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OUR CALENDAR

THE measurement of time is not an easy task, although it involves merely the counting of repeated motions. To aid us we have the two primary periodic movements of the earth, namely the rotation of the earth on its axis, which gives us day and night, and the revolution of the earth round the sun, which gives us the year and the seasons. Thus we might easily think our problem solved for us by these physical laws. But when we consider further that the earth is not a perfect sphere, that its axis of rotation is inclined at an angle to the plane of rotation, that the orbit of revolution is not a circle but elliptic, that the actual time of a revolution round the sun varies slightly from the apparent time of revolution because of the precession of the equinoxes, and that the year is not an exact multiple of the day, we can begin to appreciate some of the difficulties presented to a calendar maker. Then add to the above the month based upon the motion of a third body, the moon, and we have additional difficulties immediately created in the making of a calendar.

With this introduction it is necessary that we first consider the units of time now in use, carefully define and understand them, determine their origin and use, in order that we may be in a position to intelligently trace the history and development of our present calendar with its defects and apparent discrepancies.

As we all know, the earth rotates on its own axis and at the same time revolves round the sun. In addition, the moon revolves round the earth. These physical phenomena are used in creating our units of time, which form the basis of measurement.

The day is defined as the time taken by the earth to make one complete rotation on its axis and "is the interval between two consecutive passages of a given celestial object across the meridian." This is a constant interval, but the sidereal day, measured by successive passages of a given star, differs slightly from the mean solar day, measured by successive passages of the sun. This difference arises from an apparent eastern motion of the sun relative to the fixed stars, which motion is not constant from day to day. This fact explains the discrepancy between the readings of an accurate watch and sundial. We use, therefore, the period of twenty-four hours, or civil day, corresponding to a mean solar day, rather than either the sidereal day or real solar day, as our unit of time. This civil day begins at midnight and ends at midnight at present, although this arrangement has not always been the custom. The ancient Chaldeans and Babylonians began their day at the rising of the sun, the Athenians at the setting of the sun, the Umbri in Italy at midday, the Egyptians at midnight, and the Romans frequently at six o'clock in the morning. This latter custom was undoubtedly the result of the account of creation given in Genesis, which referred to the evening and morning as forming the day. This custom was continued by the ancient Gauls and Germans and can be found in our expression "fortnight."

The next division or unit of time is the week, which has a very interesting origin and history. A period longer than the day and shorter than the month, it has at different times and by different people consisted of a varying number of days from three to eight. While the origin of the week is somewhat obscure, yet we find evidence of a three day week among certain Indian

tribes in South America, a four day week among the natives of the Congo region of Africa, and five, six, or eight day weeks among the natives inhabiting other parts of Africa. The five day week, also, can be found in Persia, Java, New Guinea, and Mexico. But of more immediate interest to us we find traces of the five day week among the Nordic or Scandinavian people living in the region of the Baltic Sea in northwestern Europe. The Northmen's week of five days, with six such weeks forming a month, was divided as follows:

Tysdag—Tuesday
Odinsdag—Wednesday
Thorsdag—Thursday
Frjadag—Friday
Langardag (bath-day) or Thvattdag (washing-day)—Saturday.

There is no doubt concerning the derivation of the first four days, but it is quite possible that Saturday was derived from some Norse divinity, rather than as explained above. There is seemingly no reason to believe that the name was derived from the classical Saturn, Saturday being used in Scandinavia long before the name Saturn was known. The names of our week days indicate conclusively that the five day week was used in Britain also.

The seven-day week, the other most universally discovered week, is of Semitic origin, originating in West Asia, where it was used by the Chaldeans and Egyptians, later by both the Greeks and Mohammedans. But it was among the Jewish people that we find the full development of the seven-day week. It may represent the special veneration held by these people for the number seven, or it may have represented the number of planets or notes in the musical scale. Perhaps all three circumstances exerted their influence, although we find that according to Jewish tradition this seven-day week was instituted at the creation of the world. Allowed to lapse during the period of Egyptian captivity, the observance of this seven-day week was revived while the children of Israel were journeying through the Wilderness, when the supply of manna was omitted on the seventh day. Thus while we find the seven-day week, we also find that the last day of the week was observed as the Sabbath day, and not the first, as in our present calendar.

It is not surprising, therefore, to find the seven-day week naturally accepted by the Christian world. To commemorate the fact that the Resurrection of Christ occurred on the first day of the week and also that the foundation of the Christian Church at Pentecost occurred on the first day of the week, the necessary change was made so that the first day and not the last day of the week might be observed as the Sabbath. For many years, however, both the first and last, or seventh, days of the week were observed as days of rest and worship until the practice was formally abolished by the Council of Laodicea in 346 A. D. With the legal establishment of Christianity in the Roman Empire during the fourth century, various laws were enacted for the observance of the Sabbath, which resulted indirectly in establishing the seven-day week as an accepted and recognized unit in the calendar.

Consequently we find the seven-day week carried by the Christian missionaries into Britain, where the five-day week was being used. And apparently these missionaries were responsible for a compromise with paganism, in which they accepted the British names for five of the seven days and were satisfied with giving to the two additional days of the week the names already used in other parts of the Roman Empire, namely Sunday and Monday after the sun and moon respectively. As a result, therefore, our present week, both in number and names of days, has been greatly influenced by Christianity as well as by paganism.

Of the four units of time—the day, the week, the month, and the year—the most in-

teresting of all is perhaps the month. While the day is a unit derived from the physical action of the earth, the week the result of human invention, the month owes its origin to the action of the moon as it revolves round the earth. The time of the moon's revolution, reckoned from the position of the moon among the stars to its return to the same position, is 27 days, 7 hours, 43 minutes, 11.5 seconds. But again, as in the measurement of the day, the apparent interval between two successive full moons, called the synodical or lunar period, is 29 days, 12 hours, 44 minutes, 2.8 seconds. This latter period was used as one of the natural units of time by the ancients, largely because of ease of observation, but must be distinguished from the calendar or civil month now in use consisting of from 28 to 31 days.

The historical development of the month is so closely interwoven with the year as a unit of time, it is necessary, before proceeding further, to understand accurately the meaning and length of the year as a unit of time. As we know, the year is defined as the interval of time required by the earth to make one complete revolution round the sun. And yet even this definition is capable of several interpretations and meanings. The sidereal year is the interval of time as measured with reference to the fixed stars, while the tropical or solar year is the interval of time between two successive returns of the sun to the equinox. As the latter determines the seasons, it is therefore used in the construction of a calendar, although it varies slightly from the sidereal year.

Among the early Chinese, Chaldeans, Egyptians, Greeks, and possibly Latins the year was assumed to consist of 360 days. But even before the Christian era this was known to be incorrect, for as Sir Isaac Newton claimed, this method of making a year to consist of 360 days or twelve months of thirty days each, created a lunar (moon) year and not a solar year. This explanation evidently accounts for the early plan of the ancients with their limited knowledge of the length of the true solar year. We know, however, that the Egyptians added five days to each year in an effort to adjust properly this difference between the so-called lunar and solar years.

In spite of this knowledge furnished by the Egyptians, the ancients especially the Greeks and Romans, continued to make use of the lunar year in making their calendar with months and days inserted at various times to keep the seasons in place. For instance, the Greek month contained about 28 days and twelve such months made their year of 255 days, to which every eight years they added ninety days divided into three months of thirty days each.

The Egyptians apparently assumed the leadership in correcting these defects so baffling to the other Mediterranean people, when under the influence and teachings of Hipparchus they discovered that about six hours had to be added to the 365 days in order to make an exact solar year. While the other ancient people were slow in adopting this change and correction, further investigation during later centuries has substantiated the work of Hipparchus, for we know the exact length of the solar year to be 365 days, 5 hours, 48 minutes, 48.15 seconds, or nearly 365¼ days.

Different combinations of these four fundamental units of time measurement have produced various calendars. The Chinese make use of a luni-solar calendar, the Mexicans use a year of eighteen months, while Mohammet introduced a purely lunar calendar for his people. The Jewish year is divided in months of from 29 to 30 days with an intercalary month introduced usually every third year. The French Republican Calendar, used from 1793 to 1805 in France, abolished the week entirely, substituting decades, and introduced a year of

twelve thirty-day months with five days added at the end of each year.

Passing over a study of the calendars mentioned in the preceding paragraph, we come to the Roman calendar, which is of especial interest to us, as it is the source from which the calendar of modern Europe and America has been derived.

From an investigation of the earlier writers we find that evidently the original Roman calendar was based upon a month of from thirty to thirty-one days with a total of ten months, making a year of 304 days. From the same investigation it is believed that two additional months were added by Numa, the successor to Romulus, the founder of Rome. In adding these two months Numa deducted one day from each of the thirty day months, making them twenty-nine, made one of the new months, February, a twenty-nine day month, but left January with thirty days. This latter arrangement was followed partly because January was dedicated to the Infernal Gods and partly because of the Roman desire to keep a year of odd numbered days, as the early Romans were quite superstitious in their disbelief of even numbers. These twelve months, however, did not form a correct solar year.

Nevertheless, this Roman calendar as changed by Numa remained in use without further modification until the time of Julius Cæsar, who decided to reform the calendar and thereby remove the confusion resulting from the addition of arbitrary intercalations of days and months from time to time in an effort to bring the year in accord with the seasons.

Consequently in the year 45 B. C. Cæsar with the aid of the astronomer Sosigenes of Alexandria introduced the so-called Julian Calendar, which is our calendar of today with but slight modification. The simplicity of his plan is a credit to the genius of the man. Accepting as the basic feature of his calendar the adoption of the solar year of 365 days, 6 hours or 365¼ days, Cæsar decided to abandon all attempt to make either the months separately or the entire twelve month period correspond to the lunation period.

Prior to this time the year had always begun in March but Cæsar decreed it should begin on the first day of January, and also deliberately fixed the number of days each month should contain. These numbers were as they now exist except that August, then known as Sextilis, was to contain thirty days and February twenty-nine days. In order to allow for the six hours, or one-fourth day, required in addition to the 365 days to complete the solar year Cæsar further decreed that an extra day should be added to February every fourth year or leap year, thereby giving February thirty days at regular intervals of four years.

In 44 B. C., the second year of the Julian Calendar, the name of the month Quintilis was changed to commemorate its founder. In like manner, Augustus Cæsar in 8 B. C. persuaded the Roman Senate to change the name of the month Sextilis to August, named after himself. And in order to make his month contain as many days as July, named after his predecessor, he took one day from February and added to August, thereby giving August thirty-one days and February twenty-eight days except in leap years, when it would have twenty-nine days.

Although the Julian Calendar is not absolutely accurate due to the fact that the exact solar year is slightly shorter than 365¼ days, it remained in use unchanged until 1582 when the error was corrected by Pope Gregory XIII, and the corrected calendar since that time has been known as the Gregorian Calendar after its author.

Due to the difference between the Julian year and the solar year the equinox had fallen back from March 21, the equinoctial date at the time of the Nicean Council in 325 A. D., to March 11. Consequently Gregory, acting upon the advice of the Je-

suit astronomer Clavius, ordered the day following October 4 in the year 1582 should not be called the fifth of October, but should be called the fifteenth of October in order to correct the equinoctial discrepancy. In addition, to prevent a future displacement of the equinox, Gregory ordered a slight revision of the leap year rule as follows:

"All years whose date number is divisible by four without a remainder are leap years, unless they are century years. The century years are not leap years unless their date number is divisible by 400, in which case they are."

The changes ordered by Gregory were immediately adopted by all Catholic nations, but the Greek Church and most of the Protestant nations declined to accept the correction. Hence arose the names Old Style or Julian and New Style or Gregorian. Since that time, however, the remaining European countries have adopted the revised calendar, the Protestant States of Germany in 1699 and Great Britain in 1752 for herself and her American Colonies. The countries holding allegiance to the Eastern or Greek Church delayed their acceptance until recent years.

Recognized and accepted by the various nations of the world, the Gregorian Calendar remains, in spite of its irregular months and quarters and its inability to foretell future week day dates.

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TEACHING NOTES ON THE INDUSTRIAL REVOLUTION

Part One. The General Principles

I. The Industrial Revolution is one of the three great movements (the Reformation, the French Revolution, and the Industrial Revolution) resulting in the modern democratic world.

II. Life, based on agrarian foundations, had been practically static for thousands of years.

III. The handicraft and the domestic systems were the types of industry in vogue from the early Middle Ages until the rise of the factory system.

IV. The Industrial Revolution began with a series of inventions and changes in the textile and related industries in England during the second half of the eighteenth century.

V. Every phase of industry and daily life has been affected by the Industrial Revolution.

Part Two. Questions Based on General Principles

I. 1. What great movement brought religious democracy to the modern world?
   2. What great movement awakened new political and social ideas?
   3. How much practical bearing upon the everyday lives of the people did these movements have?
   4. What, then, is largely responsible for the vast difference between medieval and modern life?
      a. Is it the way we worship?
      b. Is it the way we think about politics and ethics?
      c. Or is it the way we live and do things?
   5. Or are these three movements so closely interrelated that it is practically impossible to distinguish the effect of each upon modern living? Can it all be called growth in different ways towards one goal—democracy?

II. 1. Could prehistoric man make fire? bake pots? spin? weave? extract iron from ore? till the ground?
   2. Upon what mode of life were the foundations of civilization built?
   3. How did the people live in the time of the Pharaohs?