In this paper Dr. Gösta Langenfelt states that King Alfred is the first discoverer of the general principle on which the modern time-measurer, the wheel-clock, is based.
In the remote days of the early human civilizations, time was not divided into hours, minutes, and seconds. People distinguished, of course, between day and night, and they were also able to tell each other in certain vague terms when to meet, to begin work, to have their meals, etc. But the exact time could never be given. Neither could they say exactly how long a certain action lasted. In his work: *Primitive Time-Reckoning*, Professor Martin P:son Nilsson has given us (p. 42) examples of the means by which Primitive Man solved the difficulty of measuring short divisions of time. In Madagascar half an hour is expressed by the word “rice-cooking,” while a moment is rendered as “the frying of a locust.” The Cross River natives expressed the notion of less than a quarter of an hour by saying: “the time in which maize is not completely roasted.” Malays, Javanese, and Chinese use “a blink of the eyes” just in its literal sense, which, of course, is of the same origin as the English “twinkling of an eye,” the German *Augenblick* and the Swedish *ögonblick*, although the meaning of it in these three languages has been expanded. Compare also the Russian *seichass*, “this hour” being narrowed to “this moment,” while the German *Moment* may, like “a twinkling of an eye”, be drawn out.

We shall find similar terms to express a short duration of time in the English language of the Middle Ages. In the long and interesting poem: *The Vision of Piers Plowman* (by William Langland) we find in the B-text (about 1377), line 348: “in a pater noster while,” that is, the action took just as long time as to read a “pater noster.” Other expressions of medieval origin are *speech-while* and *breathing-while* and, in the 16th century, even *pissing-while* (!), etc. Measures of length were also used for “time”: *mile*, “the time in which one might journey a mile,” hence *mile-way* (= 20 minutes) and *furlong* (1/8 mile), hence *furlong-way* (= 2 1/2 minutes). But there were also terms for a point of time. In the 15th century collection of English short prose tales, called *Gesta Romanorum*, there is the story of “Plebeius the Emperoure,” in which the husband-knight says to his wife, who is besieged by three lovers... “say to the fyrst knyght that he bryng (bring) his mony at mydnyte, and to the seconde, that he bryng his mony at the thirde cokkis crow, and to the third knyght, that he bryng his mony in the morowe.” While the first and the last ex-
pressions are still current to-day, the second is too vague for modern people, at least for town-dwellers. A farmer or a labourer might know the time even in our age. In his diary Pepys writes on September 24th, 1667: ... “we stayed till past candle-light...” and on August 26th, 1668, he takes down: ... “(We were)... there till after candle-lighting.” Similar vague terms still remain in current speech: at daybreak, at dawn, at sunrise, in the early morning, at noon, at midday, in the afternoon, in the evening, at sunset, at dark, after dark.

Certain inventions to measure time were made at an early date in the history of mankind. The Greek *clepsydra,¹* or water clock, introduced in Rome in the middle of the second century B.C., was an earthenware bulb containing water, which “stole away” (hence its name) through a hole, or holes, bored in the nether part of the bulb. It was not exactly an instrument of precision, since the trouble with it was that it gained an imposing trifle of about fifteen minutes in every hour! (The *clepsydra* explains the Latin expressions *aquam dare*, to give the advocate speaking time; *aquam perdere*, to waste time.) Another device, Babylonical, or generally Oriental, was the sun-dial, perfected during the centuries and finally used for intricate geometrical problems. (Ward says: Egypt, 8th-10th century B.C.) The sun-dial, which is well-known still to-day, divided the day from sunrise to sunset into twelve equal parts. The night was also supposed to have equally twelve parts: *horae*. Now, in the Mediterranean countries, the lengths of the day and the night were not so distinctly varying as in more northerly climates, but still there was a notable difference between summer and winter. Consequently the hours of the day varied in duration according to the period of daylight. These equal parts of the day were called *temporary* or *planetary* hours. The practical complexities of that method of time-keeping are quite beyond the grasp of the disciplined clock-watcher of modern times, but it may be supposed that the Romans clung to the old system of counting only sunrise, midday and sunset. Abu'l Hassan, an Arab, who lived about the beginning of the 13th century, was, however, able to reform the sun-dial, so that every 24th division of *the day and night* was measured and became equal in length (how?), or an *equinoctial* hour. But historians do not know whether this became com-

¹ Ward (Time Measurement, Historical Review, Science Museum 1936) puts the Egyptian water clock, from which the Greek one derived, at about 1400 B. C.
mon knowledge. In the interval between the twelfth and the sixteenth centuries, the mechanical clock was invented, and our modern hour, one 24th of the day and night, began to be used in reckoning time, although it took a long time before the old way of calculating the hours of the day, even for business, was abandoned.

The Anglo-Saxon nations in England were not ignorant of the modern way of counting the hours, that is, every equal 24th of the day and night was called an hour. It behooved the Roman Catholic clergy to have knowledge of the march of time to be able to explain astronomical matters (based on Latin treatises, though). Venerable Bede, a monk at Jarrow in northern England and the author of the *Ecclesiastical History of the English Nation* (d. 735), wrote several books on time and time-reckoning. In one of them he tells us that time may be computed in three ways: either in the natural way, or according to habit, or according to authority. In a following chapter he speaks of the minor divisions of time, the hour being one 24th of the day and night. In another chapter he distinguishes between the vulgar way of calling the time between sunrise and sunset "day" while it is correct to designate all the 24 hours by the name of a "day."

In Germanic countries the term of *day* for the 24 hours met with a certain resistance. As a matter of fact, the Germanic tribes (nations) preferred *night* instead. This linguistic habit is verified by Julius Caesar and Tacitus. Thus in Caesar's *Commentarii de bello gallico* (IV, 18) one finds: "Ob eam causam spatia omnis temporis, non numero dierum, sed noctium finiunt . . .," and in Tacitus' *Germania* (XI): "Nec dierum numerum, ut nos, sed noctium computant . . ." Traces of this ancient terminology is still found in English to-day, thus: a *fortnight* (= 14 nights, 2 weeks) and the obsolete *sennight*, from *seven-night* (= 1 week).

Then Bede shows that day and night are unequal in length in different places, such as at Meroe (in Egypt), in different parts of India, in Alexandria, Italy, Britain, and in the Thule of Pytheas, altogether basing this on various Latin Classics, especially Pliny. About Thule he gives the old Plinian story, that it has six months' day in summer and six months' night in winter. Thule is situated 6 days' sailing northwards from Britain. Once, in his *History* mentioned above (Book I, chapter I), he says about the summer nights of Britain: "And because it (Britain) lies almost under the very north pole of the world,
it has bright nights in the summer, so often at midnight it is a matter of doubt to the beholders whether the evening twilight yet remains or the dawn of morning has already arrived, since the sun during the night goes not far beneath the earth on its return to east through the regions of the north: whence also it has days of great length in summer, and, on the contrary, nights of great length in winter, that is, of eighteen hours' length, by reason of the sun then departing into the regions of the south.\(^1\) It has very short nights in the summer, and very short days in the winter, that is, of only six equinoctial hours; whereas in Armenia, Macedonia, and Italy, and other regions of the same latitude, the longest day or night is fifteen hours, the shortest full nine.” As is seen, Bede’s astronomy was of an early medieval kind. Still it was full of many correct statements of value to the people of those days.

The important thing is, however, that, like the other Anglo-Saxon computists, Bede keeps apart the natural day of 24 equally long hours, and the artificial day between sunrise and sunset. In the Middle Ages it was, however, necessary to stress this difference. Geoffrey Chaucer, that gifted English poet (d. 1400), writes in his immortal *Canterbury Tales* (1386: the Squire’s Tale, line 108): “in the space of a day natureel, (This is to seyn, in foure and twenty houres),” where he refers to a day from one sunrise to the next sunrise. John de Trevisa, the medieval English teacher, points out (1398): “Some daye is artyfycyall and some naturell . . . a naturell daye conteynyth xxiiii houres”—where “artificial” refers to the old way of reckoning twelve hours from sunrise to sunset. Even Eden, the learned geographer, thinks it advisable to explain in his *Arte Navigationis* (1561): “The houre naturell or equall, is .24. parte of the day naturell . . . The artificiall or temperall houre, is a twelfth parte of the daye arcke or the nyghte arcke.”

St. Benedict of Nursia (d. about 544), the founder of the Benedictine monastic order, prescribed a rule for his monks, and “the horarium (of these monks) is set out in their early legislation with a fullness and simplicity that leaves nothing, save the addition of clock hours, to be desired,” says Dom David Knowles, but he writes also: “The silence of the Rule together with the absence of clock-times and

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\(^1\) I am sorry to say that Bede’s statement is not borne out by facts, except in the extreme north of Scotland (north of Inverness), where Bede had never been.
the variations introduced for seasonal or liturgical reasons make complete accuracy (of St. Benedict’s horarium) unattainable.” However, Cuthbert Butler, another Benedictine, has, to my mind, solved the puzzling regulations of the horarium. Having the Roman time-reckoning in mind we are better equipped to understand St. Benedict’s rule. There is a chapter Daily Life in St. Benedict’s Monastery in Butler’s book, Benedictine Monachism, and it gives us certainly a true picture of it. “The day,” writes Butler, “i.e. the period from sunrise to sunset, was divided into twelve equal ‘horae,’ and likewise the night, or period from sunset to sunrise, into twelve equal ‘horae.’” Consequently, only at the vernal and the autumn equinox, were the ‘horae’ of the day and those of the night equally long (= 60 minutes). In summer the day-hours were longer than the night hours, in winter vice versa. Besides, sunrise and sunset depended on the geographical situation of the monasteries. In Rome, near Monte Cassino, the longest day covers fifteen natural hours; thus the artificial hour (since there were only twelve) amounted to 75 modern minutes. The shortest day in Rome is 9 natural hours, hence the twelve artificial hours lasted only 45 minutes each. On November 1st in Rome the sun sets at 4:45 p.m. and rises at 6:30 a.m. This means that the night contains 13 3/4 natural hours, and the artificial hour is 69 minutes.”

Pre-eminent among Anglo-Saxon princes was Alfred of Wessex (849-899). He was a king who knew warfare, he was a strategist, a ruler with political insight and international diplomatic contacts. He was also the deliverer of his country from the Danish Viking yoke, and foreshadowed the unity of all the English kingdoms of the day into one England, not to say, one Britain. He was a lawgiver for his country, although his activities as such amount to little. But all this would not entitle him to the epithet: eminent. It is his personal qualities that make him an interesting human being. He was devoted to the task of educating his people, and according to the conditions of this time, this meant to make his priests learn Latin and to afford to all people, who knew reading, books in the Old English language. His choice of books depended on his fervent Christianity: Boethius’ Consolation of Philosophy, the histories of Venerable Bede and the Spaniard Orosius, the Dialogues and the Pastoral Care of Gregory the Great. It is a mere chance that we know so much about him, for the Old English annals: the Anglo-Saxon Chronicle, said to have been begun by Alfred, are very laconic and sometimes lacking for
several years. In 883 he succeeded in persuading Asser, a Welsh priest, to come to his court at Winchester: he was made a bishop. Full of enthusiasm for his royal friend, Asser sat down to write his biography which he finished about 893. It was, of course, written in Latin.

This *Life of Alfred* seems to have existed in several copies, but none of them have survived the ravages of time. Archbishop Parker published Asser’s work in 1574 after a manuscript later destroyed in the 18th century, but in so uncritical a way that he mixed parts of another old manuscript: *the Annals of St. Neot*, into Asser’s text. The trick was found out and scholars now began to doubt the existence of a real Asserian biography. Wise, the editor of Asser in 1732, and Petrie (& Hardy), publishing anew the same story about Alfred in 1848, were careful to signal by brackets what was considered to be spurious. In 1904 W. H. Stevenson published his painstaking edition of what was believed to be “pure Asser,” the additions being printed in special type. Stevenson had no doubts about the residue being a document contemporary with Alfred.¹)

From this it appears that King Alfred was also an inventor: he made an instrument to measure time exactly. This invention is referred to on p. 89 (103,11; Stevenson’s edition of the Latin original). King Alfred is said there to have promised to devote half his corporal and mental faculties to the service of God, both day and night. Asser’s biography continues: . . “But because he could not exactly and equally distinguish the night-hours owing to the darkness and the day-hours owing to the density of the rains and the fogs, he began pondering in what sure way he would, without any doubts, be able invariably to fulfill unto his death his promise (to serve God) which he had given.”

“(104). After having thought about this for some time he found, finally, a special, useful way: he ordered his clerks to deliver a sufficient quantity of wax, brought together in penny-weights, and had them weighed on a two-pounds balance, and when so much wax had been measured as weighed 72 penny-weights, he then asked the clerks to make six candles, each of equal weight, so that every candle had 12 inches marked on them along their length. When he had thus discovered this way, the candles burned for 24 hours, faultlessly, day

¹ Quite recently Prof. Galbraith, Oxford, in a lecture, has vindicated the theory that the so-called “Asserian” biography is a 12th c. product. Even so, the invention ascribed to King Alfred is recorded earlier in England than elsewhere.
and night, in front of the holy relics of many of the chosen ones of Our Lord, which always accompanied him everywhere. But since they could not burn during the whole of one day and night, they being lighted at the vespers of the preceding day, because of a severe draught sometimes stirring day and night without stopping through the doors and the windows of the churches through the mortar and the tabularum, or through the many rifts of the walls and the thin tents, which forced them to burn down earlier than they ought to have done and before the exact hour by ending their light, he then thought how he could prevent such a draught, and when he had found a way, both ingenious and wise, he had a lantern constructed of wood and ox-horn. For white ox-horn split into thin layers by axes does not shine (be transparent) less than glass vessels. This lantern was made, as was said before, in a beautiful way of wood and horn, and when, at night, a candle was put in it, it burned brightly, inwards and outwards, without being hindered by a breath of air, because he had similarly had a door of horn made to the opening of the lantern. This invention finished, the six candles burned, one after the other, for 24 hours without interruption, neither quicker nor slower. When they had burned down, others were lighted.”

Before proceeding to estimate the value of the invention, I want to draw attention to a few points in the description of it. The candles weighed twelve pennyweights each or, according to Stevenson (p. 381), 5/8 oz. avoirdupois, that is, 17 grammes, and they had each a length of 12 inches, or nearly 30 centimeters. This would mean rather a tall but very thin candle. In order to find out whether it is possible to make such a candle, I asked the Liljeholmens Stearinfabrik (Stockholm), which they graciously consented to, to make one in accordance with Alfred’s specification as it appears in Asser, so that I might test it for accuracy. This candle, when made, was exactly 12 inches high, of bee’s wax, weighing 18 grammes, and with a very simple wick: it burnt for 4 hours and 20 minutes,—the twenty extra minutes are accounted for by the extra grammé. Thus Alfred was right in his calculations, and six candles would burn for 24 hours.

The only hitch about such a candle is that it showed a definite time only at every inch notch, or every twenty minutes,—for 4 hours divided by 12, give twenty minutes. Alfred could not check half an hour except by computation: half an inch. In Old English there existed a noun twentig for the number of twenty of something, for
instance: “An twentig is ðara boca ðe Adeluuold gesealde” (Of the books that Athelwold gave there is a score), but there was no need for “twenty” since our minute was not in use then. The Old English minute was a tenth of an hour, and the minute of 60 seconds was introduced only in the fourteenth century. When 3 inches, respectively 6, 9 and 12 inches, had burnt, Alfred knew that 1 resp. 2, 3 and 4 hours had passed. Besides, one might, of course, say instead of “20 minutes,” “one third of an hour,” “two thirds of an hour,” etc. Further, it is clear that only one candle burnt at one time, not all six together at the same time, for it is expressly said that “the six candles burnt, one after another,” and that “at night, a candle was put in it,” i.e. in the lantern. The lighting of the first candle (of the six in 24 hours) occurred at vesper; that time of the day was then the starting-point of Alfred’s horologium. It is obvious from the text that this time-measurer travelled with Alfred to many parts in the country, for partly this is said, partly it is implied by mentioning church and tent in the plural and the precise description of many different sorts of walls, crannies and draughts.

The fact that twenty-four hours are mentioned throughout the passage makes it quite correct to assume that Alfred did not intend to measure time according to artificial time-reckoning, that is, 12 hours from sunrise to sunset, and 12 hours from sunset to sunrise, independently of season and place. Besides, how could he? No, he must have wanted to follow the natural hours (= 60 minutes) during the space of twenty-four hours from vesper to vesper. This is a remarkable thing, and as Stevenson points out (ibid. 339) Alfred “has the credit of anticipating by several centuries the use of this, the modern system, which is so largely the result of the introduction of the wheel-clock.” Alfred was, of course, not ignorant of what Bede had explained about the natural hours. If he built up such a device of measuring time, he could not by any practical means get at the hours of Roman time-reckoning. Consequently, Alfred’s invention was revolutionary,—pity that he had no followers. It is remarkable that Bilfinger (Die Mittelalterlichen Horen...) does not mention Alfred’s horologium.

The statement that six candles were used for 24 hours, thus one candle for 4 hours, does not give us any clue to William of Malmesbury’s threefold division of day and night. If there had been three candles for 24 hours, one candle would have burnt for 8 hours, but
that was not the case. But, of course, in such a case, the candle would have been difficult to manufacture and unwieldy to handle. With the mention of William of Malmesbury we approach another problem, which has had vast consequences in the social life of the Western world: the eight hours day. In 1954 I published a work: The Historic Origin of the 8 Hours Day (Kungl. Vitterhets Historie och Antikvitets Akademiens Handlingar, Del 87), in which, to my mind, I proved that this modern piece of social legislation has its roots in the English writings of the Early Middle Ages.

William wrote a chronicle, Gesta Regum Anglorum, 1114-1123, of the Anglo-Saxon kings. There were at the time a number of chroniclers among the monks: from Ethelwardus (d. 998)—he was a layman,—to Henry of Huntingdon (d. 1155). Their manuscripts were copied and read in other monastic institutions. All these writers give their report of King Alfred’s life, generally following Bishop Asser’s biography, although they do not copy everything, but pick out what seems most interesting to them. In William of Malmesbury there occurs for the first time the information that Alfred made a threefold division of day and night. He writes: “Finally, that I may briefly elucidate his whole life, he divided the twenty-four hours, that rotate together between day and night, in that way that he spent eight hours in writing, reading and praying, eight hours in caring for his body (repose) and eight hours in dispatching the affairs of the realm.” As will be remembered, Asser never mentioned this in his biography, at least not in what has been left of his manuscript to posterity. From which source might William have picked up this important detail? Such a division is quite unique for that age. Among primitive races no testimony of such a phenomenon exists, which is, besides, self-explanatory. Nor can the threefold division be derived from Antiquity, nor from the monastic rules, because such a division depends upon an exact time-measurer. As we have seen, the balance-clock was invented only at some time in the 13th century, at the earliest, and William of Malmesbury died in 1143! The only solution of the dilemma must be to couple the threefold division with Alfred’s invention: his time-measurer based on candles. Then arises the question: did Alfred himself realize the possibility of dividing the twenty-four hours into three eights? Or did William of Malmesbury invent the pious legend?

In Asser’s biography it is stated that King Alfred used to carry
with him a small book in which he took down things of interest to him. This book is completely lost. But William of Malmesbury speaks of this notebook: “which in the language of the country was called *Handboc* (Encheiridion),” in Latin: *Manualis Liber*. It is difficult to tell, but to me the only solution of the question is that in his Handbook King Alfred had sketched a timetable implying a threefold division of the twenty-four hours. When busy with his planning the device for time-measuring, he may have grasped the fact that 24 could be divided by 8 into 3, and then this fortunate discovery might have tempted him to scribble down the idea that such a division of day and night might be favourable to God and the cure of his own body. A later scribe of the Malmesbury monastery, writing in French, has also seen the difficulty of reconciling Asser’s statement about the six candles burning down in twenty-four hours and William’s statement about the threefold division of day and night, for he writes: “This Alfred lived an extraordinary life. I will tell you briefly. The twenty-four hours between night and day(!) he divided into three parts. Eight hours in writing, reading and praying: eight hours in rest to the body; and eight hours in discourse and provisions for the kingdom. He used to maintain a man in his chapel who served for this office, who divided the four-and twenty hours by means of *three* (my italics G.L.) even candles. He burnt the first candle until eight hours were passed, and so on with the others.”

William of Malmesbury is considered by modern historians to have been a most conscientious, truthful and trustworthy chronicler. King Alfred’s *Handbook* is also traced in medieval literature in some other connections. At the time of William of Malmesbury, the *Handbook* might have been in existence and even perused by the learned monk of Glastonbury and Malmesbury. Even if we cannot with certainty ascribe the threefold division of the twenty-four hours to King Alfred—a measure he never dreamt of introducing in his Anglo-Saxon society of the ninth century!—we can with certainty point to King Alfred as the first discoverer of the general principle on which the modern time-measurer, the wheel-clock, is based.