχηται. Περὶ μὲν οὖν φυλακῶν ἰσότητος ἱκανῶς μοι δεδηλώσθω.

> Un meilleur procédé consiste à l'enduire, à l'intérieur, de cire qu'on enlève quand les nuits rallongent afin que la clepsydre contienne plus d'eau; on en rajoute au contraire quand elles raccourcissent, pour diminuer la capacité. Ceci posé, je crois m'être suffisamment expliqué sur l'égalité des veilles.
> (Anne-Marie Bon translation)

Aeneas Tacitus also mentions the klepsydra in a fragment of the Πολιορκήτικα (XLVIII), where he speaks of the exactness with which "the orifice through which the water flows out should be made."[163] We do not know whether Aeneas Tacitus' suggestion was ever put into practical application.

As I mentioned earlier, Plato was supposedly responsible for devising a water clock for use at night by his associates at the Academy (Athenaeus, Deipnosophists, IV. 174. c). Armstrong and McK. Camp consider that it "was essentially a large-scale klepsydra."[164]

> λέγεται δὲ Πλάτωνα μικράν τινα ἔννοιαν δοῦναι τοῦ κατασκευάσματος νυκτερινὸν ποιήσαντα ὡρολόγιον ἐοικὸς τῷ ὑδραυλικῷ οἷον κλεψύδραν μεγάλην λίαν.

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[162] West, p. 63.

[163] Young, p. 277.

[164] Armstrong and McK. Camp, p. 160, n. 19.

> but it is said that Plato imparted a slight hint of its construction in having made a time-piece for use at night which resembled a water-organ, being a very large water-clock.
> (C. B. Gulick translation)

West remarks that: "It does not sound very sophisticated."[165]

Now we come to the archaeological remains of two monumental water clocks, the outflow klepsydra turned inflow klepsydra from the Greek Agora at Athens, and the water clock in the Tower of the Winds in the Roman Agora. Armstrong and McK. Camp give the most detailed account of the water clock in the Athenian Agora,[166] and D. J. Price and J. V. Noble give the most comprehensive account of the water clock in the Tower of the Winds.[167]

In the last chapter I described the construction of the water clock in the Athenian Agora in great detail. Therefore, I shall here present only a brief description of the major points of its construction as related to its probable function. The remains of the device were discovered in the 1953 excavations of the Athenian Agora by the American School of Classical Studies at Athens. The water clock, in the southwest portion of the Agora, was constructed, in the second half of the fourth century B. C., against the north

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[165] West, p. 63, n. 3.

[166] "Notes on a Water Clock in the Athenian Agora," pp. 147-161.

[167] "The Water Clock in the Tower of the Winds," pp. 345-355.

side of the structure which has been identified as the Heliaia. Mabel Lang gives us a concise description of it.

> A shaft (A) lined with hydraulic cement must have been filled from a similarly coated reservoir (B). Much worn steps (C) leading down to the lower level give access to the metal-lined aperture (D), through which, when unplugged, the water would be drained from the shaft at a regular rate. The diameter of the metal tube and the dimensions of the shaft must have been calculated so that the sinking water-level accurately reflected the passage of the hours. The walls of the shaft itself may have been marked with the hours, but it is more likely, for visibility at a distance, that some kind of flag mounted on a float would be viewed against a calibrated background. Since the standard twelve hours between sunrise and sunset necessarily changed their length from season to season (ranging from perhaps 45 minutes at the winter solstice to 72 minutes at midsummer), frequent changes must have been made to adjust the rate of flow.[168]

The water clock was apparently supplied with water from a nearby aqueduct, which also brought it to the Southwest Fountain House. Armstrong and McK. Camp feel that the remains of the water clock indicate that it was converted from a device of the outflow variety to an inflow type, sometime during the third century B. C., and as previously noted, "the installation in the Agora was dismantled in the 2nd century B. C. after the construction of the Middle Stoa and the raising of the ground level between the Stoa and the Heliaia."[169] It seems inescapable that the water clock was so located as to be a convenient indicator of the time for the people in the Agora, and Armstrong and McK. Camp remark that:

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[168] Mabel Lang, Waterworks in the Athenian Agora, ills. 43, 44.

[169] The Athenian Agora Guide, p. 169.

> The position of the clock is noteworthy. Set up in the southwest corner of the Agora, facing north on the open square and at the head of the streets which led through the populous deme of Melite to the Pnyx and the Peiraieus Gate, the device is an ideal location for a large public timepiece; close to major public buildings and readily available to anyone frequenting the Agora square.[170]

We find much the same comment in the Athenian Agora Guide.

> As a public time-piece the installation was well placed close to one of the principal entrances to the Agora. In this respect it anticipated the water clock housed in the Tower of the Winds (1st century B. C.) which was conveniently situated near the east entrance to the Market of Caesar and Augustus.[171]

Thus this water clock probably functioned as a public time-piece.

The final piece of horological evidence, under this section on water clocks, upon which I shall comment is the Tower of the Winds. As I mentioned in the section on sundials, our only literary references to the Tower of the Winds (Varro R.R. III.V.17; Vitruvius I. VI. 4), mention neither the sundials on the exterior nor the water clock in the interior of the building. However, the fact that Varro terms it a horologium, clearly indicates its function as a time-piece.

The man responsible for the design of this structure was Andronikos of Kyrrhos in Macedonia. He was also responsible for the construction, according to an identifying inscription, of a multiple faced, roofed, spherical sundial found in the sanctuary of Poseidon on the Island of Tenos, Greece.[172] The tower itself is an octagonal marble building, with sculptural reliefs of the eight winds on the

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[170] Armstrong and McK. Camp, p. 151.

[171] The Athenian Agora Guide, p. 169.

[172] Gibbs' catalogue number 7001G.

upper portion of each side, and a sundial below each carving. A ninth dial, as previously noted, was carved on the surface of the cylindrical tower attached to the south wall. Noble and Price have presented a convincing reconstruction of the water clock in the interior of the tower.[173] The device itself has been lost, probably dismantled sometime in antiquity, but enough traces of it remain for Noble and Price to make their reconstruction. It is not my purpose here to present all the evidence which Noble and Price cite in support of their reconstruction. It can be found in their article. However, I shall present their summary of their restoration:

> Water from the Clepsydra Spring, located on the north slope of the Acropolis near the Grotto of Pan, entered the cylindrical tower under hydraulic pressure. The pipe through which it entered ran up the wall and emptied into a large upper reservoir, which supplied water under constant pressure to the water clock. An overflow drain was located near the top tank, from which the water, of varying rate of flow, was piped to the center of the octagonal tower to operate fountains or other displays. Water for the clock was drawn off near the bottom of the tank and was controlled by a carefully regulated valve. It was adjusted so that a lower tank would be completely filled in precisely 24 hours. As the lower tank filled, a float rose with the water, and a thin bronze chain connected to the float transmitted its motion to a display apparatus in the center of the octagonal tower. At the end of 24 hours, when the lower tank was filled and the float had reached its top position, an attendant opened the valve at the bottom of this tank and allowed the water to drain into the rectangular drain hole. The process was then repeated for the next 24 hours. The water supply for the clock was drawn off a little above the supply tank, so that any sludge or dirt which had settled to the bottom of the tank would not clog the fine orifice used to regulate the water clock. The arrangement described here is in accord with comparable mechanisms described by Vitruvius.[174]

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[173] "The Water Clock in the Tower of the Winds," pp. 345-355.

[174] _Ibid_., pp. 350-351.

As I commented in the previous chapter, Noble and Price believe that "the visual device used to display the information transmitted by the clock mechanism"[175] was the anaphoric type as described by Vitruvius.

With its sundials and water clock, the Tower of the Winds was an excellent time piece. On a clear day a citizen could tell the time from the exterior of the structure, and on an overcast day, or at night, the hour could be ascertained by visiting the interior of the building and consulting the water clock.

Henry S. Robinson remarks that the tower must have been open to the public twenty-four hours a day:

> the doors were probably not locked from the exterior, we may be justified in suggesting that the northeast door was always open . . .
>
> The populace of Athens, then, had access to the clock inside the Horologion at all hours of the day and night, but it is logical to suppose that a building of this type would have been constructed only in a position where it was readily accessible to large gatherings of people. Most public gatherings occurred in other parts of the city: in the Theatre of Dionysos, on the Pnyx, in the Heliaea and other lawcourts near the old Agora. But it was in the market-place that the people congregated most regularly, and it was to a large public market that the functions of the Horologion would have been most valuable. The construction of the Tower presupposes, I think, the existence of a trading-center near-by. Such a center exists in the so-called Roman Agora, part of which must have been built at the same time as the Tower, if not earlier.[176]

It is apparent that both the water clock in the Athenian Agora, and the Tower of the Winds, or as it is also called, the Horologion

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[175] Noble and Price, p. 351.

[176] Robinson, "The Tower of the Winds and the Roman Market Place," p. 297.

of Andronikos, were so placed as to be conveniently accessible to many of the Athenian citizens as they went about their daily activities in the Agora, firstly the Greek Agora, and then latterly, as the Romans became the donimating force, in the Roman Agora.

Before I conclude this chapter on the evidence for time-keeping devices in ancient Athens, I must mention the method that the Classical Athenians employed for marking meetings of the ekklesia and of the law courts. E. L. Hicks tells us that "at Athens the method of ensuring punctuality in the ecclesia was by hoisting a flag by way of signal, which was lowered at the commencement of proceedings. . . . Ecclesiazusae (lines 282 foll., 289 foll.)."[177] In the Athenian law courts, "the signal for attendance was a similar flag. See Wasps 689."[178] It is interesting to note that at Iasos, a Greek island along the coast of Asia, a water clock was used to promote punctuality at the ekklesia. All those citizens who arrived before the water ran out of the clock would receive vouchers for payment for a day's attendance. We learn about this device from an early third century B. C. Iasosian inscription, the text of which can be found in Hicks' article on Iasos.[179]

I have now finished listing the literary and archaeological evidence for timekeeping devices in Athens from the end of the fifth century B. C. to the middle of the first century B. C. In the next chapter I shall state my conclusions and examine the significance of the material.

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[177] E. L. Hicks, "Iasos," Journal Of Hellenistic Studies, 8 (1887), p. 110.

[178] Ibid., n. 2.

[179] Ibid., p. 103.

III

CONCLUSIONS

Overlapping in a thesis such as this is inevitable because of the amount of evidence cited and the need to refer back to it at a later stage of the work. However, in this, my concluding chapter, I shall try to keep such overlaps to a minimum.

From the evidence on Athenian timekeeping presented in the second chapter, we can draw the following conclusions:

1. Sometime during the middle of the fifth century B. C. there was, at Athens, an awakening to the practical value of marking time.
2. The outflow klepsydra was an important piece of equipment in the Athenian law courts during the fifth and fourth centuries B. C.
3. The use of the klepsydra in the law courts suggested to various Athenians purposes for it in other walks of life.
4. The Athenians recognized the value of placing time-pieces in areas of high density traffic, such as the Agora, both Greek and Roman, the Pnyx and the Theatre of Dionysos.
5. The early Athenian "clocks," such as the outflow klepsydras, measured fixed amounts of time and the uses found for them reflect this fact. However, as advances in technology led to more accurate methods of marking time, the Athenians were quick to change to the more advanced timepieces.

I shall now discuss individually each of the conclusions which I have just presented.

In discussing the first conclusion, it is noteworthy that the two earliest pieces of evidence for Athenian timekeeping are within a few years of each other: 433/2 B. C. for Meton's sundial and 425/4 B. C., for Aristophanes' Acharnians. Young notes the date of Meton's sundial and comments that "the introduction of the clepsydra in this period may be a result of the apparently increasing consciousness of time."[180] However, she adds, "A more immediate cause might be found in the constant enlargement of the jury-pay, which may have suggested to the State the curtailment of the length of cases".[181] It seems to me that Young's second statement is simply

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[180] Young, p. 277, n. 7.

[181] Ibid. One may quibble with Young's use of the word constant in referring to the enlargement of jury-pay. Concerning the question of the original amount of jury-pay, J. J. Buchanan informs us: "trustworthy information for the answer is wanting. The only possible starting-point is the raising of the payment by Kleon to 3 obols, a figure still obtained in Aristotle's day. . . . Whether the rate had previously been 2 obols and, if so, whether it had from the outset been 2 obols, we cannot say." J. J. Buchanan, Theorika (Locust Valley, N. Y.: J. J. Augustin, 1962). p. 17. However, Young may equally well be referring to a constant increase in the number of jurors and jury days needed to process court cases. In both instances there would have been an increase in the amount of money paid out by the State for jury attendance. More than one private case could be tried in a single day (see: D. M. MacDowell, The Law in Classical Athens (Ithaca, N. Y.: Cornell University Press, 1978), pp. 248-249.), and the introduction of the klepsydra may have been seen as a method of ensuring that cases did not drag on unnecessarily.

a different aspect of the first. Athens, as Mabel Lang informs us, was "a city notorious throughout Greece for the litigiousness of her citizens".[182] Many large law courts had to be provided with juries and these juries were of a large size (201, 501 and even more jurors).[183] Each juror in attendance at court would receive his daily jury-pay, three obols by 425 B. C. If the introduction of the klepsydra to the law courts was an attempt on the part of the State to limit the amount of obols paid out for man days in jury attendance, we can still say that there was an increasing awareness of time. The Athenian State had become aware, to quote the old adage, that "time is money."

The second conclusion, that the outflow klepsydra was an important piece of equipment in the law courts of Athens, is fairly straightforward. Comic writers use the klepsydra to symbolize the law courts, and also, as in Wasps 856-858, mention it as an essential part of the court apparatus. The orators frequently refer to it under the term ὕδωρ in their speeches. Finally, Aristotle, in the Constitution of Athens, describes how it functions in the courts. The klepsydra regulated the length of speeches in the court, and we have clearly seen that the orators, for one, were well aware of its function and consequently of the passage of time. The law courts

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[182] Mabel Lang, The Athenian Citizen, Excavations of the Athenian Agora Picture Book No. 4 (Princeton, N. J.: American School of Classical Studies at Athens, 1960).

[183] D. M. MacDowell, The Law of Classical Athens, p. 40.

were a facet of the everyday life of many Athenian citizens, whether they were acting as part of the court apparatus or as litigants. Consequently the court klepsydra must have been a familiar device to a majority of the Athenian citizenry.

Conslusion number three flows directly out of the above assertion. The Athenian authorities were well aware of the value of the klepsydra for regulating court proceedings and for the fair allottment of time for forensic speeches. It may also have been "an ancient precaution to eliminate filibustering from the sessions of the Council."[184] However, against this view, Young cites "the complete absence of literary testimony to its use in the Bouleuterion, and, conversely, the unanimous agreement of the ancient sources in referring it to the law courts."[185] Yet we do know that Athenians were devising uses for it, other than court oriented ones, whether or not they ever met with practical application. Aeneas Tacitus, a military man, "recommend[ed] the use of clepsydrae to ensure the fair distribution of watches among the troops."[186] Eubulus wrote of a prostitute who "timed her favours by the water-clock" (Deipnosophists XIII. 567. d). In the Deipnosophists (IV. 174. c), we also find reference to a water clock devised by Plato for use at the Academy, a little more sophisticated than the court apparatus perhaps, but as

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[184] Young, pp. 282-283.

[185] Ibid., p. 283.

[186] West, p. 63.

I noted earlier, "essentially a large scale klepsydra."[187] Finally, we have Aristotle's ambiguous statement in the Poetics about the use of klepsydras to time tragedies.[188] All of this information points to a growing awareness on the part of Athenian citizens, in general, of the practical concept of time. The klepsydra may not have been a daily "clock," but at least it measured intervals of time.

Conclusion four deals with the placement of Athenian time-pieces. The astronomer Meton reportedly erected a sundial on the Pnyx and Thompson and Kouroiniotes believe they have discovered its location. If the device was indeed constructed where they believe it to have been, in their words, "the situation was excellent for the purpose since here the instrument would catch the earliest beams of the setting sun summer and winter alike."[189] The Pnyx was also the site of public gatherings. The Athenian Agora water clock, before the construction of the Middle Stoa, at which time it was dismantled, was in an excellent location to serve as a public time-piece. The Agora was the centre of Athenian daily life, and the water clock, placed as it was in the southwest corner of the open square, could be viewed by anyone heading into the Agora from that direction or out of the market-place towards the Pnyx and the Peiraeius Gate, or from virtually anywhere in the Agora square itself. There is evidence that a water clock was set up in the Agora of Samos.[190] Therefore,

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[187]See p. 62; Armstrong and McK. Camp, p. 160, n. 19.

[188]See p. 61 and n. 161.

[189]Kourouniotes and Thompson, "The Pnyx in Athens," p. 211.

[190]H. Thompson and R. E. Wycherley, The Athenian Agora: Volume XIV, p. 202, n. 55.

it would seem that the advantages of an Agora location for a public time-piece were realized in at least some parts of the Greek world.

The probability of high density traffic and ready accessibility to large numbers of people, may also account in part, for the placement of the Tower of the Winds. In other words, developers may have seen the need for a market-place to have a public time-piece. The relationship between the Tower of the Winds and the Roman Market-place is not precisely known, nor is the precise date of the construction of the Tower. Robinson states that "although there is not sufficient evidence to give the correct date for the Tower, I should favor the later dating--in the second half of the first century--which would make its construction roughly contemporary with the initial gift from Caesar."[191] Whether the Tower of the Winds and the Roman Market-place were built at the same time or not is not as important as noting that the Tower was in the Market-place, where many people would have cause to come in contact with it.

The archaeological evidence has shown that several sundials were situated around the Theatre of Dionysos. The dates of these dials are uncertain, and they may very well be outside the scope of our interest. However, the Theatre of Dionysos was an area in which public gatherings took place. Indeed, Robinson notes that "it

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[191] Robinson, "The Tower of the Winds and the Roman Market-Place," p. 302.

is probable . . . that in the first century B. C. most, if not all, meetings of the assembly took place in the Theatre of Dionysos."[192] As well as perhaps serving to mark the time of performances at the theatre, as Gatty has suggested for the large sundial below the Acropolis, above the Theatre of Dionysos, the dials may also have served to mark the time for public gatherings. The above associations between time-pieces and areas where people regularly congregated, point to a genuine interest, on the part of the Athenian citizenry, in the practical application of time.

We now come to my fifth and final conclusion, that the Athenians were alive to the technological advances taking place in the ancient world and quickly assimilated them into their own society. The major piece of evidence for this statement is the change in the fourth century B. C. Athenian Agora klepsydra from outflow to inflow sometime in the third century B. C., shortly after the invention of the latter by Ktesibios. During the Hellenistic Age, there appears to have been a sudden flowering of interest in sundials, clearly recognizable as such, dating to the beginning of this period, during the third century B. C.[193] The archaeological remains of Athenian sundials are difficult to date, but they begin during the Hellenistic period and, as we have seen from the remains listed in the last

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[192] Robinson, p. 297, n. 14.

[193] Gibbs, p. 5.

chapter, steadily increase during the Roman occupation.

Athenian man may not have been as time conscious or thoroughly dependent upon the clock as we are today, but I think we can see the beginnings of this syndrome and its gradual progression from the fifth to the first centuries B. C. What role did clock time play in Ancient Athens?--More or less the same role that it plays in our lives today, that of universal organizer. The good old days that we hear people speak about, when life was not ruled by the clock, may not have been as "timeless" as we imagine.

The purpose of this thesis has been to investigate the practical aspect of time in Ancient Athens from the mid fifth century B. C. to the birth of Christ. My original premise was that, while not "modern" in his concept of time, the ancient Athenian became increasingly aware of its value in regulating his daily activities, especially as the pace of his life heightened and technological advances were made in timekeeping. The evidence which I have presented throughout the course of this thesis indicates, to me, that such was the case.

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