THE SCIENCE NEWS-LETTER

A Weekly Summary of Current Science

EDITED BY WATSON DAVIS

ISSUED BY
SCIENCE SERVICE
B and 21st Streets
WASHINGTON, D. C.

EDWIN E. SLOSSON, Director
WATSON DAVIS, Managing Editor

SUBSCRIPTION: $5 A YEAR, POSTPAID

Vol. IX, No. 281 Saturday, August 28, 1926

ANCIENT MAYAS HAD GOOD ROAD SYSTEM

The good roads movement is no new thing in America. Far back in the days when the later Roman emperors were pushing the highways of white stone to the outer limits of their domain, and making "Roman roads" a phrase to conjure by for all time, there was an empire in the American tropics that had its own system of roads that rivaled those of Rome. The jungle has taken them back again, as it took the ancient capitals of the Maya people, but a report to the Carnegie Institution of Washington, recently sent in by its well-known explorer Dr. Sylvanus G. Morley, now tells of his discovery of the roads that led to Coba.

Coba was the capital of a Maya empire even more ancient than that of Chichen Itza, already made famous by the archeological excavations by Dr. Morley. Having partly finished his work at the later city, the American scientist this season conducted a little preliminary work in the ruins of Coba, and among the striking evidences of the high civilization that flourished there near the beginning of the Christian era probably the most outstanding feature is the great system of radiating roads "sacbeob", "white roads", the Maya called them.

Dr. Morley states that he has found seven of these great highways, and has received from the natives reports of others which he expects to investigate later. They were all constructed of stone, were from thirty to sixty feet wide, and as a rule stood about two feet above the surrounding terrain. In places, however, they ran for miles at a height of eighteen or twenty feet.

The most notable find in the city of Coba itself was a ten-foot monument, evidently to one of the emperor-builders. It consists of a shaft four feet square, with a principal figure holding the double-ended Maya scepter-staff in both his arms, standing on the back of a captive, and receiving the homage of two other kneeling figures. The rest of the surface of the monument is closely covered with sculptured triumphs and with columns of hieroglyphic writing.

What these hieroglyphics may signify is still unknown, for though Dr. Morley has succeeded in deciphering the highly perfected Maya calendar, no key has yet been discovered to the code that hides the history of America's first empire-makers.

EXCAVATIONS IN PHILISTINE CITY CONFIRM OLD TESTAMENT HISTORY

"They put his armor in the house of their gods, and fastened his head in the temple of Dagon." The tragedy of Saul, as related in the Book of Chronicles and also in Samuel, has received still further light from the excavations of the joint expedition of the Museum of the University of Pennsylvania and the British Museum working at the ancient Philistine stronghold at Beth-Shan.

According to a report just received from Alan Rowe, field director of the expedition, the two pagan temples were originally built by hireling Asiatic soldiers of Israel's ancient Egyptian oppressors and dedicated to Egyptian deities modified by the mercenaries' Semitic background. Mr. Rowe states that in all, four Caananitish temples were found at Beth-Shan. They were all erected during a period when Palestine was a conquered province of Egypt, and before the coming of the Children of Israel. Two of them were built by the Pharaoh of the Oppression, Rameses II, and one during the short reign of his father, Seti I.

During the decline of the Nineteenth Dynasty in Egypt, when a succession of weak monarchs held the throne, the Israelites broke away from their bondage, as related in Exodus, and during the same period the Philistines recovered their ancient city from the hands of the weakened garrison of non-Egyptian hired soldiers. They did not demolish the temples, however, but simply identified the already half-Semitized deities in them with their own Baal, whom they called Dagon, and with Ashtoreth, the Semitic Venus. This god and goddess were still worshipped in their two respective temples when the Israelitish irruption into the land occurred, and the long wars for the possession of the Promised Land began.

After David had succeeded to the throne he avenged his former lord by heavily defeating the Philistines, capturing Beth-Shan and demolishing the temples. This occurred somewhere about 1000 B.C.

"David must surely have established a sanctuary or a tabernacle to the God of Israel at Beth-Shan", says Mr. Rowe. "If there was such a sanctuary, the only place large enough for it was either on the ruins of the Dagon temple or in the reconstructed Ashtoreth temple. A new floor which the excavators found laid in the former building over the debris of destruction, was perhaps his work."

PREHISTORIC CAMEL AWAITS SUITABLE NAME

A camel that lived in Florida a million years ago, more or less, and that is different from any other branch of the camel tribe, is at last about to be christened. This nameless orphan was discovered at Melbourne, Florida, recently by Dr. J.W. Gidley, curator of vertebrate paleontology of the National Museum.

Dr. Gidley is now engaged in studying teeth and leg bones of the ancient beast, with a view to describing and naming it.

The bones indicate that the Florida camel had long slender legs and should have been a fast runner, he concludes. It was a little smaller than the old world camels and a little larger than the guanacos of South America. Presence of this desert animal in Florida is taken by Dr. Gidley as an indication that Flordia may have been more dry and desert-like, in patches at least, than today, but there is a chance,

he adds, that this may not have been the case, as sometimes one genus of an animal family adapts itself to donditions entirely different from those to which the family is accustomed.

The new genus of ancient American camel is being compared with fossil bones of other better known kinds by the paleontologist. There have been a number of kinds of camels in this country as far back as the eocene period of geological time, which means 40,000,000 years or even longer ago according to recent estimates of the earth history. Some of the prehistoric specimens had long legs and some had short legs, Dr. Gidley says. Some had long necks and some short. Some were like the old world camels, but bigger, and some were like strange little colts, no larger than a big, long-legged dog.

REFRIGERATION BY A FLAME

By Dr. Edwin E. Slosson,
Director, Science Service, Washington, D.C.

There are a dozen different household refrigerators now on the market and each is better than all the others. I know that because it has been proved to me in perso by representatives of the various manufacturers in the two weeks since I carelessly allowed it to be known that I was thinking of buying an iceless icebox as a surprise to my wife. So many eloquent advocates of family coolers have visited me that I get cold shivers whenever I see a stranger at my door. When the methyl chloride man gets me convinced that he has the best refrigerant, one of the sulfur dioxide agents comes in and overturns all his arguments, and the next caller converts me to iso-butane.

And in the midst of this mental confusion I open the foreign mail and find in "Engineering" and "La Nature" new and original refrigerators have been invented, one cooled by a gas flame and the other by steam.

Both are based upon the familiar principle, that the rapid evaporation of a liquid into a gas absorbs heat from its surroundings and accordingly cools them. One uses ammonia for this purpose and the other simply water.

The former is the invention of two Swedes, Baltzat de Platen and Carl G. Munters of the Royal University of Technology at Stockholm. In employing ammonia as the cooling gas it is like most regrigerating plants, but it has no condensing pump as is customary. In fact it has no machinery, no moving parts of any kind. It consists simply of a series of four tight metal containers, connected by tubes, the whole charged with ammonia, water and hydrogen under a pressure 180 pounds per square inch and hermetically sealed. The first vessel is a generator in which ammonia gas is liberated from the liquor by heating with a gas jet or electric coil. The ammonia gas then passes into a rectifier and condenser where it is cooled by running water and reduced to the liquid state. This liquefied ammonia goes next into the evaporator where it is relieved of its pressure and becomes gaseous again. The evaporator is situated inside the refrigerator-box. which is continually cooled by the expansion of the liquid ammonia into ammonia gas. This finally flows into the absorber where it dissolves in water and runs back to the generator to start upon its rounds once more. The evaporation of the ammonia is due to its fall in pressure from 180 pounds per square inch in the generator to a partial pressure of 30 pounds per square inch in the evaporator. This is accomplished by an ingenious application of a law discovered by John Dalton over a century ago, that the total pressure of a mixture of

gases is equal tothe sum of the pressures that each gas in the same space would exert if the other gas were absent. Now the evaporator is filled with an atmosphere of hydrogen gas which gives a partial pressure of 150 pounds. When the ammonia which has been liquefied under a pressure of 180 pounds comes into the chamber where the pressure due to hydrogen is only 150 pounds, it evaporates at a rate sufficient to make up the difference between the two, 30 pounds, and this causes the cooling. The hydrogen is kept from getting into the other part of the apparatus by a curved tube filled with water through which ammonia can pass but not hydrogen.

The manufacturers claim that the family size refrigerator will absorb heat to the amount of 320 British Thermal Units per hour and may be run for a day by currents of 3 kilowatt hours of electricity and about 120 gallons of water. If electricity is not available a gas flame may be used for heating the generator. The apparatus is not at present automatically started and stopped but is so arranged that a single handle turns on the gas and water supply together. So the cook can bake her cake by a gas fire and then switch it over to freeze her icecream.

The French machine invented by R. Follain is interesting because water is the only means employed. This is doubly advantageous since water is everywhere cheap and absorbs a larger quantity of heat on evaporation than any other substance known. In this apparatus the evaporation is hastened and therefore the cooling effect is intensified by creating a vacuum above the surface of the water in an airtight tank by the injection of a steam jet in a constricted tube. The water vapor and steam are condensed in an adjoining chamber by a spray of cold water. Several such systems can be arranged in series in order to secure the desired reduction of temperature. Such a machine will cool 1250 gallons of water from 77 degrees to 37 degrees Fahrenheit. To accomplish this requires about 790 pounds of water used as steam for the injector and 22 tons of water for cooling.

But there is not room enough in our pantry for all this. I think I will postpone my purchase until one of the machines drives all its rivals out of the market. But the danger of such a policy of watchful waiting is that the law of the survival of the fittest does not always hold in the commercial struggle for existence. The machine which comes out supreme in sales may be the poorest and cheapest to make, because it has the largest surplus to spend on advertisements and agents.

SHOWS FOREST DEVELOPMENT FOLLOWS PATH OF EVOLUTION

Not only does each kind of tree and bush and flower in a forest have its evolutionary ancestry, but the whole forest is the product of changes from one kind of vegetational society to another through many generations, and is thus itself the outcome of an evolution.

Prof. H. C. Cowles, head of the botany department of the University of Chicago, explained before the International Congress of Plant Sciences, held at Ithaca, N.Y., August 16 to 23, the latest developments in his doctrine of the evolution of plant societies, or "succession" as it is more usually called. He used for his text the changes that have taken place in the swamps and forests of the great dunes region along the shores of Lake Michigan in Indiana and Michigan, a region which he has studied for many years.

The evolution of plant society, Prof. Cowles said, began here as with a clean-wiped slate when the frozen land was left bare by the retreat of the great

continental glaciers a hundred thousand years or so ago. The first plants that came in on the heels of the retreating ice were the scrubby willows, birches and other tundra growths now commonly found in Alaska and northern Canada. These were followed by sub-Arctic species of slightly more vigorous habits, and these again by a gradually developing forest reaching its full climax with a rich covering of beech, maple and hemlock on the Michigan dunes. As each step in the evolutionary process gave way to its successor, the plants that marked it did not wholly disappear, but remnants of their number linger still in out-of-the-way corners from which the more luxuriant newcomers have not yet been able to dislodge them. It thus happens that these dunes or any similar regions will constitute a sort of living museum of their own botanical history.

They even contain what may be prophecies of their future, Prof. Cowles added, for here on the drier parts of the dunes are found advance guards of desert vegetation: tough grasses and herbs reminiscent of the plains of Kansas, together with at least one sagebrush species and one kind of prickly pear cactus. If, as some students of the subject predict, the earth is now passing into a dry-climate period, the evolutionary calendar of the forest succession is the first to tell of it.

ICE AGE SAW FORESTS ON PLAINS OF POLAND

A book of the forests of the ice age, whose leaves were the leaves of the trees themselves, preserved a hundred thousand years or more in thick deposits of peat, was read before the International Congress of Plant Sciences by Prof. Wladyslaw Szafer of Cracow, Poland.

The Ice Age was not one long continuous freeze, Prof. Szafer reminded his hearers, but came as a kind of series of millenium-long cold waves, with equally lengthy warm periods in between, when the empty lands of the North filled up with grass and flowers and trees, only to lose them again with the next advance of the ice.

The recently discovered deposits of plant remains in Poland indicate that between the third and fourth glacial "waves" there were rich forests in Poland. Compared with similar deposits already known from Germany and the Scandinavian countries, they indicate that Poland then had a climate warmer but also drier than that of the coastal regions.

A dramatic story is unfolded by the records in successive layers in the deposit, according to Prof. Szafer. The first sign of returning life after the retreat of the ice is shown by remnants of arctic plants -- shrubby birches and willows, like those of modern mountain tops and tundras. Above these is a sub-arctic phase, with several kinds of pine and a species of larch. Then comes a mixed phase of pine and oak. Finally the broad-leaved forests of temperate lands are in evidence: first a layer of hornbeam mingled with fir and yew, and then beeches, maples, ironwood and other trees of a climate like our own. This represents the highest development reached in the "recess" between glacial advances.

After the climax was reached, the record shows, a recession in the trees began as the climate once more turned cold and the return of the ice was on. The climax forest was succeeded by a second fir and yew growth, and this by the pine and oak and then the pure pine stage, until finally nothing was left but the meager tundra growth of birch and willow bushes fighting against the slowly conquering ice.

TOEING-IN, LIKE INDIANS, MAY NOT BE NORMAL FOR US

The Indian who toed-in as he went his swift, sure-footed way through the primeval forest is often held up as a correct model of correct walking, but toeing-in straight is not necessarily the normal angle of gait for Americans of today who wear shoes and take on excess fat. At least, this is the conclusion reached by Miss Sadie D. Patek, of the Department of Anatomy at Stanford University, who has measured the angle at which 150 women students walk.

Results of the tests, appearing in a recent issue of the American Journal of Physical Anthropology, indicate that women whose feet make the smallest angle as they walk do not necessarily have the strongest or highest arches. Miss Patek believes that the angle of gait may be influenced by heredity, age, weight, and height, and also sometimes by the length of the foot and other proportions of the body, and by the previous habits of life and activity. Her measurements show, for instance, that heavily built women tend to toe out at a wider angle than women under 130 pounds, and toward the other extreme of weight, very light women also show a greater angle of gait.

New evidence that most people's feet do not match was obtained by Miss Patek, when she discovered that none of the women students walked at the same angle on both sides, and only five individuals showed less than one degree of difference between the two feet. She compares this result with Stanley Dougan's test of over 200 young men, which revealed six individuals with the same angle of gait on both sides. Walking with the feet practically parallel was found very rarely by either experimenter.

"The average angle of gait for the right foot of the women students was 6.5 degrees, for the left 7.0 degrees, giving an average for both feet of 6.8 degrees," Miss Patek states. "Dougan determined the average angle of gait for the men to be 7.2 degrees for the right foot, 5.8 for the left, with an average for both of 6.5 degrees."

The average length of the college woman's foot is 9.3 inches, and the average width 3.2 inches, judging by the 150 girls measured in the test.

GREENLAND'S PLANT LIFE DESCRIBED AT CONGRESS

Greenland is not wholly an icy waste; it has at least a small group of plants that it can call its own. Dr. C. H. Ostenfeld of the University of Copenhagen, who has made careful examinations of the plant specimens collected by many Arctic expeditions, told of the results of his studies at the meeting of the International Congress of Plant Sciences. He said in part:

"The number of species of flowering plants and fern-allies is only 390. A not inconsiderable part of the more hardy species are supposed to have survived the ice-age in Greenland, but a more accurate determination of this group is not possible. The main part of the Flora , however, has migrated into Greenland after the maximum extent of the ice-covering, and the immigration has probably been favored by the post-glacial warmer epoch which has been found to have existed also in Greenland. Most of the species have come from arctic North America, and a much smaller number -- about 75 species -- from Europe. This European element consists of high-arctic species, probably immigrating through Spitzbergen; less arctic species arriving from Iceland; and species which were introduced during the time of the old Norse settlements."

COMMON GARDEN FLOWERS HAVE ANCIENT LINEAGE

When did the ancestors of asters and zinnias and other bright flowers of our gardens first appear on the earth? They are among the oldest of flowering plants, and much more ancient than we have heretofore imagined, was the answer given before the International Congress of Plant Sciences, by Dr. G. R. Wieland, associate of the Carnegie Institution of Washington and lecturer at Yale University.

It has always been assumed that the trees related to our pines and others belonging to the kin of the tropical cycads were older in their origin than the bright-petaled flowers, Dr. Wieland told his hearers. Trees of this kind were common far back in the Age of Coal, and indeed make up a large bulk of most coals. But there are increasing evidences that in the Permian age, immediately following the Age of Coal, and perhaps in the coal age itself, there were plants with small, delicately formed flowers and tiny seeds that were the forerunners of the common flowers and weeds of today.

Dr. Wieland pointed out that after the lapse of millions of years the pine-like trees would have a better chance of surviving as fossils, since their cones are relatively big and tough, whereas the delicate petals and soft fruits of the bright-flowered plants would have been more likely to be destroyed by withering immediately after they fell, or through the mischances of geological changes since.

By the time the dinosaurs arrived on the scene, millions of years after the coal was formed but other millions before man appeared, Dr. Wieland states, the vegetation of the earth was quite "modern" in aspect. But it is unlikely that a dinosaur could have appreciated a rose.

INTERNATIONAL LEAGUE PROPOSED FOR WAR AGAINST PLANT DISEASE

The banding together of the civilized nations of the earth to fight diseases of plants as they now unite to fight human plagues was advocated by two of the foreign delegates at the International Congress of Plant Sciences, Prof. E. van Slogteren, of Lisse, Holland, and Dr. E. Foex, of Paris.

Each of the two scientists pointed out that the control of the diseases that wreck our crops is an international affair, and that a plant epidemic appearing in one country may quickly become a very serious problem in a neighboring state, or in a country to which exports are made. International quarantine barriers are recognized as difficult of enforcement and frequently the cause of international irritation; and they may at any time be nullified by the carriage of the germs of the disease by birds or insects. Nevertheless it is also recognized that they may at times be desirable or at least unavoidable, and methods should be worked out for their most effective and least burdensome application.

More effective, Dr. van Slogteren suggested, would be international organization for the fighting of the plagues at home, so as to stop undesirable immigrants at the source or even to wipe them out completely.

Dr. Foex proposed that a call be issued for an international conference on plant diseases and pests, to be held during the current year. This conference would be called upon to take up the work partially completed by earlier conferences which met on the same subject, but whose programs were seriously interfered with by the war.

ELECTRICAL "DIVINING-ROD" FINDS GREAT GOLD DEPOSIT

A gold ore deposit thought to be of gigantic proportions has been discovered at Boliden, in the province of Vesterbotten not far from the Arctic Circle, according to Dr. Axel Gavelin, head of the Swedish Geological Survey. Electrical prospecting methods developed by Hans Lundberg and Karl Sundberg, mining engineers, are responsible for the find. It comprises thirty-four ore bodies, all covered by glacial drift, swamps or lakes.

Discussing the find, Dr. Gavelin said it was all the more interesting because of the unique methods by which it was discovered. The electrical "divining-rod" is no poor relation to the witching rods found throughout the world, he said, for the new electrical device is based strictly upon established scientific principles and no element of mysticism enters into its operations. A parallel electrical field is conducted into the earth, equipotential lines in the surface are fixed by the use of extremely sensitive telephones, and by delicate electrical instruments it is possible to chart the field electromagnetically, the disturbances in the electrical field thus shown making it possible to locate ores because of their electrical properties.

As most of the outcroppings of ore to the surface of the earth have long since been discovered, the new method is of great importance at this time, Dr. Gavelin pointed out, because it has already located ores at barren and rocky locations where the existence of ores could not possibly be predicted by any known method.

The extent of the new find has not been determined, no borings having as yet "struck bottom" or penetrated through the ore. One deposit was traced through ice to the bottom of a lake, thirty feet down. Besides gold, the ore contains silver, copper, sulfur, arsenic and iron. The arsenic deposit is thought to be the richest in the whole world. Assay indicates that each mined meter will yield 850 pounds of gold, 2.5 tons of silver, about 1300 tons of copper, and more than 2000 tons of arsenic. Preparations for the construction of a railroad to Skelleftea on the Baltic coast have begun.

AUTO RADIATORS CHROMIUM PLATED

More than 300 radiators per day are being plated with chromium in the plating plant of the manufacturers of a well-known standard automobile. Corrosion tests conducted at the U. S. Bureau of Standards at Washington show the chromium-plated steel will stand up under exposure to weather conditions much longer than will nickel-plated parts.

In order to subject plated articles to corrosion tests simulating average weather conditions over extended periods, accelerated corrosion, known as the "salt-spray test", is induced by placing the plated metal in a specially constructed box into which finely divided salt solution is sprayed. The number of hours required for appearance of evidence of corrosion are indicative of the months or years the metal can be expected to withstand average climatic conditions.

Under such a test nickel-plated steel often shows rust through the coating within an hour or two, although under identical treament chromium-plated steel has been

known to withstand the dissolving action of the brine for 100 hours without appreciable disintegration. Such resistance to corrosion has been found to be an indication that the chromium deposit would offer the steel protection against average weather conditions for approximately ten years.

AUTO GAS NOT GOOD FOR TRAFFIC COPS

How much automobile exhaust gas does a busy traffic policeman inhale in a day? A little too much, according to tests made on over thirty patrolmen stationed at lively corners. Results of those tests, which have just been reported to the American Medical Association, are believed to confirm the possibility that such workers might be inhaling enough of the dangerous carbon monoxide gas to affect their bodily condition.

The investigation was conducted by Dr. Elizabeth D. Wilson, Dr. H. R. Owen, and Miss Irene Gates, all of Philadelphia, and Wilfred T. Dawson, of Galveston. They report that after eight hours spent close to automobile fumes, some of the traffic policemen had enough carbon monoxide in their blood to cause slight headache and quickened pulse rate. In some cases running up stairs was followed by dizziness and dimness of vision. The carbon monoxide taken into the system is usually eliminated from the blood by the next morning, they find. But they suggest that if the condition should become severe and troublesome it may be necessary for police departments to shorten the hours of duty in crowded sections of a city.

The investigators state that in the past few years a number of traffic officers in Philadelphia have complained of headache, slight nausea, and muscular weakness at the end of the day after duty in the most congested mercantile districts of the city, and that these symptoms might be traced to carbon monoxide.

GOOD LIGHTING INCREASES PRODUCTION

It makes a big difference to a corporation as well as to its workers whether or not factories are well illuminated, tests conducted by lighting engineers in a factory have disclosed, for an increase in candlepower results in markedly increased production.

In the tests, which were carried out at a roller bearing factory without the knowledge of the workers, the old absolete lightingfixtures were replaced by high grade industrial lighting units installed on 8 by 10 foot centers, about 12 feet from the floor. Inserting electric lights which gave the same degree of illumination as previously, production increased 4 per cent. Upon doubling this, production increased 8 per cent.

The increase in operating expenses, due to increased power consumption, was only 2.5 per cent. of the payroll.

TABLOID BOOK REVIEW

ASTRONOMY TODAY; by the Abbe Th. Moreux, translated by C. F. Russell. New York, E. P. Dutton and Co., 1926. 256 pp., $4.00.

For some inexplicable reason, the last year has seen an unusually large number of elementary books on astronomy from numerous publishers. Some have been remarkably good, and others very poor, the present book coming somewhere between the two extremes. Though the translation is satisfactory, it is regrettable that the plates were not changed for in many cases the French names on the diagrams would make them unintelligible to the reader who did not understand the language. It is also surprising that no mention is made of Hubble's work at the Mt. Wilson Observatory, which has practically proven that the spiral nebulae are really stellar systems external to the Galaxy, though this was announced in 1924. A complete revision of the book would materially help it.

THE SPECTROSCOPE AND ITS USES IN GENERAL AND ANALYTICAL CHEMISTRY ; by T. Thorne Baker, New York, William Wood and Co., 208 pp. $3.00.

Probably no more revolutionary discovery has ever been made in any field of science than Wollaston's discovery of the dark lines in the solar spectrum over a century ago, which led to Fraunhofer's invention of the spectroscope in 1815. But though this instrument is now the indispensible tool of the physicist, the astronomer and the chemist, and is probably as important as the microscope is to the bacteriologist, comprehensive manuals of its use are not common. In this book the author has treated the principal types of spectroscope, and their use, especially in the chemical laboratory, both briefly and carefully. Besides such phases of the subject as spectroscopy of phosphorescence and fluorescence, and by ultra-violet and infra-red light, he devotes the final chapters to the relations of spectroscopy to atomic structure, including a condideration of series spectra, and X-ray spectrometry.

GLORIES OF THE CAROLINA COAST; by James Henry Rice, Jr. The R. L. Bryan Co., Columbia, S.C., 1925. 133 pp., $2.00.

According to this book, the Carolina coast is one of the most beautiful spots in the world. On the basis of what is evidently a very thorough knowledge of this region, the author describes in an interesting manner its beauties as well as its natural history.

Gold that is almost pure contains only copper as an alloying metal, but gold below 18 carat has silver added also.

The government's standard clock which is used in testing timepieces varies only about two-hundredths of a second in a day.
